Technical report No 04/2009

Annual European Community greenhouse gas inventory 1990–2007 and inventory report 2009

Submission to the UNFCCC Secretariat

Version 27 May 2009

European Environment Agency

Title of inventory	**Annual European Community greenhouse gas inventory 1990–2007 and inventory report 2009**
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Acknowledgements

This report was prepared on behalf of the European Commission (DG Environment) by the European Environment Agency (EEA) European Topic Centre for Air and Climate Change (ETC/ACC) supported by the Joint Research Centre (JRC) and Eurostat.

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The EEA project manager was Ricardo Fernandez. He acknowledges the great input provided by Andreas Barkman (EEA), Hermann Peifer (EEA), David Simoens (EEA), Sheila Cryan (EEA), Ronald Velgue (DG Environment) and Erasmia Kitou (DG Environment). The EEA also acknowledges the input and comments received from the EC Member States, which have been included in the final version of the report as far as practically feasible.

Executive summary

ES.1 Background information on greenhouse gas inventories and climate change

The European Community (EC), as a party to the United Nations Framework Convention on Climate Change (UNFCCC), reports annually on greenhouse gas (GHG) inventories for the year t-2 and within the area covered by its Member States (i.e. domestic emissions taking place within its territory).

The present inventory also constitutes the EU-15 voluntary submission under the Kyoto Protocol. Under the Kyoto Protocol, the EU-15 took on a common commitment to reduce emissions by 8 % between 2008 and 2012 compared to emissions in the 'base year'.([1]) The EU-27 does not have a common Kyoto target.

The legal basis for the compilation of the EC inventory is Council Decision No. 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.([2]) The purpose of this decision is:

1. to monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States;
2. to evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol;
3. to implement UNFCCC and the Kyoto Protocol obligations relating to national programmes, greenhouse gas inventories, national systems and registries of the Community and its Member States, and the relevant procedures under the Kyoto Protocol;
4. to ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the Community and its Member States to the UNFCCC secretariat.

The EC GHG inventory comprises the direct sum of the national inventories compiled by the EC Member States making up the EU-15 and the EU-27. Energy data from Eurostat are used for the reference approach for CO_2 emissions from fossil fuels developed by the Intergovernmental Panel on Climate Change (IPCC). The main institutions involved in the compilation of the EC GHG inventory are the Member States, the European Commission Directorate-General for the Environment (DG ENV), the European Environment Agency (EEA) and its European Topic Centre on Air and Climate Change (ETC/ACC), Eurostat, and the Joint Research Centre (JRC).

The process of compiling the EC GHG inventory is as follows. Member States submit their annual GHG inventories by 15 January each year to the European Commission, DG ENV, with a copy to the EEA. The EEA and its ETC/ACC, Eurostat and JRC then perform initial checks on the submitted data. The draft EC GHG inventory and inventory report are circulated to Member States for review and comments by 28 February. Member States check their national data and the information presented in the EC GHG inventory report, send updates if necessary and review the EC inventory report itself by 15 March. The EEA prepares the final EC GHG inventory and inventory report through its ETC/ACC by 15 April for submission by the European Commission to the UNFCCC Secretariat; a resubmission is prepared by 27 May, if needed.

On 23 January 2008 the European Commission adopted the 'Climate Action and Renewable Energy'

([1]) For the EU-15, the base year for CO_2, CH_4 and N_2O is 1990; for fluorinated gases 12 Member States have selected 1995 as the base year, whereas Austria, France and Italy have chosen 1990. As the EC inventory is the sum of Member State inventories, the EC base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 12 Member States and 1990 emissions for Austria, France and Italy. The EU-15 base year emissions also include emissions from deforestation for the Netherlands, Portugal and the United Kingdom (see Tables 1.4 and 1.5).

([2]) OJ L 49, 19.2.2004, p.1. Note that Council Decision No. 280/2004/EC entered into force in March 2004. Therefore, the compilation of the 2004 inventory report started under the previous Council Decision 1999/296/EC.

package. The proposal was part of draft legislation implementing the 'Integrated Energy and Climate Change' package of 10 January 2007, which was endorsed by the European Council in March 2007. In December 2008 the European Parliament and the Council reached agreement on the package. It was adopted by the Council on 6 April 2009. The package underlines the objective of limiting the rise in global average temperature to no more than two degrees Celsius above pre-industrial levels. To achieve this goal Member States agreed to reduce total EU greenhouse gas emissions by 20 % compared to 1990 by 2020.

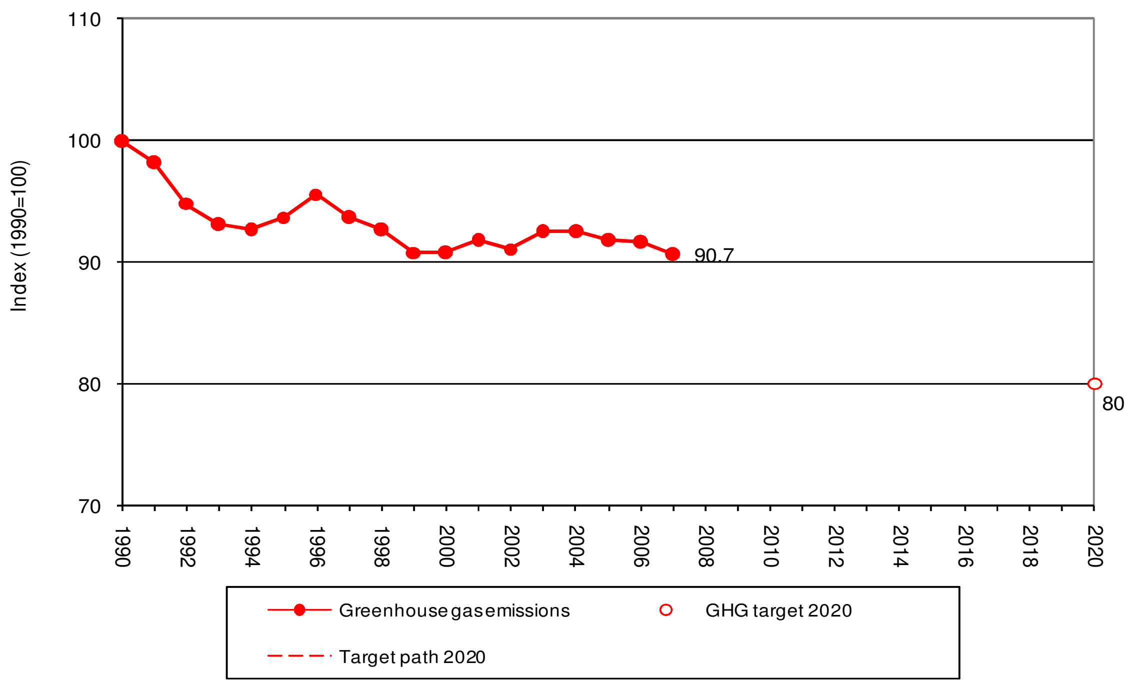
Both trading, i.e. EU Emissions Trading Scheme (ETS), and non-trading sectors will contribute to the 20 % objective. Minimising overall reduction costs implies a 21 % reduction in emissions from EU ETS sectors compared to 2005 by 2020 and a reduction of approximately 10 % compared to 2005 by 2020 for non-EU ETS sectors. The non-trading sectors broadly include direct emissions from households and services, as well as emissions from transport, waste and agriculture. The coverage of the non-trading sectors currently represents about 60 % of total greenhouse gas emissions.

ES.2 Summary of greenhouse gas emission trends in the EC

EU-27

In March 2007 the EC made a firm independent commitment to achieve at least a 20 % reduction of greenhouse gas emissions by 2020 compared to 1990.([3]) Total GHG emissions, without Land Use, Land-Use Change and Forestry (LULUCF) in the EU-27 decreased by 9.3 % between 1990 and 2007 (519 million tonnes CO_2 equivalents). Emissions decreased by 1.2 % (59 million tonnes CO_2 equivalents) between 2006 and 2007 (Figure ES.1).

Figure ES.1 EU-27 GHG emissions 1990–2007 (excluding LULUCF)



Notes:

GHG emission data for the EU-27 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF or emissions from international aviation and international maritime transport.

([3]) All emissions information for the EU-27 in this report uses 1990 as the starting point when addressing emission reductions. Unlike the EU-15, the EU-27 does not have a common target under the Kyoto Protocol.

CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to the UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered.

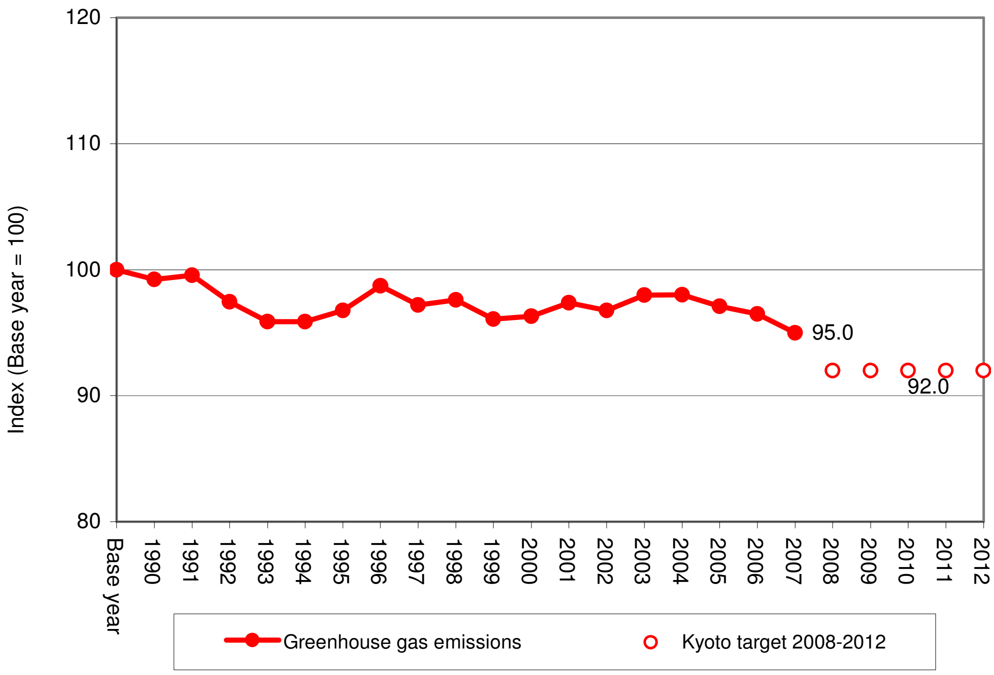
The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

EU-15

In 2007 total GHG emissions in the EU-15, without LULUCF, were 4.3 % (181 million tonnes CO_2 equivalents) below 1990. Emissions decreased by 1.6 % (64 million tonnes CO_2 equivalents) between 2006 and 2007.

Under the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–12 compared to the 'base year'.([4]) This can be achieved by a combination of existing and planned domestic policies and measures, and using carbon sinks and Kyoto mechanisms. Emissions (i.e. domestic) in 2007 were 5.0 % or 214 million tonnes CO_2 equivalents lower than emissions in the base year (Figure ES.2).

Figure ES.2 EU-15 GHG emissions 1990–2007 (excluding LULUCF) compared with the target for 2008–12



Notes:

GHG emission data for the EU-15 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF or emissions from international aviation and international maritime transport.

CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to the UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 million tonnes CO_2 equivalents. The EU-15 would need to reduce greenhouse gas emissions by about 341 million tonnes, on average between 2008 and 2012, on the basis of the 2009 greenhouse gas inventory in order to meet its 8 % Kyoto target. This can be achieved through a combination of existing and planned domestic policies and measures, and using carbon sinks and Kyoto mechanisms.

([4]) Following the UNFCCC reviews of Member States' 'initial reports' during 2007 and 2008 and pursuant to Article 3, paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 million tonnes CO_2 equivalents.

Main trends by source category, 2006–2007

Between 2006 and 2007, EU-15 emissions decreased by 1.6 %, which was a little more than in the EU-27 (-1.2 %). This was mainly due to larger increases of CO_2 emissions from public electricity and heat production and road transport in the EU-27, and smaller emission decreases from manufacturing industries (Table ES.2).

Table ES.2 Overview of EU-27 and EU-15 source categories whose emissions increased or decreased by more than 20 million tonnes CO_2 equivalents in the period 2006–2007

Source category	**EU-27**	**EU-15**
	Million tonnes (CO_2 eq.)	
Public electricity and heat production (CO_2 from 1A1a)	+15.0	+10.7
Road transport (CO_2 from 1A3b)	+5.3	+1.7
Cement production (CO_2 from 2A1)	+4.5	+2.0
Consumption of halocarbons (HFC from 2F)	+4.4	+3.1
Manufacture of solid fuels (CO_2 from 1A1c)	+3.6	+1.0
Fugitive emissions (CH_4 from 1B)	-3.1	-2.2
Iron and steel production (CO_2 from 1A2a+2C1)	-3.8	-2.2
Manufacturing industries (excl. iron and steel) (energy-related CO_2 from 1A2 excl. 1A2a)	-4.7	-8.2
Households and services (CO_2 from 1A4)	-79.1	-66.8
Total change 2006–2007	**-59.4**	**-64.0**

Notes:

As the table only presents sectors whose emissions have increased or decreased by at least 3 million tonnes of CO_2 equivalents, the sum for each country grouping does not neccsarily match the total change listed at the bottom of the table

Main reasons for changes in EU-15 emissions, 2006-2007

The 64.0 million tonnes (CO_2 equivalents) decrease in GHG emissions between 2006 and 2007 was mainly due to:

- Lower CO_2 emissions from households and services([5]) (-66.8 million tonnes or -10.8 %). The use of fossil fuels (i.e. oil, gas and coal) decreased further (-10.1 %), particularly in households, mainly due to a lower number of heating degree days. Germany reported the highest emission decrease (-22.9 %), as a result of a warmer winter, meaning fewer days requiring heating (-7.1 %); a fuel tax increase in 2007, which encouraged accrual of stocks in 2006; and a sharp increase in nominal gas prices for households in 2007. These reasons might also be relevant for other EU-countries.
- Lower CO_2 emissions from manufacturing industries (excluding iron and steel) (-8.2 million or -1.9 %) tonnes, mainly in Italy, Spain and the United Kingdom.
- Lower CH_4 fugitive emissions (-2.2 million tonnes or -6.5 %) mainly in Germany and the United Kingdom, due to reduced coal mining activity and improvements to the gas distribution network.
- Lower emissions from iron and steel production due to reduced energy use, mainly in Germany (-2.2 million tonnes or -1.4 %).

Substantial increases in GHG emissions between 2006–2007 took place in the following source categories:

([5]) This includes emissions from fuel combustion in commercial and institutional buildings, and all emissions from fuel combustion in households. It also includes a smaller source category covering fuel combustion emissions from agriculture, forestry and fishing. It should be noted that greenhouse gas emissions from households and services do not include indirect emissions. That is, greenhouse gas emissions resulting from the production of heat and electricity supplied to households and services are included under public electricity and heat production. Direct combustion emissions from households are outside the EU ETS.

- CO_2 emissions from public electricity and heat production (+10.7 million tonnes or +1.0 %)
  Countries show diverse trends. CO_2 emissions from public electricity and heat production increased mainly in Germany, Greece, the Netherlands and Spain, due to higher electricity production in conventional thermal power plants. Denmark, Finland and the United Kingdom reported decreases. Denmark produced less electricity from coal and higher imports and lower exports; Finland reduced electricity production from coal and made more use of hydropower. The UK's reductions were mainly due to a further shift from coal to gas. In the EU-15 the use of liquid fuels decreased by 21 %, while the use of solid fuels was constant and the use of gaseous fuels increased by 8 %. These trends are reflected in emissions trends.
- Increases in HFC from the consumption of halocarbons (+3.1 million tonnes or +6.1 %) stem from refrigeration and air conditioning. France, Germany and Italy report the highest increases.

Main reasons for changes in EU-27 emissions, 2006–2007

Between 2006 and 2007, decreases in EU-27 emissions were mainly due to:

- CO_2 households and services (-79.1 million tonnes or -10.9 %).
  Reductions in the EU-27 were higher than in the EU-15 due to substantial decreases in the Czech Republic, Hungary and Poland. In these countries the use of solid, gaseous and liquid fuels decreased in response to warmer weather conditions in 2007.
- CO_2 from manufacturing industries excluding iron and steel (-4.7 million tonnes or -0.9 %).
  The decrease is mainly due to EU-15 Member States. Several newer Member States report increased emissions, with the Czech Republic reporting the highest increase.
- CO_2 from iron and steel production (-3.8 million tonnes or -1.8 %)
  The Czech Republic reported an emission decrease even larger than the EU-15.
- Fugitive CH_4 emissions from energy supply (-3.1 million tonnes or -4.4 %)
  The decrease in the EU-27 is mainly due to the EU-15, as well as the Czech Republic and Poland.

Substantial emission increases were due to:

- CO_2 from public electricity and heat production (+15.0 million tonnes or +1.1 %)
  The increase was caused by the EU-15, as well as emissions growth in Bulgaria, the Czech Republic and Estonia due to increased electricity generation from conventional thermal power plants. Poland and Slovakia reported decreases due to increased electricity imports.
- CO_2 from road transportation (+5.3 million tonnes or +0.6 %)
  Apart from EU-15 States, the highest increases were reported by the Czech Republic, Lithuania, Slovakia and Slovenia, mostly due to increased use of diesel oil.
- Higher CO_2 emission from cement production (+4.5 million tonnes or +4.4 %)
  Beside the increases in the EU-15, Poland reported a major increase in emissions from cement production.
- Increases in HFC from the consumption of halocarbons (+4.4 million tonnes or +7.8 %) stems from refrigeration and air conditioning. From the new Member States, the Czech Republic and Poland reported the highest increases.
- Higher CO_2 emissions from the manufacture of solid fuels (+3.6 million tonnes or +5.4 %)
  Poland contributed most to this increase.

Overview of GHG emissions in EC Member States

Table ES.3 Greenhouse gas emissions excluding LULUCF (CO_2 equivalents) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [a] (million tonnes)	2007 (million tonnes)	Change 2006–2007 (million tonnes)	Change 2006–2007 (%)	Change 1990-2007 (%)	Change base year–2007 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	79.0	79.0	88.0	-3.6	-3.9%	11.3%	11.3%	-13.0%
Belgium	143.2	145.7	131.3	-5.3	-3.9%	-8.3%	-9.9%	-7.5%
Denmark	69.1	69.3	66.6	-4.4	-6.2%	-3.5%	-3.9%	-21.0%
Finland	70.9	71.0	78.3	-1.6	-2.0%	10.6%	10.3%	0.0%
France	562.6	563.9	531.1	-10.6	-2.0%	-5.6%	-5.8%	0.0%
Germany	1215.2	1232.4	956.1	-23.9	-2.4%	-21.3%	-22.4%	-21.0%
Greece	105.6	107.0	131.9	3.8	2.9%	24.9%	23.2%	25.0%
Ireland	55.4	55.6	69.2	-0.5	-0.7%	25.0%	24.5%	13.0%
Italy	516.3	516.9	552.8	-10.2	-1.8%	7.1%	6.9%	-6.5%
Luxembourg	13.1	13.2	12.9	-0.39	-2.9%	-1.6%	-1.9%	-28.0%
Netherlands	212.0	213.0	207.5	-1.0	-0.5%	-2.1%	-2.6%	-6.0%
Portugal	59.3	60.1	81.8	-2.9	-3.4%	38.1%	36.1%	27.0%
Spain	288.1	289.8	442.3	9.3	2.1%	53.5%	52.6%	15.0%
Sweden	71.9	72.2	65.4	-1.5	-2.2%	-9.1%	-9.3%	4.0%
United Kingdom	771.1	776.3	636.7	-11.2	-1.7%	-17.4%	-18.0%	-12.5%
EU-15	**4232.9**	**4265.5**	**4052.0**	**-64.0**	**-1.6%**	**-4.3%**	**-5.0%**	**-8.0%**
Bulgaria	117.7	132.6	75.5	4.2	5.9%	-35.8%	-43.0%	-8.0%
Cyprus	5.5	Not applicable	10.1	0.2	1.6%	85.3%	Not applicable	Not applicable
Czech Republic	194.7	194.2	150.8	1.7	1.2%	-22.5%	-22.4%	-8.0%
Estonia	41.9	42.6	22.0	2.8	14.8%	-47.5%	-48.3%	-8.0%
Hungary	99.2	115.4	75.9	-2.9	-3.7%	-23.5%	-34.2%	-6.0%
Latvia	26.7	25.9	12.1	0.4	3.5%	-54.7%	-53.4%	-8.0%
Lithuania	49.1	49.4	24.7	1.9	8.1%	-49.6%	-49.9%	-8.0%
Malta	2.0	Not applicable	3.0	0.07	2.3%	45.7%	Not applicable	Not applicable
Poland	459.5	563.4	398.9	-0.4	-0.1%	-13.2%	-29.2%	-6.0%
Romania	243.0	278.2	152.3	-1.6	-1.0%	-37.3%	-45.3%	-8.0%
Slovakia	73.3	72.1	47.0	-2.0	-4.1%	-35.9%	-34.8%	-8.0%
Slovenia	18.6	20.4	20.7	0.2	0.7%	11.6%	1.8%	-8.0%
EU-27	**5564.0**	**Not applicable**	**5045.1**	**-59.4**	**-1.2%**	**-9.3%**	**Not applicable**	**Not applicable**

([a]) *The base year under the Kyoto Protocol for each Member State and the EU-15 is outlined in Tables 1.4 and 1.5. As Cyprus, Malta and the EU-27 do not have targets under the Kyoto Protocol, they do not have applicable Kyoto Protocol base years .*

ES.3 Summary of emissions and removals by main greenhouse gas

EU-27

Table ES.4 gives an overview of the main trends in EU-27 GHG emissions and removals for 1990–2007. The most important GHG by far is CO_2, accounting for 83 % of total EU-27 emissions in 2007 excluding LULUCF. In 2007, EU-27 CO_2 emissions without LULUCF were 4 187 Tg, which was 4.8 % below 1990 levels. Compared to 2006, CO_2 emissions decreased by 1.3 %.

Table ES.4 Overview of EU-27 GHG emissions and removals from 1990 to 2007, expressed in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Net CO_2 emissions/removals	4.057	3.755	3.838	3.753	3.741	3.669	3.714	3.758	3.722	3.793	3.819	3.783	3.794	3.771
CO_2 emissions (without LULUCF)	4.400	4.150	4.251	4.163	4.152	4.084	4.106	4.184	4.158	4.252	4.264	4.232	4.243	4.187
CH_4	602	547	541	525	505	494	481	466	457	446	433	426	422	416
N_2O	513	455	460	458	434	411	409	403	392	391	394	389	375	374
HFCs	28	41	47	54	55	48	47	46	49	53	54	58	59	63
PFCs	20	14	13	11	10	10	8	8	9	8	6	5	5	4
SF_6	11	16	15	14	13	11	11	11	10	9	9	9	10	10
Total (with net CO_2 emissions/remova	**5.230**	**4.827**	**4.915**	**4.813**	**4.758**	**4.643**	**4.671**	**4.692**	**4.638**	**4.700**	**4.717**	**4.671**	**4.665**	**4.638**
Total (without CO2 from LULUCF)	**5.573**	**5.223**	**5.328**	**5.223**	**5.169**	**5.059**	**5.062**	**5.118**	**5.074**	**5.159**	**5.162**	**5.119**	**5.114**	**5.054**
Total (without LULUCF)	**5.564**	**5.213**	**5.318**	**5.214**	**5.159**	**5.049**	**5.053**	**5.109**	**5.066**	**5.150**	**5.153**	**5.111**	**5.104**	**5.045**

EU-15

Table ES.5 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2007. Also in the EU-15 the most important GHG is CO_2, accounting for 84 % of total EU-15 emissions in 2007. In 2007, EU-15 CO_2 emissions without LULUCF were 3 391 Tg, which was 0.9 % above 1990 levels. Compared to 2006, CO_2 emissions decreased by 1.8 %.

Table ES.5 Overview of EU-15 GHG emissions and removals from 1990 to 2007, expressed in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Net CO_2 emissions/removals	3.138	3.024	3.080	3.025	3.077	3.037	3.087	3.135	3.111	3.156	3.190	3.156	3.158	3.126
CO_2 emissions (without LULUCF)	3.360	3.286	3.363	3.308	3.355	3.328	3.354	3.422	3.411	3.477	3.488	3.459	3.452	3.391
CH_4	436	411	406	394	385	376	366	354	344	331	320	314	309	305
N_2O	387	371	375	374	354	334	331	323	315	313	314	309	295	292
HFCs	28	41	47	53	54	47	46	44	46	50	50	53	54	57
PFCs	17	11	11	10	9	9	7	6	8	7	5	4	4	3
SF_6	11	15	15	14	13	11	11	10	9	9	9	9	9	9
Total (with net CO_2 emissions/remova	**4.016**	**3.873**	**3.934**	**3.870**	**3.891**	**3.813**	**3.848**	**3.873**	**3.834**	**3.866**	**3.888**	**3.845**	**3.828**	**3.793**
Total (without CO2 from LULUCF)	**4.239**	**4.136**	**4.218**	**4.153**	**4.170**	**4.104**	**4.114**	**4.160**	**4.134**	**4.187**	**4.187**	**4.148**	**4.122**	**4.058**
Total (without LULUCF)	**4.233**	**4.128**	**4.210**	**4.146**	**4.163**	**4.098**	**4.108**	**4.154**	**4.127**	**4.180**	**4.180**	**4.141**	**4.116**	**4.052**

ES.4 Summary of emissions and removals by main source and sink categories

EU-27

Table ES.6 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2007. The most important sector by far is energy (i.e. combustion and fugitive emissions) accounting for 79 % of total EU-27 emissions in 2007. The second largest sector is agriculture (9.2 %), followed by industrial processes (8.5 %).

Table ES.6 Overview of EU-27 GHG emissions from the main source and sink categories from 1990 to 2007, expressed in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	4.277	4.032	4.142	4.037	4.024	3.964	3.970	4.053	4.023	4.109	4.106	4.066	4.068	3.999
2. Industrial Processes	478	456	452	460	432	393	405	393	390	401	412	420	417	430
3. Solvent and Other Product Use	16	14	14	14	14	14	14	13	13	13	13	12,405	13	12
4. Agriculture	579	504	506	507	505	501	493	485	479	474	473	466	463	462
5. Land-Use, Land-Use Change and Fore	-334	-385	-403	-400	-401	-406	-383	-417	-427	-450	-436	-439	-440	-407
6. Waste	213	207	203	196	184	178	172	164	160	154	149	146	144	141
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/remova	**5.230**	**4.827**	**4.915**	**4.813**	**4.758**	**4.643**	**4.671**	**4.692**	**4.638**	**4.700**	**4.717**	**4.671**	**4.665**	**4.638**
Total (without LULUCF)	**5.564**	**5.213**	**5.318**	**5.214**	**5.159**	**5.049**	**5.053**	**5.109**	**5.066**	**5.150**	**5.153**	**5.111**	**5.104**	**5.045**

EU-15

Table ES.7 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2007. More detailed trend descriptions are included in chapters 3 to 9 of the present report.

Table ES.7 Overview of EU-15 GHG emissions from the main source and sink categories from 1990 to 2007, expressed in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	3.257	3.178	3.263	3.195	3.238	3.213	3.228	3.299	3.284	3.343	3.345	3.313	3.301	3.233
2. Industrial Processes	372	371	369	378	357	325	330	321	320	325	331	332	325	332
3. Solvent and Other Product Use	14	12	12	12	12	12	12	11	11	11	10	10,432	10	10
4. Agriculture	419	402	406	407	407	406	403	394	389	385	383	377	373	371
5. Land-Use, Land-Use Change and Fore	-217	-255	-276	-276	-271	-284	-260	-280	-294	-314	-292	-296	-288	-259
6. Waste	171	165	161	153	148	141	136	129	123	117	112	109	107	105
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/remova	**4.016**	**3.873**	**3.934**	**3.870**	**3.891**	**3.813**	**3.848**	**3.873**	**3.834**	**3.866**	**3.888**	**3.845**	**3.828**	**3.793**
Total (without LULUCF)	**4.233**	**4.128**	**4.210**	**4.146**	**4.163**	**4.098**	**4.108**	**4.154**	**4.127**	**4.180**	**4.180**	**4.141**	**4.116**	**4.052**

ES.5 Summary of EC Member State emission trends

Table ES.8 gives an overview of Member State contributions to EC GHG emissions in 1990–2007. Member States show large variations in GHG emission trends.

Table ES.8 Overview of Member State contributions to EC GHG emissions excluding LULUCF from 1990 to 2007, expressed in CO_2 equivalents (Tg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	79	81	84	83	82	81	81	85	87	93	92	93	92	88
Belgium	143	149	154	145	151	144	145	145	143	146	146	142	137	131
Denmark	69	76	90	80	76	73	68	69	69	74	68	63	71	67
Finland	71	71	77	76	72	72	70	75	77	85	80	69	80	78
France	563	556	571	565	578	562	557	558	549	552	552	554	542	531
Germany	1.215	1.085	1.105	1.068	1.042	1.010	1.008	1.025	1.006	1.007	997	969	980	956
Greece	106	110	113	118	123	123	127	128	128	131	131	132	128	132
Ireland	55	59	61	63	66	67	69	71	69	69	69	70	70	69
Italy	516	530	523	529	540	546	550	555	556	570	574	574	563	553
Luxembourg	13	10	10	10	9	9	10	10	11	12	13	13	13	13
Netherlands	212	225	233	226	227	215	214	216	215	217	218	212	209	208
Portugal	59	70	68	71	76	84	82	84	89	84	86	89	85	82
Spain	288	319	312	333	343	372	386	386	403	410	426	441	433	442
Sweden	72	74	77	73	73	70	68	69	70	70	70	67	67	65
United Kingdom	771	712	733	708	704	671	674	677	656	661	658	653	648	637
EU-15	**4.233**	**4.128**	**4.210**	**4.146**	**4.163**	**4.098**	**4.108**	**4.154**	**4.127**	**4.180**	**4.180**	**4.141**	**4.116**	**4.052**
Bulgaria	118	89	87	84	74	69	69	69	66	72	71	71	71	76
Cyprus	5	7	7	7	8	9	9	9	9	9	10	10	10	10
Czech Republic	195	153	160	153	145	141	147	149	145	146	147	146	149	151
Estonia	42	21	22	21	20	18	18	19	18	20	20	20	19	22
Hungary	99	80	82	80	80	80	78	80	78	81	80	80	79	76
Latvia	27	13	13	12	12	11	10	11	11	11	11	11	12	12
Lithuania	49	22	23	23	23	21	19	20	21	21	22	23	23	25
Malta	2	3	3	3	3	3	3	3	3	3	3	3	3	3
Poland	459	446	454	449	414	400	389	385	371	384	384	387	399	399
Romania	243	181	187	167	149	132	136	140	147	154	155	149	154	152
Slovakia	73	53	51	50	50	49	48	50	49	50	50	49	49	47
Slovenia	19	19	19	20	19	19	19	20	20	20	20	20	21	21
EU-27	**5.564**	**5.213**	**5.318**	**5.214**	**5.159**	**5.049**	**5.053**	**5.109**	**5.066**	**5.150**	**5.153**	**5.111**	**5.104**	**5.045**

Note:

For some countries the data provided in this table is based on gap filling (see subsection 1.8.2 for details).

The overall EC GHG emission trend is dominated by the two largest emitters, Germany and the United Kingdom, which account for about a third of total EU-27 GHG emissions. These two Member States have achieved total GHG emission reductions of 393 million tonnes CO_2 equivalents compared to 1990.([6])

The main reasons for the favourable trend in Germany were increasing efficiency in power and heating plants and the economic restructuring of the five new Länder after the German reunification. Reduced GHG emissions in the United Kingdom were primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production and N_2O emission reduction measures in adipic acid production.

Italy and France are the third and fourth largest emitters both with a share of 11 %. Italy's GHG emissions are about 7 % above 1990 levels in 2007. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol refining. France's emissions were 6 % below 1990 levels in 2007. In France large reductions were achieved in N_2O emissions from adipic acid production but CO_2 emissions from road transport increased considerably between 1990 and 2007.

Spain and Poland are the fifth and sixth largest emitters in the EU-27, accounting for 9 % and 8 % repectively of total EU-27 GHG emissions. Spain increased emissions by 54 % between 1990 and 2007. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 13 % between 1990 and 2007 (-29 % since its base year of 1988). The main factors for decreasing emissions in Poland — as for other new Member States — were the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

ES.6 International aviation and maritime transport

Emissions of greenhouse gases from international aviation and shipping activities continued to rise in

([6]) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes on the basis of the 2008 inventory in order to meet the Kyoto target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

2007, increasing by 1.8 % in the EU-27. Contributions from these sectors, currently not included in the national greenhouse gas totals, rose by 3.7 million tonnes for aviation and 1.8 million tonnes for international shipping. EC greenhouse gas emissions from international aviation are lower than for international maritime transport but are growing significantly more rapidly. The average annual EU-27 growth rates since 1990 were 4.5 % and 2.9 %, respectively. Together, the two sectors currently account for about 6 % of total greenhouse gas emissions.

ES.7 Information on recalculations

Base year emissions for the EU-15 are fixed (i.e. 4265.5 million tonnes CO_2 equivalents) as a result of the UNFCCC reviews during 2007 and 2008. The recalculation is the result of inventory improvements, which Member States were required to undertake for the whole time series to ensure consistency.

In the EU-15, the change in emissions between 2006 and 2007 was -1.6 %, between 1990 and 2007 it was -4.3 %, and between the fixed Kyoto base year and 2007 it was -5.0 %. The effect of the recalculation in 2006, comparing the 2008 and 2009 inventories, was 0.8 %. This means that of the 5.0 % reduction in emissions between the Kyoto base year and 2007, 0.8 % has been due to recalculations. These were mainly due to the revised energy balance in Germany and the use of a revised emission factor for agriculture (nitrogen leaching) in Germany. The other main reason was more widespread use of the COPERT4 model for estimating N_2O emissions from road transport. The N_2O emission factor in COPERT4 is lower than in COPERT3. This has the effect of reducing N_2O emissions more in later years because of the upward trend in the use of catalysts to reduce NO_x emissions.

In the EU-15, recalculations for the year 1990 were of minor influence (-0.3 % between the 2008 and 2009 submissions). In the EU-27, recalculations affected the year 1990 by -0.2 % and the year 2006 by -0.7 %.

Table ES.9 Overview of major recalculation in 1990

Source category	Member State	Deviation		Explanation for Recalculation
		Gg CO2 Equ.	%	
4.D.3.2-Nitrogen Leaching and Run-off,N_2O	DE	-8,198	-68.4	A lower emission factor has been used.
4.A-Enteric Fermentation,Dairy Cattle,CH_4	DE	-3,050	-24.1	Estimation of a new MCF Use of a different mean emission factor Population data has been updated.
EU-15 Total recalculations	**EU-15**	**-10,922**	**-0.3**	
EU-27 Total recalculations	**EU-27**	**-13,318**	**-0.2**	

Table ES.10 Overview of major recalculation in 2006

Source category	Member State	Deviation		Explanation for Recalculation
		Gg CO2 Equ.	%	
1.AA.2.C-Chemicals,,Solid Fuels,CO_2	CZ	-9,433	-94.9	For all 1A2: there are some allocation problems Recalculated from the final Energy balance
1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2	DE	-7,239	-2.5	improvement of the calculation method as a result of quality control new available data
4.D.3.2-Nitrogen Leaching and Run-off,N_2O	DE	-6,692	-66.8	A lower emission factor has been used.
1.AA.2.F-Other (please specify),Liquid Fuels,CO_2	DE	-4,920	-29.6	Revision of activity data from 2003 onwards
1.AA.4.B-Residential,Gaseous Fuels,CO_2	DE	-3,202	-5.6	new available data
1.AA.1.A-Public Electricity and Heat Production,Solid Fuels,CO_2	PL	-4,008	-2.3	Activity data on fuel consumption for years 1990-2006 were updated due to correction made in EUROSTAT database. CO2 emissions for individual sub-sectors of 1.A category for 2006 were verified for harmonization of distribution of particular ETS installations into given sub-categories for the years 2005, 2006 and 2007
1.AA.3.B-Road Transportation,Gasoline,N_2O	GB	-3,127	-83.4	Change to N2O factors, revised from COPERT4 and Emissions Inventory Guidebook
1.AA.3.A-Civil Aviation,Jet Kerosene,CO_2	DE	-3,051	-57.7	Recalculations are due to a) separate reporting of Aviation Gasoline and b) a changed split factor used for separating national and international aviation.
1.AA.2.A-Iron and Steel,Solid Fuels,CO_2	DE	-3,051	-41.3	new available data
1.AA.2.A-Iron and Steel,Solid Fuels,CO_2	CZ	3,794	322.6	For all 1A2: there are some allocation problems
1.AA.2.F-Other (please specify),Solid Fuels,CO_2	CZ	3,910	126.2	For all 1A2: there are some allocation problems
2.C.1-Iron and Steel Production,CO2	PL	4,271	104.3	For 2005-2006 CO2 emission values were verified for 2.C.1 sub-categories as follows: Iron Ore Sintering,. Blast Furnaces Process, Basic Oxygen Furnace Steel and Electric Furnace Steel. For the sub-categories listed above, CO2 emission values were taken from verified reports. For the reason, that these emissions include also emissions from fuel consumption in the mentioned processes, this fuel consumption was subtracted from 1.A.2.a)
1.AA.1.A-Public Electricity and Heat Production,Gaseous Fuels,CO_2	DE	9,356	30.9	new available data
EU-15 Total recalculations	**EU-15**	**-35,166**	**-0.8**	
EU-27 Total recalculations	**EU-27**	**-36,577**	**-0.7**	

ES.8 Information on indirect greenhouse gas emissions for the EU-15

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: all are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation.

Table ES.11 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990 and 2007. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (75 %), followed by CO (58 %), NMVOC (48 %) and NO_x (35 %).

Table ES.11 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2007 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	(Gg)													
NOx	13.448	11.870	11.610	11.209	11.039	10.761	10.494	10.279	10.007	9.916	9.704	9.442	9.141	8.812
CO	52.273	41.593	40.008	38.062	36.410	34.028	31.691	29.885	28.046	27.186	26.076	24.120	23.083	22.083
NMVOC	15.877	12.941	12.441	12.230	11.806	11.333	10.631	10.153	9.676	9.735	9.113	8.875	8.704	8.205
SO2	16.464	9.941	8.914	8.163	7.623	6.756	6.072	5.807	5.567	5.096	4.879	4.562	4.354	4.163

In the EU-27, SO_2 emissions decreased by 70 %, followed by CO (55 %), NMVOC (45 %) and NO_x (34 %) (Table ES.12).

Table ES.12 Overview of EU-27 indirect GHG and SO_2 emissions for 1990–2007 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	(Gg)													
NOx	16.740	14.488	14.287	13.807	13.423	12.997	12.314	11.965	11.674	11.640	11.845	11.538	11.352	10.977
CO	64.251	50.994	50.048	47.649	45.400	42.717	37.559	35.139	33.148	32.295	34.142	31.738	30.139	28.914
NMVOC	17.949	14.754	14.352	14.096	13.630	13.078	12.280	11.755	11.301	11.392	10.742	10.468	10.403	9.799
SO2	24.952	16.622	15.463	14.414	12.741	11.287	9.978	9.650	9.167	8.671	8.458	7.956	7.799	7.587

ES.9 Information on using EU ETS for national GHG inventories in

EU Member States

The NIR 2009 includes an analysis of the use of data and emissions reported under the ETS for preparing national GHG inventories in the EU-15. This analysis shows that most Member States used the ETS data to improve and refine the estimation and reporting of CO_2 emissions from energy and industrial processes. Fourteen countries used ETS data for quality assurance/quality control purposes and checked data consistency between both sources.

From EU-15 Member States, seven countries used ETS emissions directly in the inventory, five used activity data provided under the ETS and six used ETS information to improve country-specific emission factors for the inventory. The use of ETS data improved the inventory data quality with respect to completeness (additional emission sources can be estimated for which no data were available before the ETS data), accuracy (e.g. due to improved country-specific emission factors) and improved allocation of emissions to correct CRF source categories.

PART 1: ANNUAL INVENTORY SUBMISSION

1 Introduction to the EC greenhouse gas inventory

This report is the annual submission of the European Community (EC) to the United Nations Framework Convention on Climate Change (UNFCCC). It presents the greenhouse gas (GHG) inventory of the EC, the process and the methods used for the compilation of the EC inventory as well as GHG inventory data of the individual EC Member States for 1990 to 2007. The GHG inventory data of the Member States are the basis of the EC GHG inventory. The data published in this report are also the basis of the progress evaluation report of the European Commission, required under Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.

This report aims to present transparent information on the process and methods of compiling the EC GHG inventory. It addresses the relevant aspects at EC level, but does not describe particular sectoral methodologies of the Member States' GHG inventories. Detailed information on methodologies used by the Member States is available in the national inventory reports of the Member States, which are included in Annex 12. Note that all Member States' submissions (CRF tables and inventory reports), which are included in Annex 12 and made available at the EEA website, are considered to be part of the EC submission. Several chapters in this report refer to information provided by the Member States, where additional insights can be gained. In many cases this Member State information is presented in summary overview tables.

The EC greenhouse gas inventory has been compiled under Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([7]). The emissions compiled in the EC GHG inventory are the sum of the respective emissions in the respective 15 or 27 national inventories, except for the IPCC reference approach for CO_2 from fossil fuels. Since the data are revised and updated for all years, they replace EC data previously published, in particular, in the 2008 submission by the European Commission to the UNFCCC Secretariat of the *Annual European Community greenhouse gas inventory 1990–2006 and inventory report 2008* (EEA, 2008a) and in the report entitled *Greenhouse gas emission trends and projections in Europe 2008* (EEA, 2008b).

This inventory report includes data for the EU-15 and for the EU-27 Member States. The EU-15 Member States are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. The 12 new Member States are Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia. Most chapters and annexes of this report refer to EU-15 and EU-27 although more detail is provided for EU-15 (for more information see Section 1.8.5). This means that all the detailed information provided in previous reports for the EU-15 is also available in this report.

1.1 Background information on greenhouse gas inventories and climate change

The annual EC GHG inventory is required for two purposes.

Firstly, the EC, as the only regional economic integration organisation having joined the UNFCCC and the Kyoto Protocol as a party, has to report annually on GHG inventories within the area covered by its Member States.

Secondly, under the monitoring mechanism, the European Commission has to assess annually whether the actual and projected progress of Member States is sufficient to ensure fulfilment of the EC's

([7]) OJ L 49, 19.2.2004, p. 1.

commitments under the UNFCCC and the Kyoto Protocol. For this purpose, the Commission has to prepare a progress evaluation report, which has to be forwarded to the European Parliament and the Council. The annual EC inventory is the basis for the evaluation of actual progress.

The legal basis of the compilation of the EC inventory is Council Decision No 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([8]). The purpose of this decision is to: (1) monitor all anthropogenic GHG emissions covered by the Kyoto Protocol in the Member States; (2) evaluate progress towards meeting GHG reduction commitments under the UNFCCC and the Kyoto Protocol; (3) implement the UNFCCC and the Kyoto Protocol as regards national programmes, greenhouse gas inventories, national systems and registries of the Community and its Member States, and the relevant procedures under the Kyoto Protocol; (4) ensure the timeliness, completeness, accuracy, consistency, comparability and transparency of reporting by the Community and its Member States to the UNFCCC Secretariat.

Under the provisions of Article 3.1 of Council Decision No 280/2004/EC, the Member States shall determine and report to the Commission by 15 January each year (year X) *inter alia*:

- their anthropogenic emissions of greenhouse gases listed in Annex A to the Kyoto Protocol (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride SF_6)) during the year before last (X – 2);
- provisional data on their emissions of carbon monoxide (CO), sulphur dioxide (SO_2), nitrogen oxides (NO_x) and volatile organic compounds (VOCs) during the year before last (year X – 2), together with final data for the year three-years previous (year X – 3);
- their anthropogenic greenhouse gas emissions by sources and removals of carbon dioxide by sinks resulting from land-use, land-use change and forestry during the year before last (year X – 2);
- information with regard to the accounting of emissions and removals from land-use, land-use change and forestry, in accordance with Article 3(3) and, where a Member State decides to make use of it, Article 3(4) of the Kyoto Protocol, and the relevant decisions thereunder, for the years between 1990 and the year before last (year X – 2);
- any changes to the information referred to in points (1) to (4) relating to the years between 1990 and the year three-years previous (year X – 3);
- the elements of the national inventory report necessary for the preparation of the Community greenhouse gas inventory report, such as information on the Member State's quality assurance/quality control plan, a general uncertainty evaluation, a general assessment of completeness, and information on recalculations performed.

The reporting requirements for the Member States under Council Decision 280/2004/EC are elaborated in the Commission Decision 2005/166/EC laying down rules implementing Decision 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol ([9]). According to the Council decision and the Commission decision the reporting requirements are exactly the same as for the UNFCCC, regarding content and format. The EC and its Member States use the 'UNFCCC guidelines on reporting and review' (Document FCCC/CP/2002/8), and prepare inventory information in the common reporting format (CRF) and the 'national inventory report' that contains background information.

In accordance with UNFCCC guidelines, the EC and its Member States use the IPCC *Good practice guidance and uncertainty management in national greenhouse gas inventories* (IPCC, 2000), which is consistent with the *Revised 1996 IPCC guidelines for national greenhouse gas inventories* (IPCC, 1997). The use of IPCC (2000) by countries is expected to lead to higher quality inventories and more reliable estimates of the magnitude of absolute and trend uncertainties in reported GHG inventories.

([8]) OJ L 49, 19.2.2004, p. 1.

([9]) OJ L 55, 1.3.2005, p. 57.

1.2 A description of the institutional arrangements for inventory preparation

Figure 1.1 shows the inventory system of the European Community. The DG Environment of the European Commission is responsible for preparing the inventory of the European Community (EC) while each Member State is responsible for the preparation of its own inventory which is the basic input for the inventory of the European Community. DG Environment is supported in the establishment of the inventory by the following main institutions: the European Environment Agency (EEA) and its European Topic Centre on Air and Climate Change (ETC/ACC) as well as the following other DGs of the European Commission: Eurostat, and the Joint Research Centre (JRC) ([10]).

Figure 1.1 Inventory system of the European Community

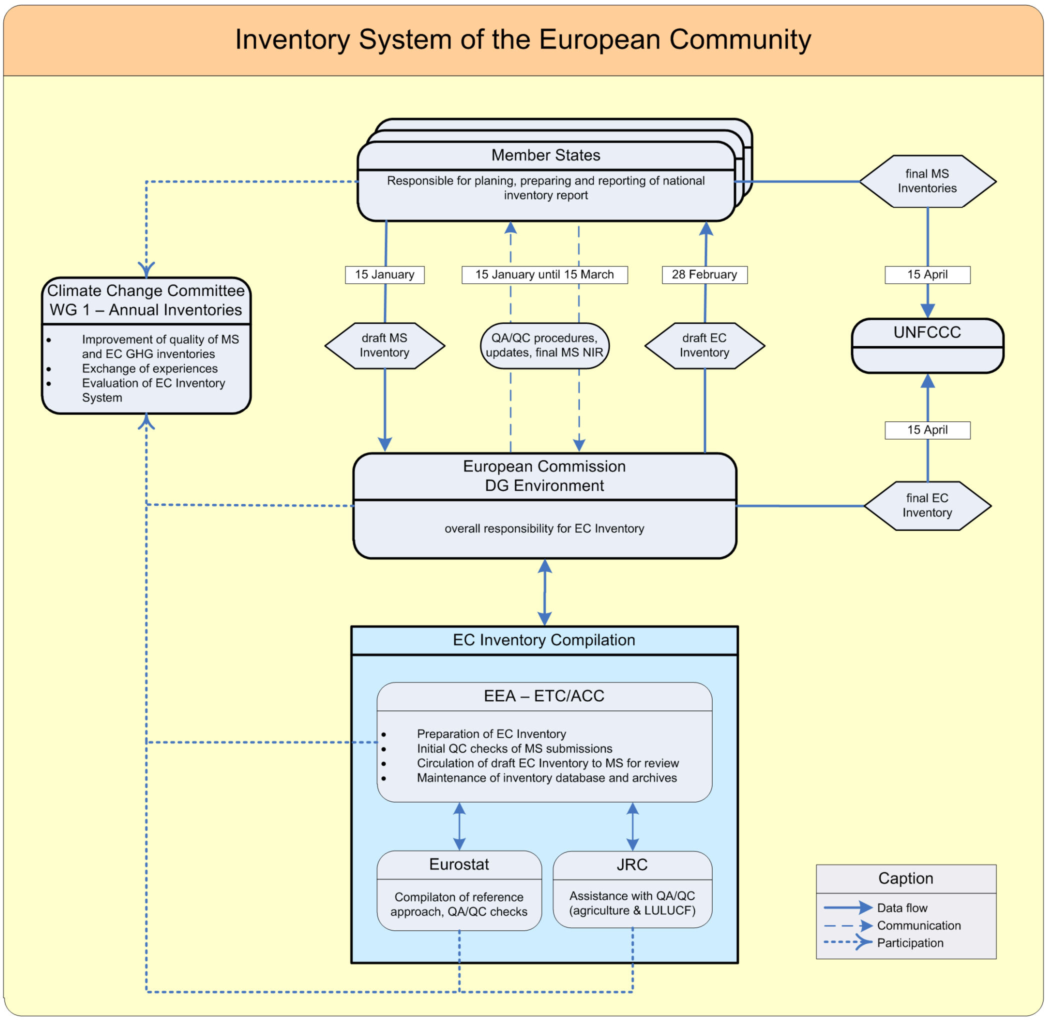


Table 1.1 shows the main institutions and persons involved in the compilation and submission of the EC inventory.

([10]) The Statistical Office of the European Communities (Eurostat) and the Joint Research Centre (JRC) are DGs of the European Commission. For simplicity reasons, these institutions are referred to as 'Eurostat' and the 'JRC' in this report.

Table 1.1 List of institutions and experts responsible for the compilation of Member States' inventories and for the preparation of the EC inventory

Member State/EC institution	Contact address
Austria	Manfred Ritter Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna
Belgium	Peter Wittoeck Federal Department of the Environment Pachecolaan 19 PB 5, B-1010 Brussels
Bulgaria	Detelina Petrova Executive Environment Agency 136, Tzar Boris III Blvd. 1618 Sofia
Cyprus	Christos Malikkides Head, Industrial Pollution Control Section, Department of Labour Inspection Ministry of Labour and Social Insurance 12, Apellis Street, 1493 Nicosia
Czech Republic	Pavel Fott Czech Hydrometeorological Institute (CHMI) Na Sabatce 17, CZ 14306 Prague 4
Denmark	Jytte Boll Illerup Danish National Environmental Research Institute PO Box 358, DK-4000 Roskilde
Finland	Riitta Pipatti Statistics Finland PB 6 A, FIN-00022 Statistics Finland
France	Ministère de l'Ecologie et du Développement Durable (MEDD) 20 avenue de Ségur, F-75007 Paris Jean-Pierre Fontelle Centre Interprofessionel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 7 Cité Paradis, F-75010 Paris
Estonia	Jaan-Mati Punning Institute of Ecology at TPU Kevade 2, Tallinn 10137
Germany	Michael Strogies Federal Environmental Agency Wörlitzer Platz 1, D-06844 Dessau-Roßlau
Greece	Ms Elpida Politi Hellenic Ministry for the Environment 241, Kifissias Street, 14561, Athens, Greece Prof. Ioannis Ziomas National Technical University of Athens Heroon Polytechniou 9, Zografos, 157 80, Athens, Greece
Hungary	László Gáspár Ministry of Environment and Water, department of Climate Policy Fõ u. 44-50, Budapest, 1011 Hungary
Ireland	Michael McGettigan, Paul Duffy Environmental Protection Agency Richview, Clonskeagh Road, Dublin 14, Ireland
Italy	M. Contaldi, R. de Lauretis, D. Romano National Environment Protection Agency (ANPA) Via Vitaliano Brancati 48, I-00144 Rome
Latvia	Agita Gancone Latvian Environment, Geology and Meteorology Agency Maskavas street 165, Riga, LV-1019
Lithuania	Vytautas Krusinskas Lithuanian Ministry of Environment A. Jaksto 4/9, LT 01105 Vilnius
Luxembourg	Eric De Brabanter Ministère de l'Environnement 18, Montée de la Pétrusse, L-2918 Luxembourg
Malta	Sharon.Micallef Malta Environment Planning Authority P.O. Box 200, Marsa GPO 01, Malta
Netherlands	Laurens Brandes Netherlands Environmental Assessment Agency PO Box 303, 3720 AH Bilthoven, The Netherlands
Poland	Krzysztof Olendrzynski Institute of Environmental Protection, National Emission Centre Kolektorska 4, 01-692 Warszawa
Portugal	Teresa Costa Pereira Direccao-Geral do Ambiente Rua da Murgueira — Bairro do Zambujal, P-2721-865 Amadora
Romania	Sorin Deaconu National Environmental Protection Agency Splaiul Independentei 294, Sector 6, Cod Postal 060841, Bucharest, Romania
Slovakia	Janka Szemesova Department of Emissions, Slovak Hydrometeorological Institute

Member State/EC institution	Contact address
	Jeseniova 17, 833 15 Bratislava, Slovak Republic
Slovenia	Tajda Mekinda Majaron Environmental Agency of the Republic of Slovenia Vojkova 1/b, SI-1000 Ljubljana
Spain	Ángleles Cristóbal Ministerio de Medio Ambiente Plaza de San Juan de la Cruz s/n, E-28071 Madrid
Sweden	Anna Forsgren Ministry of Environment S-103 33 Stockholm
United Kingdom	Sara Choudrie AEA group The Gemini Building, Fermi Avenue, Harwell, Didcot Osfordshire, OX11 0QR
European Commission	Erasmia Kitou European Commission, DG Environment Rue de la Loi 200, B-1049 Brussels, Belgium
European Environment Agency (EEA)	Ricardo Fernandez European Environment Agency Kongens Nytorv 6, DK-1050 Copenhagen, Denmark
European Topic Centre on Air and Climate Change (ETC/ACC)	Bernd Gugele, Sabine Goettlicher, Manfred Ritter European Topic Centre on Air and Climate Change Umweltbundesamt Spittelauer Laende 5, A-1090 Vienna, Austria
Eurostat	Nikolaos Roubanis Statistical Office of the European Communities (Eurostat), Jean Monnet Building, L-2920 Luxembourg, Luxembourg
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1.2.1 The Member States

All Member States are Annex I parties to the UNFCCC except Cyprus and Malta. Therefore, all Member States except Cyprus and Malta have committed themselves to prepare individual GHG inventories in accordance with UNFCCC reporting guidelines and to submit those inventories to the UNFCCC secretariat by 15 April. In addition, all Member States (including Cyprus and Malta) are required to report individual GHG inventories prepared in accordance with UNFCCC reporting guidelines to the Commission by 15 January every year under Council Decision 280/2004/EC.

The European Community’s inventory is based on the inventories supplied by Member States. The total estimate of the Community’s greenhouse gas emissions should accurately reflect the sum of Member States’ national greenhouse gas inventories. Member States are responsible for choosing activity data, emission factors and other parameters used for their national inventories as well as the correct application of methodologies provided in the IPCC 1996 Guidelines, IPCC Good Practice Guidance and IPCC Good Practice Guidance for LULUCF. Member States are also responsible for establishing QA/QC programmes for their inventories. The QA/QC activities of each Member State are described in the respective national inventory reports and summarised in the European Community inventory report.

Apart from submitting their national GHG inventories and inventory reports the Member States take part in the review and comment phase of the draft EC inventory report, which is sent to the Member States by 28 February each year. The purpose of circulating the draft EC inventory report is to improve the quality of the EC inventory. The Member States check their national data and information used in the EC inventory report and send updates, if necessary. In addition, they comment on the general aspects of the EC inventory report.

The Member States also take part in the Climate Change Committee established under Council Decision No 280/2004/EC. The purpose of the Climate Change Committee is to assist the European Commission in its tasks under Council Decision No 280/2004/EC.

Under Council Decision 280/2004/EC all Member States are required to establish national systems. Table 1.2 summarises the information on national systems/institutional arrangements in the EC Member States.

Table 1.2 Summaries of institutional arrangments/national systems of EU15 Member States

MS	Content	Source
Austria	Austria has a centralized inventory system, with all the work related to inventory preparation being carried out at a single national entity. The most important legal arrangement is the Austrian Environmental Control Act (Umweltkontrollgesetz, Federal Law Gazette 152/1998). It defines the main responsibility for inventory preparation and identifies the Umweltbundesamt as the one single national entity with overall responsibility for inventory preparation. The "Inspection body for GHG inventory" within the Umweltbundesamt is responsible for the compilation of the GHG inventory. Sector experts collect activity data, emission factors and all relevant information needed for finally estimating emissions. The sector experts also have specific responsibilities regarding the choice of methods, data processing and archiving and for contracting studies, if needed. As part of the quality management system the head of the "Inspection body for GHG inventory" approves the methodological choices. Sector experts are also responsible for performing Quality Control (QC) activities that are incorporated in the Quality Management System (QMS). During the inventory preparation process, all data collected together with emission estimates are fed into a database, where data sources are well documented for future reconstruction of the inventory. The Austrian Inventory is based on the SNAP nomenclature and has to be transformed into the UNFCCC CRF to comply with the reporting obligations under the UNFCCC. In addition to the actual emission data, the background tables of the CRF are filled in by the sector experts, and finally QA/QC procedures as defined in the inventory planning process are carried out before the data are submitted to the UNFCCC. For inventory management reliable data management has been established to fulfil the data collecting and reporting requirements. This ensures the necessary documentation and archiving for future reconstruction of the inventory and consequently enables easy access to up-to-date and previously submitted data for the quantitative evaluation of recalculations. As part of the QMS (Corrective and Preventive Actions) an efficient process is established to grant transparency when collecting and analyzing findings by UNFCCC review experts or any other issues concerning the quality of activity data, emission factors, methods and other relevant technical elements of inventories. Any findings and discrepancies are documented; responsibilities, resources and a time schedule are attributed to each of these in the improvement plan. Measures, which include possible recalculations, are taken by the sector experts. The national energy balance is the most important data basis for the Austrian Air Emissions Inventory. The Austrian statistical office (Statistik Austria) is required by contract with the Federal Ministry of Agriculture, Forestry, Environment and Water Management and with the Federal Ministry of Economics and Labour to annually prepare the national energy balance. The compilation of several other relevant statistics is regulated by law. Other data sources include reporting obligations under national and European regulations and reports of companies and associations. The main data sources used for activity data were: • Energy Balance from Statistik Austria; EU-ETS; Steam boiler database (for the sector Energy) • National production statistics, import/export statistics; EU-ETS; direct information from industry or associations of industry (for the sector Industry) • Import/export statistics, production statistics, consumption statistics (for the sector Solvents) • National Studies, national agricultural statistics obtained from Statistik Austria (for the sector Agriculture) • National forest inventory obtained from the Austrian Federal Office and Research Centre for Forest (for the sector LULUCF) • Database on landfills Umweltbundesamt (for the sector Waste). The main sources for emission factors are: (1) national studies for country specific emission factors, (2) plant-specific data reported by plant operators (3) IPCC GPG (4) Revised IPCC 1996 Guidelines (5) EMEP/CORINAIR Guidebook.	Austria's Annual Greenhouse Gas Inventory 1990–2007 Jan 2009 pp. 21-23
Belgium	In the Belgian federal context, major responsibilities related to environment lie with the regions. Compiling GHG inventories is one of these responsibilities. Each region implements the necessary means to establish their own emission inventory in accordance with the IPCC guidelines. The emission inventories of the three regions are subsequently combined to form the national GHG emission inventory. Since 1980, the three regions have been developing different methodologies (depending on various external factors) for compiling their atmospheric emission inventories. During the last years important efforts are made to tune these different methodologies, especially for the most important (key) sectors. Obviously, this requires some coordination to ensure the consistency of the data and the establishment of the national inventory. This co-ordination is one of the permanent duties of the Working Group on « Emissions » of the Coordination Committee for International Environmental Policy (CCIEP), where the different actors decide how the regional data will be aggregated to a national total, taking into account the specific characteristics and interests of each region as well as the available means. This working group consists of representatives of the 3 regions and of the federal public services. The Interregional Environment Unit (CELINE - IRCEL) is responsible for integrating the emission data from the inventories of the three regions and for compiling the national inventory. The National inventory report is then formally submitted to the National Climate Commission, established by the Cooperation agreement of 14 November 2002, for approval, before its submission to the secretariat of the United Nations Framework Convention on Climate Change and to the European Commission, under the Council Decision 280/2004/EC concerning a Mechanism for Monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.	Belgium's GHG Inventory (1990 – 2007) National Inventory Report submitted under the United Nations Framework Convention on Climate Change Mar 2009 pp.1-2
Denmark	The National Environmental Research Institute NERI, Aarhus University, is responsible for the annual preparation and submission to the UNFCCC and the EU of the National Inventory Report and the GHG inventories in the Common Reporting Format in accordance with the UNFCCC Guidelines. NERI have been and are engaged in work in connection to the meetings of the Conference of Parties (COP) to the UNFCCC and the meetings of the parties (COP/MOP) to the Kyoto protocol and its subsidiary bodies, where the reporting rules are negotiated and settled. Furthermore, NERI participates in the EU Monitoring Mechanisms on greenhouse gases Working Group 1 (WG1), where the guidelines, methodologies etc. on inventories to be prepared by the EU Member States are regulated.	Danish Annual EC Greenhouse Gas Report 2009: Inventories 1990-2007Jan 2009 p.26

MS	Content	Source
Finland	In accordance with the Government resolution of 30 January 2003 on the organisation of climate policy activities of Government authorities in Finland, Statistics Finland assumed the responsibilities of the National Entity for Finland´s greenhouse gas inventory from the beginning of 2005. Statistics Finland as the general authority of the official statistics of Finland is independently responsible for greenhouse gas inventory submissions under the UNFCCC, the Kyoto Protocol and the EU monitoring mechanism. Besides Statistics Finland, the Finnish Environment Institute, MTT Agrifood Research Finland and the Finnish Forest Research Institute take part in the inventory preparation. Statistics Finland acquires also parts of the inventory calculations as purchased services from VTT (Technical Research Centre of Finland) and Finavia. In Finland the national system, as intended in the Kyoto Protocol (Article 5.1), is based, besides regulations concerning Statistics Finland, on agreements on the production of emission/removal estimations and reports between the inventory unit at Statistics Finland and the expert organisations mentioned above. Statistics Finland has also agreements with the responsible ministries defining the responsibilities and collaboration in relation to the reporting requirements under the UNFCCC and Kyoto Protocol, as well as the EU monitoring mechanism. In Finland the National System is established on a permanent footing and it guides the development of emission calculation in the manner required by the agreements. The National System is designed and operated to ensure the transparency, consistency, comparability, completeness, accuracy and timeliness of greenhouse gas emission inventories. The quality requirements are fulfilled by implementing consistently the inventory quality management procedures. A detailed description of the National Greenhouse Gas Inventory System in Finland can be found from the report "National Greenhouse Gas Inventory System in Finland" which is available on the web: http://tilastokeskus.fi/tup/khkinv/3_fin_national_system_20061215.pdf.	GHG Emissions in Finland 1990-2007 National Inventory Report to the European Union Draft Jan 2009 p.8 and pp. 17-19
France	The responsibility of the definition and control of the National emission inventory (Système National d'Inventaire des Emissions de Polluants dans l'Atmosphère (SNIEPA)) is pertained by the **Ministère de l'Ecologie et du Développement Durable** (MEDD). The MEDD coordinates with other relevant ministries the concerned decisions and relating to SNIEPA the institutional, juridical and the procedural arrangements. This way, it defines the responsibilities to different involved organisations. It carries out the arrangements, which assure the realisation of processes related to the determination of calculation methods, data collection, processing of data, archiving, quality assurance and control, the dissemination according to national and international arrangements. The different requirements lead to the elaboration of an emission inventory often carrying the similar substances and sources justified by the concern for coherence, quality and effectiveness to hold the principle of uniqueness of the inventory. This strategy corresponds to the recommendations of international requests, like the European Commission and the United Nations. The emissions inventories must guarantee quality coherence, comparability, transparency, exactness, punctuality, completeness, which requests the organisation of an administrative as well as technical system. The present chapter describes the organisation of the actual system, which was dealt with in the inter-ministerial decree of 29th decembre 2006 relating to SNIEPA. The responsibilities are as following: The coordination for the realisation of the inventory is assured by MEDD. Other ministries and public organisations contribute by supplying data and statistical information. The elaboration of the inventory concerning methods, the collection and processing of data, archiving and writing of reports and quality issues done by CITEPA (Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique) through MEDD. CITEPA assists MEDD with the coordination of the whole national inventory system, which comprises also emission registries like EPER and other aspects to ensure coherence of information. MEDD makes all information within the existing regulation frame available to CITEPA (like annually emission declarations of classified installations). MEDD guides the GCIIE (Groupe de concertation et d'information sur les inventaires d'émission). GCIIE consists of the following representants: Mission Interministérielle à l'Effet de Serre (MIES), Ministry of Agriculture, notably the Service central des enquêtes et études statistiques (SCEES), Direction générale des politiques économique, européenne et internazionale (DGPEEI), Ministère chargé de l'économie et de l'industrie (MINEFI), Direction générale de la forêt et des affaires rurales (DGFAR), Direction générale de l'INSEE, Direction générale de l'Energie et des Matières Premières (DGEMP), Direction générale du Trésor et de la politique économique (DGTPE), Direction générale des entreprises (DGE), Ministère chargé de l'équipement, de l'urbanisme et des transports (MTETM), Direction des affaires économiques et internationales (DAEI), Direction générale de l'aviation civile (DGAC), Direction générale de la mer et des transports (DGMT), Direction de la sécurité et de la circulation routières (DSCR), Direction générale de l'urbanisme, de l'habitat et de la construction (DGUHC), Centre d'études sur les réseaux, les transports, l'urbanisme et les constructions publiques (CERTU), Ministère de l'Ecologie et du Développement Durable (MEDD), Direction de la prévention des pollutions et des risques (DPPR), la Direction des etudes économiques et de l'évaluation environnementale (D4E); The dissemination of the emissions inventory is split between different organisations which receive the approved inventory by MEDD.	Rapport d'Inventaire National – Inventaire des émissions de gaz à effet de serre en France de 1990 à 2007 Mar 2009, pp.18-20, (submitted in French, translated)

MS	Content	Source
Germany	The national Inventory System in Germany complies with the requirements laid down in the Guidelines for National Systems (UNFCCC Decision 19/CMP.1). The use of the IPCC-Guidelines and IPCC Good Practice Guidance and a continuous Quality Management and continuous improvement of the inventory ensure a transparent, consistent, comparable, complete and accurate inventory. In the position paper "Nationales System" (June 2007) Umweltbundesamt was laid down as the national coordination centre for emission inventory reporting. Other involved institutions and agencies: • Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU) • Federal Ministry for Consumer Protection, Food and Agriculture (BMELV) • Federal Ministry of of the Interior (BMI) • Federal Ministry of Defence (BMVg) • Federal Ministry of Finace (BMF) • Federal Ministry of Economis and Technology • Federal Ministry of Transport, Building and Urban Affairs Tasks of the national coordination centre (Umweltbundesamt)are: • Planning of the inventories • Compilation of the inventories • Archiving of the inventories • Quality control and Quality Assurance To meet these tasks the national coordination centre has developed a database "Zentrale System Emissionen" (which is the main instrument for documentation and quality assurance on the level of data) and the Quality sytem "Emissionsinventare" (which regulates responsibilities and quality aims). The national coordination centre within UBA cooperates with other working groups within UBA. For coordination of the tasks within UBA a working team "Arbeitskreis Emissionsinventare" was installed. Research centres contribute to inventory compilation with research projects that are carried out within the framework of the research programme "Umweltforschungsplan". For the integration of non-governmental organisation a convention was devised that binds the respective entities to contribute to the inventory compilation.	Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2007 Jan 2009 pp. 54-60 (submited in German, translated)
Greece	The Ministry for the Environment, Physical Planning and Public Works (henceforth Ministry for the Environment, MINENV) is the governmental body responsible for the development and implementation of environmental policy in Greece, as well as for the provision of information concerning the state of the environment in Greece in compliance with relevant requirements defined in international conventions, protocols and agreements. Moreover, the Ministry for the Environment is responsible for the co-ordination of all ministries involved, as well as of any relevant public or private organization, in relation to the implementation of the provisions of the Kyoto Protocol according to the Law 3017/2002 with which Greece ratified the Kyoto Protocol. In this context, the Ministry for the Environment and more specifically the Division of Air Pollution and Noise Control has the overall responsibility for the national GHG inventory, and the official consideration and approval of the inventory prior to its submission. The entities participating in it are: • The Ministry for the Environment designated as the national entity responsible for the national inventory, which keeps the overall responsibility, but also plays a more active role in the inventory planning, preparation and management. • The National Technical University of Athens (NTUA) / School of Chemical Engineering, which has the technical and scientific responsibility for the compilation of the annual inventory. • Governmental agencies and ministries, international associations, along with individual private industrial companies. The Ministry for the Environment, designated as the national entity, has the overall responsibility for the national GHG inventory. Among its responsibilities are the following: • The co-ordination of all ministries and governmental agencies involved, as well as any relevant public or private organization. In this context, it oversees the operation of the National System and decides on the necessary arrangements to ensure compliance with relevant decisions of the COP and the COP/MOP. • The official consideration and approval of the inventory prior to its submission • The response to any issues raised by the inventory review process under Article 8 of the Kyoto Protocol, in co-operation with the NTUA Inventory Team • The timely submission of the GHG inventory to the European Commission and to the UNFCCC Secretariat • The keeping of the Centralised Inventory File, which is delivered to the institute which has the technical responsibility for the inventory planning, preparation and management (currently NTUA) at the beginning of each inventory cycle. The Centralised Inventory File is kept at the premises of MINENV • The administration of the National Registry. • The supervision of Quality Assurance/Quality Control Plan (QA/QC). MINENV has an active role in monitoring and overseeing the inventory process through continuous communication and frequent scheduled and / or ad-hoc meetings with the Inventory Team of NTUA and the competent ministries or other agencies involved.	Greece – Information under Article 3(1) of the Decision 280/2004/EC, Jan 2009, pp.3-6

MS	Content	Source
Ireland	In 2005, UK consultants NETCEN carried out a scoping study to identify the essential elements and structure of a national inventory system for Ireland to meet the needs of Decision 280/2004/EC and to comply with obligations under Articles 5 and 7 of the Kyoto Protocol. The establishment of Ireland's national inventory system was completed by Government Decision in early 2007, building on the framework that has been applied for many years. It puts in place formal procedures for the planning, preparation and management of the national atmospheric inventory and identifies the roles and responsibilities of all the organisations involved in its compilation. All formal mechanisms together with the QA/QC procedures are fully operational in this present reporting cycle. The EPA Office of Climate, Licensing and Resource Use (OCLR) is the inventory agency and the EPA is also designated as the single national entity with overall responsibility for the annual greenhouse gas inventory. The national system is also exploited for the purpose of inventory preparation and reporting under the LRTAP Convention ensuring efficiency and consistency in the compilation of emission inventories for a wide range of substances using common datasets and inputs.As a formal management system, the national system aims for continuous improvement to increase the quality and robustness of the national atmospheric inventory over time. In addition to the primary data received from the key data providers, the inventory team obtains considerable supplementary information from other teams in OCLR and the Office of Environmental Enforcement within the EPA. These sources include Annual Environmental Reports (AER) submitted by licensed companies and the National Waste Database. The inventory team also draws on national research related to greenhouse gas emissions and special studies undertaken from time to time to acquire the information needed to improve the estimates for particular categories and gases. The approval of the completed annual inventory involves sign-off by the QA/QC manager and the inventory manager before it is transmitted to the Board of the EPA via the Programme Manager of the Climate Change Unit in OCLR. Any issues arising from the Board's examination of the estimates are communicated to the inventory experts for resolution before final adoption of the inventory. The results are released at national level in advance of their official submission to the European Commission in accordance with Decision 280/2004/EC in January of the reporting year and subsequently to the UNFCCC secretariat. For the 2008/2009 reporting cycle, the inventory agency was able to comply with a request from Government to produce preliminary greenhouse gas emissions estimates for 2007 by mid October 2008.	Ireland National Inventory Report 2009,GHG emissions 1990-2007reported to the UNFCCC Mar 2009 pp.6-7
Italy	A Legislative Decree, issued on 7th March 2008, institutes the National System for the Italian Greenhouse Gas Inventory. The Institute of Environmental Protectioen and Research (ISPRA), former Agency for Environmental Protection and Technical Services (APAT) is the single entity in charge of the development and compilation of the national greenhouse gas emission inventory. The Ministry for the Environment, Land and Sea is responsible for the endorsement of the inventory and for the communication to the Secretariat of the Framework Convention on Climate Change and the Kyoto Protocol. The inventory is also submitted to the European Commission in the framework of the Greenhouse Gas Monitoring Mechanism. The Institute annually develops a national system document which includes all updated information on institutional, legal and procedural arrangements for estimating emissions and removals of greenhouse gases and for reporting and archiving inventory information. The last year report is publicly available at: http://www.apat.gov.it/site/_files/NationalSystemItaly08.pdf. A specific unit of the Agency is responsible for the compilation of the Italian Atmospheric Emission Inventory and the Italian Greenhouse Gas Inventory in the framework of both the Convention on Climate Change and the Convention on Long Range Transboundary Air Pollution. The whole inventory is compiled by the agency; scientific and technical institutions and consultants may help in improving information both on activity data and emission factors of some specific activities. All the measures to guarantee and improve the transparency, consistency, comparability, accuracy and completeness of the inventory are undertaken. ISPRA bears the responsibility for the general administration of the inventory, co-ordinates participation in reviews, publishes and archives the inventory results. Specifically, ISPRA is responsible for all aspects of national inventory preparation, reporting and quality management. Activities include the collection and processing of data from different data sources, the selection of appropriate emissions factors and estimation methods consistent with the IPCC 1996 Revised Guidelines, the IPCC Good Practice Guidance and Uncertainty management and the IPCC Good Practice Guidance for land use, land- use change and forestry, the compilation of the inventory following the QA/QC procedures, the assessment of uncertainty, the preparation of the National Inventory Report and the reporting through the Common Reporting Format, the response to the review process, the updating and data storage. Different institutions are responsible for statistical basic data and data publication, which are primary to ISPRA for carrying out emission estimates. These institutions are part of the National Statistical System (Sistan), which provides national official statistics, and therefore are asked periodically to update statistics; moreover, the National Statistical System ensures the homogeneity of the methods used for official statistics data through a coordination plan, involving the entire public administration at central, regional and local levels. The National Statistical System is coordinated by the Italian National Institute of Statistics (ISTAT). Ministries, public agencies and other bodies are obliged to provide the data and information specified in the annual statistical plan; the same obligations regard the private entities. All the data are protected by the principles of statistical disclosure control and can be distributed and communicated only at aggregate level. The main Sistan products, which are primarily necessary for the inventory compilation, are: • National Statistical Yearbooks, Monthly Statistical Bulletins, by ISTAT (National Institute of Statistics) • Annual Report on the Energy and Environment, by ENEA (Agency for New Technologies, Energy and the Environment) • National Energy Balance (annual), Petrochemical Bulletin (quarterly publication), by MSE (Ministry of Economic Development) • Transport Statistics Yearbooks, by MINT (Ministry of Transportation) • Annual Statistics on Electrical Energy in Italy, by TERNA (National Independent System Operator) • Annual Report on Waste, by ISPRA • National Forestry Inventory, by MIPAAF (Ministry of Agriculture, Food and Forest Policies). The national emission inventory itself is a Sistan product.	Italian Greenhouse Gas Inventory 1990-2007 National Inventory Report 2009, Apr 2009, pp.20-23

MS	Content	Source
Luxembourg	The Ministry of the Environment acts as the 'National Inventory Compiler' (*NIC*). In this respect, the Ministry is responsible for transmitting the inventories (and its associated NIR) to the European Commission and to the UNFCCC Secretariat. However, in conformity with the law of 27 November 1980, which created an Environment Agency, the national GHG inventories, as well as the NIR, are prepared by the Air/Noise department of this Agency. All the material, estimates and calculation sheets, as well as the documentation on scientific papers and the basic data needed for the inventories compilation, are stored and archived within the Agency; the Ministry keeping only copies of the inventories (CRF tables) and of the related reports (such as the NIR) in its archives. It is worth noticing that the Environment Agency is also responsible for preparing emission inventories under the Convention on Long Range Transboundary Air Pollution (*CLRTAP*) and the EU emission ceilings Directive (*NEC*). Acting as the NIC, the Ministry is controlling the data delivered by the Agency, notably with the help of the CRF Reporter software that helps performing the completeness and inventory checks. It is also the Ministry that generates the final MS Excel CRF tables and prepares the official submission using CRF Reporter. Submission v1.1 of March 2007 is the first one that has been realized by transferring all the data tables into – and therefore using – CRF Reporter. The version of the software that has been used is 3.1.11. Annex III indicates the issues and problems encountered by Luxembourg while transferring data into and using this version of CRF Reporter. During the year 2007, and with the help of a consultant, it is intended to develop further the national GHG inventory system allowing for a full observance of the obligations of the Kyoto Protocol. This work will be realized concomitantly with the verification and the completion of GHG inventories to be carried out in line with the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories as well as the IPCC Good Practice Guidance for LULUCF Data used to produce the annual air emission (including GHG) inventories are mainly: • taken from official statistical datasets calculated by the National Statistics Office (*STATEC*); • coming from information supplied directly by the operators of industrial or other activities; • extracted from statistical information received from other ministries (for example Ministry of Economic Affairs and External Trade for energy). However, some of the information necessary to prepare the inventories is not available in Luxembourg. In these cases, data from other European countries or from the literature were taken as default data.	National Inventory Report 1990-2004 Luxembour g Apr 2007 pp.1-2 (no report for 2008 submission)
Netherlands	The Ministry of Housing, Spatial Planning and the Environment (VROM) has the overall responsibility for climate change policy issues. In August 2004 the Ministry of VROM assigned SenterNovem executive tasks bearing on the National Inventory Entity (NIE) - the single national entity required under the Kyoto Protocol. In December 2005, SenterNovem was designated by law as the NIE. In addition to co-ordinating the establishment of a National System, the tasks of SenterNovem include the overall co-ordination of (improved) QA/QC activities as part of the National System and coordination of the support/response to the UNFCCC review process. A Pollutant Emission Register (PRTR) has been in operation in the Netherlands since 1974. This system encompasses the process of data collection, data processing and the registering and reporting of emission data for some 170 policy-relevant compounds and compound groups that are present in the air, water and soil. The emission data are produced in an annual (project) cycle. This system is also the basis for the national greenhouse gas inventory. In April 2004 full co-ordination of the PRTR was outsourced by the Ministry of VROM to the PBL (then named MNP). The main objective of the PRTR is to produce an annual set of unequivocal emission data that are up-to-date, complete, transparent, comparable, consistent and accurate. In addition to MNP, various external agencies contribute to the PRTR by performing calculations or submitting activity data. Among them are CBS (Statistics Netherlands), TNO (Netherlands Organisation for Applied Scientific Research), SenterNovem, RIZA (Institute for Inland Water Management) and several institutes related to the Wageningen University and Research Centre (WUR). The NIR is prepared by MNP. Since mid-2005, the NIR has been part of the PRTR project. Most institutes involved in the PRTR also contribute to the NIR (including CBS and TNO, among others). In addition, SenterNovem is involved in its role as NIE.	Greenhouse Gas Emissions in the Netherlands 1990-2007 National Inventory Report Jan 2009 p. 10-11
Portugal	In order to comply with the commitments at the international and EC levels, respectively, the Article 5(1) of the Kyoto Protocol and Decision 280/2004/EC of the European Parliament and of the Council, a National Inventory System of Emissions by Sources and Removals by Sinks of Air Pollutants (SNIERPA) was created. This system contains a set of legal, institutional and procedural arrangements that aim at ensuring the accurate estimation of emissions by sources and removals by sinks of air pollutants, as well as the communication and archiving of all relevant information. The system was established through Council of Ministers Resolution 68/2005, of 17 March, which defines the entities relevant for its implementation, based on the principle of institutional cooperation. Three bodies are established with differentiated responsibilities. The Institute for the Environment (IA) is responsible for the overall coordination and updating of the National Inventory of Emissions by Sources and Removals by Sinks of Air Pollutants (INERPA), the inventory's approval, after consulting the Focal Points and the involved entities; and its submission to EC and international bodies to which Portugal is associated. The sectoral Focal Points work with IA in the preparation of INERPA, and are responsible for for steering intra and inter-sectoral cooperation to ensure a more efficient use of resources. The involved entities are public or private bodies which generate or hold information which is relevant to the INERPA, and which actions are subordinate to the Focal Points or directly to the Responsible Body. The National Environmental Agency (Agência Nacional do Ambiente - APA) is the national entity responsible for the overall coordination of the Portuguese inventory of air pollutants emissions. According to these attributions, APA makes an annual compilation of the Portuguese Inventory of air emissions which includes GHGs and sinks, acidifying substances as well as other pollutants. Annually reported data, e.g. CRF tables, are stored both in paper and magnetic format.	Short Portuguese National Inventory Report on Greenhouse Gases, 1990-2007, Jan 2009, pp. 5-9

MS	Content	Source
Spain	The "Directorate-General for Environmental Quality and Evaluation at the Ministry of the Environment" (DGCEA) is the National Authority for the National Air Pollutant Emissions Inventory System. The air pollutant emissions inventories are considered to be statistics for State purposes and as such, in accordance with article 149.1.31 of the Spanish Constitution, are performed on the basis of the exclusive responsibility of the State. In this sense, the regulatory frame of reference is provided by the Spanish Public Statistical Function Act (Law 12 dated May 9th, 1989) and by the 2005-2008 National Statistical Plan, approved by Royal Decree 1 911 dated September 17th, 2004. With regard to data collection, Law 12/1989 establishes two different regimes for the regulation of statistics depending on whether data are demanded in a compulsory manner or individuals are free to provide information voluntarily. Since they form part of the National Statistical Plan and their preparation represents an obligation for the Spanish State under European Union regulations, emissions inventories fall into the first of these two regimes, i.e. the submission of data by individuals is compulsory. The DGCEA is technically supported by AED-NSD-TWOBE. Further, DGCEA cooperates with Research Institutes and University Departments, e.g. with the • Escuela Técnica Superior de Ingenieros Industriales-Universidad Politécnica de Madrid (for projections) • Sistema y Technoligías de la Producción Animal-Universidad Politécnica de Valencia (for the Sector Agriculture) • Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (for quality assurance in the Sector Energy) Further several ministries participate in the NIS. • Ministry of Agriculture, fisheries and food (Agriculture) • Ministry of Industry, Tourism and Trade (Energy and Industrial Processes) • The Tax Ministry (general statistics (e.g. census)) • Ministry of Public Safty (Transport Statistics) • Ministry of Development (Transport)	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2007 Mar 2009, Sec. 1.2 (submitted in Spanish, translated)
Sweden	The Swedish Ministry of Environment has overall responsibility and submits the inventory report to the European Commission and to the UNFCCC secretariat. The Swedish Environmental Protection Agency (Swedish EPA) co-ordinates the activities for developing the inventory report and is also responsible for the final quality control and quality assurance of the data before it is submitted. A consortium called Swedish Environmental Emissions Data (SMED), composed of Statistics Sweden, the Swedish Meteorological and Hydrological Institute (SMHI), the Swedish Environmental Research Institute AB (IVL) and the Swedish University of Agricultural Sciences (SLU) collects data and calculates emissions for all sectors. A national system meeting the requirements laid down in article 5.1 of the Kyoto Protocol is developed and was fully in operation in 2006. The process of inventory preparation is carried out differently for the different sectors: • ENERGY- STATIONARY COMBUSTION: Activity data is collected for the following subgroups: Energy industries: Data from quarterly fuel statistics, a total survey conducted by Statistics Sweden at plant level and by fuel type. For some petroleum refining plants, data from the European Union Emission Trading Scheme (ETS) is used. Manufacturing industries: Data mainly from the quarterly fuel statistics, a sample survey conducted by Statistics Sweden. In some cases data from the industrial energy statistics is used as a complement. All data is at plant level and by fuel type. Other sectors: Data from official statistical reports prepared by Statistics Sweden at national level and by fuel type. • ENERGY- MOBILE COMBUSTION: Data on fuel consumption at national level and by fuel type is collected and used in combination with emissions data and fuel data from the National Road Administration, the National Rail Administration, the Civil Aviation Administration and the Swedish Military. • INDUSTRIAL PROCESSES: The reported data for industrial processes is mainly based on information from environmental reports. The data in the environmental reports refer to emissions derived from plant specific measurements or estimates such as mass balances. The use of default emission factors is limited. SOLVENT AND OTHER PRODUCT USE: Data used for estimating emissions from solvent and other product use are based on emission factors and national activity data obtained from the Products register kept by the Swedish Chemicals Agency. AGRICULTURE: Data on animal numbers, crop areas, yields, sales of manure, manure management and stable periods are taken from official statistical reports published by the Swedish Board of Agriculture and Statistics Sweden. Some complementary information is collected from organisations and researchers, such as the Swedish Dairy Association, Swedish Poultry Meat Association, SLU and the Swedish Institute of Agricultural and Environmental Engineering. • LAND USE, LAND USE CHANGE AND FORESTRY: Estimates presented in the LULUCF sector are mainly based on data from the SLU. The SLU is responsible for the National Forest Inventory, which focuses on living biomass, and for the Swedish Forest Soil Inventory, that focuses on dry organic matter and on soil organic carbon. The two inventories are integrated and use the same infrastructure for the field sample. • WASTE: Statistics on deposited waste quantities, methane recovery and nitrogen emissions from wastewater handling, are provided by the Swedish Association of Waste Management (Avfall Sverige, former RVF), Statistics Sweden, the Swedish Forest Industries Federation and the Swedish EPA. If new data on organic content in household waste or other relevant research is published, such reports are also considered. A new system for handling emission data, entitled TPS, has been developed and used for the first time in submission 2007. It supports data input from Microsoft Excel sheets, and provides different types of quality gateways.	National Inventory Report Sweden 2009 Jan 2009 pp.25-28

MS	Content	Source
United Kingdom	The UK Greenhouse Gas Inventory is compiled and maintained by AEA of AEA Technology plc – the Inventory Agency - under contract with the Climate, Energy, Science and Analysis (CESA) Division in the UK Department of Energy and Climate Change (DECC). AEA is directly responsible for producing the emissions estimates for CRF categories Energy (CRF sector 1), Industrial Processes (CRF sector 2), Solvent and Other Product Use (CRF sector 3), and Waste (CRF Sector 6). AEA is also responsible for inventory planning, data collection, QA/QC and inventory management and archiving. Agricultural sector emissions (CRF sector 4) are produced by the Defra's Land Management Improvement Division by means of a contract with North Wyke Research. Land-Use Change and Forestry emissions (CRF sector 5) are calculated by the UK Centre for Ecology and Hydrology (CEH), under separate contract to CESA (DECC). DECC is the Single National Entity responsible for submitting the UK's greenhouse gas inventory (GHGI) to the UNFCCC. AEA compiles the GHGI on behalf of DECC, and produces disaggregated estimates for the Devolved Administrations within the UK. Key Data Providers include other Government Departments such as Department for Business, Enterprise and Regulatory Reform (BERR) and Department for Transport (DfT), Non-Departmental Public Bodies such as the Environment Agency for England and Wales (EA) and the Scottish Environmental Protection Agency (SEPA), private companies such as Corus, and business organisations such as UK Petroleum Industry Association (UKPIA) and UK Offshore Oil Association (UKOOA).As the designated Single National Entity for the UK GHG National Inventory System (NIS), Defra has the following roles and responsibilities: • National Inventory System Management and Planning (overall control of the NIS development and function; management of contracts and delivery of GHG inventory; definition of performance criteria for NIS key organisations) • Development of Legal & Contractual Infrastructure (review of legal and organisational structure; implementation of legal instruments and contractual developments as required to meet guidelines.) As the designated Inventory Agency for the UK GHG National Inventory System, AEA Energy and Environment has the following roles and responsibilities: • Planning (Co-ordination with DECC to deliver the NIS, Review of current NIS performance and assessment of required development action, and Scheduling of tasks and responsibilities to deliver GHG inventory and NIS. • Preparation (drafting of agreements with key data providers; review of source data and identification of developments required to improve GHG inventory data quality. • Management (documentation and archiving; dissemination of information regarding NIS to Key Data Providers; management of inventory QA/QC plans, programmes and activities. • Inventory Compilation (data acquisition, processing and reporting; delivery of NIR)	GB Short NIR, Feb 2009 pp. 4-10

Table 1.3 Summaries of institutional arrangments/national systems of new Member States

MS	Content	Source
Bulgaria	The Ministry of Environment and Water (MoEW) is the responsible institution for the national GHG inventory to the Secretariat of the UNFCCC. The Single Entity responsible for preparation of National GHG inventories is Executive Environment Agency (ExEA). The legal basis for the Bulgarian National System for GHG inventories is provided in the Environmental Protection Act /EPA/ (State Gazette №91/2002) and in particular by the provisions of it's Chapter 8, which establishes the National Environmental Monitoring System and lists all of its tasks. To ensure the effective and timely functioning of the National System for GHG inventories, as well as complete reporting under the UNFCCC and the Convention of Long-Range Transboundary Air Pollution (CLRTAP), the Minister of Environment and Water has issued the Order № RD-54/25.01.2007, based on the EPA, which regulate in detail the institutional, legal and procedural arrangements and responsibilities for inventory preparation under the Secretariats of UNFCCC and CLRTAP. The ExEA coordinates the data collection from the following state authorities: • National Statistical Institute (NSI) • Ministry of Economy and Energy • Statistics Department within Ministry of Agriculture and Food Supplies (MAF) • State Forestry Agency; • Soil Resource Executive Agency within MAF • National Service for Plant Protection, Quarantine and Agro chemistry • Road Control Department (RCD) within the Ministry of Internal Affairs • Operators of large combustion plants and large points sources The annual national energy and material balances as well as the data related to the solid waste generation and the wastewater discharges are prepared by NSI. NSI uses up-to-date statistical methods and procedures for data collection, summarizing and structuring that are harmonized with EUROSTAT. The GHG inventory represents a process, covering the following main activities: · Collecting, processing and assessment of input data on used fuels, materials and other GHG emission sources · Selection and application of emission factors for estimating the emissions · Determination of the basic (key) GHG emission sources and assessment of the results uncertainty. The basic source for emission factors for current inventory are the country specific practices, IPCC Revised Guidelines and the Good Practice Guidelines and CORINAIR methodology.	National Inventory Report of Greenhouse Gas Emissions in Republic Bulgaria 1988-2007 Jan 2009 pp.2-3

MS	Content	Source
Cyprus	The Ministry of Agriculture, Natural Resources and Environment (MANRE) is the Cyprus governmental body responsible for the development and implementation of environmental policy in Cyprus, as well as for the provision of information concerning the state of the environment in Cyprus in compliance with relevant requirements defined in international conventions, protocols and agreements. In this context and by a Presidential Decision, the Ministry of Agriculture, Natural Resources and Environment, and more specifically the Environment Service has the overall responsibility for the national GHG inventory. Within this framework and for the establishment of the National System foreseen in the Decision 280/2004/EC, the Ministry of Agriculture, Natural Resources and Environment and in particular the Environment Service, is responsible for the following regarding GHG emissions inventory preparation which consists of the preparation/compilation of the annual national inventory, i.e. the selection of methodologies, data collection (activity data and emission factors, provided by statistical services and other organizations), data processing and archiving, as well as the implementation of general quality control procedures; and the development of an inventory QA/QC plan, in accordance with the provisions of the IPCC Good Practice Guidance. The present report has been developed through the co-operation of the Environment Service (Ministry of Agriculture, Natural Resources and Environment) with other government agencies. The data used for the preparation of this inventory were mainly obtained from published official reports and bulletins of the Statistical Service of Cyprus and statistical departments of the Ministries involved. The main methodological references for the estimation of GHG emissions/removals were the following: • Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories; • Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories; and • Good Practice Guidance for Land Use, Land Use Change and Forestry. In the coming years, the target is to improve the inventory of Cyprus by estimating emissions in each sub-sector, especially in the industrial sector. In general, our effort is to steadily upgrade qualitatively and quantitatively our emission data submitted and every coming year expand it by additional sectors, thus minimizing the use of Notation Key NE.	National Inventory Report 2007 2009 Submission Mar 2009 pp. 2-3
Czech Republic	In the Czech Republic, the Ministry of the Environment (MoE) is the national entity with overall responsibility for the NIS. The National Inventory System - NIS was established in accord with Decision 280/2004/EC, article 4.4. For this system rules were accepted from resolution 20/CP.7 (FCCC/CP/13/Add.3) that was approved by COP/MOP-1 in Montreal, December 2005. The Czech Hydrometeorological Institute (CHMI), founded by the MoE, is designated as the coordinating and managing organisation responsible for the compilation of the national greenhouse gas inventory and reporting its results. The main roles and responsibilities of the CHMI are: inventory management, general and cross-cutting issues, QA/QC, reporting data (CRF), preparation of NIR, communication with the relevant UNFCCC and EU bodies, etc. Sectoral inventories are prepared by specialized institutions (sectoral compilers), which are coordinated and controlled by the CHMI. The responsibilities for the GHG inventory compilation from individual sectors are allocated as follows: • KONEKO marketing, Ltd. (KONEKO): responsibility for the inventory compilation in the Energy sector, in particular for stationary sources and fugitive emissions • The Transport Research Centre (CDV): responsibility for the inventory compilation in the Energy sector, in particular for mobile sources • The Czech Hydrometeorological Institute (CHMI): responsibility for the inventory compilation in the Industrial Processes and Product Use sectors • The Institute of Forest Ecosystem Research (IFER: responsibility for the inventory compilation in the Agriculture and Land Use, Land Use Change and Forestry sectors • Charles University Environment Centre (CUEC): responsibility for the inventory compilation in the Waste sector. The official submission of the National GHG Inventory is prepared by the CHMI and approved by the MoE. Moreover, the MoE secures contacts with other relevant governmental bodies, such as the Czech Statistical Office (CSO), the Ministry of Industry and Trade (MoIT) and the Ministry of Agriculture (MoA).	Reporting under the Article 3.1 of Decision No 280/2004/EC Jan 2009 pp. 2-3

MS	Content	Source
Estonia	The Ministry of the Environment organises the practical providing of GHG inventories and is the designated single national entity. The national inventory compiler is the Climate and Ozone Bureau at the Estonian Environment Information Centre (EEIC). Financial resources for GHG inventory is planned in the State Budget. Practical work has been done on the basis of contracts. The Tallinn Technical University and Estonian Environment Research Centre (EERC) are responsible for the inventories under contract to the Ministry of the Environment in Estonia. The Ministry of the Environment has signed an agreement with the Tallinn Technical University that sets out the mutual cooperation directions in the field of climate change, including greenhouse gas inventory compilation for 5 years. The Department of Thermal Engineering is responsible for preparing the emission estimates for the energy sector and the Department of Chemistry is responsible for the agriculture, waste and LULUCF sectors. The contract agreement with the Estonian Environmental Research Centre is done on annual bases, wherewith the Estonian Environmental Research Centre obligates to compile the industrial processes sector in Estonia's GHG inventory (including F-gases). **The MoE is responsible for:** • Coordinating the overall inventory preparation process • Approving the inventory before official submission to the UNFCCC • Concluding the formal agreements with inventory compilers annually by 1st of July (TUT, EERC, etc) • Coordinating the cooperative work between the inventory compilers and UNFCCC • Informing the inventory compilers about the requirements of the national system and ensuring that existing information in national institutions is considered and used in the inventory where appropriate • Coordinating the UNFCCC inventory reviews. **Climate and Ozone Bureau in EEIC is responsible for:** • Completing the National Inventory Report according to the parts submitted by the inventory compilers • Reporting the greenhouse gas inventory to the UNFCCC, including the National Inventory Report and CRF tables • Coordinating the QA/QC plan • Preparation of the UNFCCC inventory reviews and coordinating the communication with the expert review team, including responses to the review findings • Overall archiving system The Department of Thermal Engineering and Department of Chemistry at Tallinn University of Technology prepare the estimates for the Energy, Industrial Processes, Agriculture, Waste and LULUCF sectors. They collect activity data, prepare relevant QC, fill in the sectoral data to the CRF Reporter and prepare sectoral parts of the NIR. They also have archiving system for the sectors that they are working with. The EERC is responsible for the industrial process sector together with the fluorinated gases estimates. The four core institutions: MoE, EEIC, EERC and TUT are in close contact with each other. Several cooperation meetings are held to discuss and agree on the methodological issues, problems that have raised and improvements that need to be implemented. The main sources of data are from official Estonian statistics (the Statistical Office of Estonia, Estonian Animal Recording Center) and from company's annual emission reports.The estimation of GHG emissions in Estonia is based on Intergovernmental Panel on Climate Change (IPCC 1996, 2000) tier 1 and tier 2 methods, default emission factors (EFs) and available Estonian data.	Greenhouse Gas Emissions in Estonia 1990-2007 Jan 2009 pp. 18-26
Hungary	The designated *single national entity* is the Ministry of Environment and Water. Within the ministry, the Climate Change and Energy Department administers this responsibility by supervising the national system. Based on a mandate of the minister, a GHG division was established in the Hungarian Meteorological Service (OMSZ) for the preparation and development of the inventory. This division is responsible for all inventory related tasks, prepares the greenhouse gas inventories and other reports with the involvement of external institutions and experts on a contractual base and supervises the maintenance of the system. The GHG division can be regarded as a core expert team of four people. The division of labour and the sectoral responsibilities within the team are laid down in the QA/QC plan and other official documents of OMSZ. The Head of Division coordinates the teamwork and organizes the cooperation with other institutions involved in inventory preparations. He is responsible for compilation of CRF tables and NIR. The GHG division coordinates the work with other involved ministries, government agencies, consultants, universities and companies in order to be able to draw up the yearly inventory report and other reports to the UNFCCC and the European Commission. Some parts of the inventory (mainly energy and waste) are prepared by the experts of the GHG division themselves. In the industry and solvent sector the former inventory compiler acted as sectoral expert, so he collected the data and prepared the inventory. The agriculture sector of the inventory has been prepared by the Research Institute for Animal Breeding and Nutrition for several years. This institute collects the data, chooses the calculation method, prepares the inventory in CRF format and sends it to the inventory compiler. From now on the Forestry Directorate of the Central Agricultural Office is responsible for data collection and inventory preparation for the forestry part of the LULUCF sector. However, in this inventory cycle the former contributor, an internationally recognized expert in this field, has been heavily involved in inventory preparation by permanent consultancy and quality control of the results. For the calculation of soil C stock changes Karcag Research Institute of University of Debrecen (Department of Soil Utilization and Rural Development) was contracted. The annual inventory cycle is carried out in accordance with the principles and procedures set out in the IPCC (1996) Guidelines and the IPCC Good Practice Guidance. Data are collected from the emitter if it is possible (especially in case of power stations, heating stations and industrial technologies) but statistical databases are also used as source of information. The most important statistical publications are the Statistical Yearbook of Hungary, the Environmental Statistical Yearbook of Hungary both published by the Hungarian Central Statistical Office (HCSO) and the Energy Statistical Yearbook published by the Energy Efficiency, Environment and Energy Information Agency. Since the use of ETS data has several advantages, the inventory team was granted access to the verified emissions database held by the National Inspectorate for Environment, Nature and Water. Basically, the sectoral experts are responsible for the choice of methods and emission factors. The calculation method – allowing for a few exceptions – was chosen by taking into account the technologies available in Hungary and according to the recommendations of the IPCC Guidelines.	NIR for 1985-2007, Hungary (Draft Excerpts) Jan 2009 pp. 11-13

MS	Content	Source
Latvia	Latvian national GHG inventory system is designed and operated according to the guidelines for national system under article 5, paragraph 1, of the Kyoto Protocol (Decision 20/CP7) to ensure the transparency, consistency, comparability, completeness and accuracy of inventories. The new legislation act No. 157 was approved and adopted by the Cabinet of Ministers on17 February 2009. Detailed functions (roles) and responsibilities of institutions that are involved in the preparation of the National inventory are prescribed in the act, including the designation of an institution controlling the QA/QC procedures. The single national entity with overall responsibility for the Latvian GHG inventory is the Latvian Ministry of the Environment (MoE). The MoE is responsible for: • Informing the inventory compilers about the requirements of the national system; • Final checking and approving the inventory before official submission to the EC and UNFCCC; • Formal agreements with inventory experts regarding Transport sector and for experts that evaluate quality assurance process; • Coordinating the work between the inventory compilers, EC and UNFCCC (including coordination the UNFCCC inventory reviews). Latvian Environment, Geology and Meteorology Agency (LEGMA) is a governmental institution under the supervision of the Ministry of Environment of the The main data supplier for the Latvian air emission inventory is the Central Statistical Bureau of Latvia (CSB) with which LEGMA has signed additional agreement for the supply of the necessary data. For submission 2009, emission calculations for the LULUCF sector were performed by the Latvian State Forest Research Institute "Silava" in collaboration with the Ministry of Agriculture (MoA). For submission 2009, the first time Institute of Physical Energetics (FEI) calculates emissions for Transport sector according to agreement wit MoE. Latvia's GHG emissions inventories are based on the Revised 1996 Guidelines for National Greenhouse Gas Inventories (1997), Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000) and Good Practice Guidance for Land Use, Land-Use Change and Forestry (2003), IPCCC 2006 and EMEP/CORINAIR Emission Inventory Guidebook. The updated CRF Reporter version 3.2.3 is used for data compiling. To calculate GHG emissions, a supplemental locally developed database in Excel format was used for all sectors except for Road Transport and partly for Agriculture sector, where COPERT III and IV, and IPCC Software were used.	MM submission, March 2009
Lithuania	The final responsibility for the preparation of the annual GHG inventory report and its submission to the European Commission and the Secretariat of the UNFCCC is placed on the Ministry of Environment within which the inventory is coordinated by the Climate Change Division of the Environmental Quality Department. The Ministry of Environment is responsible for: • Overall coordination of GHG inventory process • Final checking and approval of GHG inventory procedures • Approval of QA/QC plan and procedures • Checking of consistency of data, documenting, processing, archiving • Checking and approval of reports provided by the inventory experts. Before submission, reports are forwarded to the National Climate Change Committee for final approval. A National Committee on Climate Change has been set up in 2001. It consists of experts from academia, government and non-governmental organizations (NGOs) and has an advisory role. The main objective of the Committee is to ensure attaining the goals related to the restriction of GHG emissions as set in the National Sustainable Development Strategy and implementing the measures for attaining such goals. The Committee also has to organize the implementation of the provisions of the UNFCCC and coordinate compliance with the requirements of the Kyoto Protocol and EU legal acts related to the UNFCCC. The Inventory preparation is coordinated by the Center for Environmental Policy which is responsible for compilation of the final report based on the sectoral reports provided by the experts/consultants. The most important data providers are Statistics department of Lithuania, Environmental Protection Agency, Lithuanian Energy Institute, State Forest Survey Service, Lithuanian Forest Research Institute, Institute of Physics, Lithuanian Institute of Agrarian Economics, Lithuanian Institute of Agriculture, Geological Survey of Lithuania, industry companies etc. The tasks and responsibilities of the participants in inventory-related activities are defined as follows: Data providers are responsible for: collection of activity data, applying QC procedures and the evaluation of uncertainties of the initial data. Among the responsibilities of the GHG Inventory experts team are the evaluation of requirements for new data, based on internal and external reviews, the determination of activity data, the determination of appropriate emission factors, the data quality control and the filling sectoral CRF tables. The team is made of technical experts responsible for GHG inventory in separate sectors. The group has to meet in decided periods but at least two times per year to discus new items related to GHG inventory. Among the responsibilities of the Center for Environmental Policy are the checking and archiving of supplied input data, the checking of assumptions and data selection criteria, the checking of data processing procedures and emission calculations and the coordination of QA/QC activities and preparation of QC and QA procedures. Further, the Center for Environmental Policy assigns the QA/QC coordinator, who is responsible for ensuring that QA/QC system is implemented and functions.	National GHG Emission Inventory Report 2008 of the Republic of Lithuania, Reported Inventory 1990-2007 Dec 2008 pp. 13-16
Malta	The Malta Environment and Planning Authority (MEPA) is the authority entrusted with the role of compiling national emission inventories, with the National Emissions Inventory Team being delegated the main responsibility for developing and managing the system and for preparing the relevant submissions. The National Emissions Inventory System Team is responsible for all functions of the inventory system, from data collection, through data management to preparation of reports. Activity data used for the preparation of this inventory was obtained from Malta's past GHG inventory compilation, the National Statistics Office, government entities (ministries, departments), other public bodies such as regulatory authorities, private establishments and published reports. The methodologies and emission factors used were principally obtained from the following guidelines: • Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories • 2006 IPCC Guidelines for National Greenhouse Gas Inventories • EMEP/Corinair Emission Inventory Guidebook – 2002 • EMEP/Corinair Emission Inventory Guidebook – 2006 • EMEP/Corinair Emission Inventory Guidebook – 2007	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2007 Mar 2009 pp. 9-12

MS	Content	Source
Poland	The GHG inventory is compiled by the National Emission Centre established in 2000 at the Institute of Environmental Protection in Warsaw. The National Emission Centre has been commissioned by the Polish Ministry of Environment to carry out inventories for the GHGs and other air pollutants. Since 2006 NEC is located within the National Administrator of Emission Trading Scheme established also in the Institute of Environmental Protection. When compiling the inventory, the National Emission Centre collaborates with a number of individual experts as well as institutions. Among the latter are: Central Statistical Office), Agency of Energy Market, Institute of Ecology of Industrial Areas in Katowice, Institute of Automobile Transport as well as Office for Forest Planning and Management The GHG emission estimates are based on methodologies elaborated by the Intergovernmental Panel on Climate Change (IPCC) and recommended by the UNFCCC, while emissions of indirect gases according to methodology elaborated by UN ECE/EMEP. Wherever necessary and possible, domestic methodologies and emission factors have been developed to reflect specific national conditions. The most important features of the inventory preparation and archiving can be briefly summarized in the following way: • activity data are mostly taken from official public statistics or when required data are not directly available, (commissioned) research reports or expert estimates are used instead, • emission factors for the main emission categories are mostly taken from reports on domestic research; IPCC default data are used in cases where the emission factors are highly uncertain (e.g. N_2O emissions from animal waste in agriculture, and CH_4 and N_2O emission from stationary combustion), or when particular source category contribution to national total is insignificant, • all activity data, emission factors and resulting emission data are stored at the National Emission Centre database, which is constantly updated and extended to meet the ever changing requirements for emission reporting, with respect to UNFCCC and LTRAP as well as their protocols.	NIR 2008 and Republic of Poland Report for the European Commission fulfilling obligations under Article 3.1 of Decision 280/2004/EC Jan 2009 p.3
Romania	The Governmental Decision no. 1570 for establishing the National System for the estimation of anthropogenic greenhouse gas emissions levels from sources and removals by sinks, adopted in 2007, and the subsequent relevant procedures are regulating all the institutional, legal and procedural aspects for supporting the Romanian authorities to estimate the greenhouse gas emissions levels, to report and to archive the National GHGI information. The main objective of the Governmental Decision is to ensure the fulfillment of the provisions and the obligations of Romania under the UNFCCC, the Kyoto Protocol and the European Community legislation. The competent authority, which is responsible for administrating the National System, is the National Environmental Protection Agency (NEPA), under the subordination of the Ministry of Environment. NEPA has also the obligation of the preparation of the National GHGI. Central public authorities and the institutions under their authority, in their coordination or subordination, different research institutes, and the economic operators have the responsibility for submitting activity data needed for the GHG emissions calculation. The main activity data supplier is the National Institute for Statistics (NIS) through the yearly-published documents like the National Statistical Yearbook and the Energy Balance. In 2002, the Ministry of Environment and NIS signed a protocol of co-operation. Under this protocol, NIS agreed to provide, besides its yearly publication, additional data, necessary for the inventory preparation. The Ministry of Environment submits officially the National GHGI to the UNFCCC Secretariat, the European Commission and the European Environment Agency taking into account the specific deadlines.	Information pursuant Article 4.1 (a) of Decision 166/2005/EC National Environmental Protection Agency Jan 2009
Slovakia	The National Inventory System (www.ghg-inventory.gov.sk) has been established and officially announced by the Decision of Minister of the Environment of the Slovak Republic on 1st January 2007. Slovak Hydrometeorological Institute (SHMÚ) is the organisation authorised by the Ministry of the Environment to provide yearly and according to the approved status (http://www.shmu.sk/ File/statut.pdf) for environmental services, including GHG emissions` inventory. Range of services, competencies, time schedule and financial budget are updated and agreed annually, too. All details of the SHMÚ activities are described in the Plan of Main Projects, which is the subject of comments for involved stakeholders and after approval published on the web page http://www.shmu.sk/File/ kontrakt_2007.pdf. Deadline for approval of this plan by the ministry is 31st December each year. The Slovak Hydrometeorological Institute has built and introduced the quality management system (QMS) according to the requirements of the EN ISO 9001:2000 standard of conformity for the following activities	Quality assurance/quality control plan for the GHG Inventory in the Slovak Republic, Nov 2008, pp.2-4
Slovenia	In the Republic of Slovenia, the institution charged with the responsibility for making GHG inventories is the Environmental Agency of the Republic of Slovenia. In accordance with its tasks and obligations to international institutions, the Environmental Agency is charged with making inventories of GHG emissions as well as emissions that are defined in the Convention on Long Range Transboundary Air Pollution within the laid-down time-limit. To this effect, the Environmental Agency has increased the number of its staff. In making the inventories, the Environmental Agency cooperates with numerous other institutions and administrative bodies which relay the necessary activity data and other necessary data for making the inventories. The chief sources of data are the Statistical Office of the Republic of Slovenia (SORS) and the Ministry of Environment and Spatial Planning; however, the Environmental Agency obtains much of its data through other activities, which it performs under the Environmental Protection Act. Emissions from Agriculture are calculated in cooperation with Slovenian Agriculture Institute (KIS) and sinks in the LULUCF sector are calculated by the Slovenian Forestry Institute (GIS).	Slovenia's National Inventory Report 2009 Jan 2009 pp. 11

1.2.2 The European Commission, Directorate-General for the Environment

The European Commission's DG Environment in consultation with the Member States has the overall responsibility for the EC inventory. Member States are required to submit their national inventories and inventory reports under Council Decision No 280/2004/EC to the European Commission, DG Environment; and the European Commission, DG Environment itself submits the inventory and inventory report of the EC to the UNFCCC Secretariat. In the actual compilation of the EC inventory and inventory report, the European Commission, DG Environment, is assisted by the EEA including its ETC/ACC and by Eurostat and the JRC.

The consultation between the DG Environment and the Member States takes place in the Climate Change Committee established under Article 9 of Council Decision No 280/2004/EC. The Committee is composed of the representatives of the Member States and chaired by the representative of the DG Environment. Procedures within the Committee for decision-making, adoption of measures and voting are outlined in the rules of procedure, adopted in November 2003. In order to facilitate decision-making in the Committee, three working groups have been established: Working Group 1 'Annual inventories', Working Group 2 'Assessment of progress (effect of policies and measures, projections)' and Working Group 3 'Emission trading'.

The objectives and tasks of Working Group 1 under the Climate Change Committee include:

- the promotion of the timely delivery of national annual GHG inventories as required under the monitoring mechanism;
- the improvement of the quality of GHG inventories on all relevant aspects (transparency, consistency, comparability, completeness, accuracy and use of good practices);
- the exchange of practical experience on inventory preparation, on all quality aspects and on the use of national methodologies for GHG estimation;
- the evaluation of the current organisational aspects of the preparation process of the EC inventory and the preparation of proposals for improvements where needed.

1.2.3 The European Environment Agency

The European Environment Agency assists the European Commission, DG Environment, in the compilation of the annual EC inventory through the work of the ETC/ACC. The activities of the ETC/ACC include:

- initial checks of Member States' submissions in cooperation with Eurostat, and the JRC, up to 28 February and compilation of results from initial checks (status reports, consistency and completeness reports);
- consultation with Member States in order to clarify data and other information provided;
- preparation and circulation of the draft EC inventory and inventory report by 28 February based on Member States' submissions;
- preparation of the final EC inventory and inventory report by 15 April (to be submitted by the Commission to the UNFCCC Secretariat);
- assisting Member States in their reporting of GHG inventories by means of supplying software tools.

The tasks of the EEA and the ETC/ACC are facilitated by the European environmental information and observation network (Eionet), which consists of the EEA as central node (supported by European topic centres) and national institutions in the EEA member countries that supply and/or analyse national data on the environment (see http://eionet.eea.eu.int/). The Member States are encouraged to use the central data repository under the Eionet for making available their GHG submissions to the European Commission and the ETC/ACC (see http://cdr.eionet.eu.int/).

1.2.4 The European Topic Centre on Air and Climate Change

The European Topic Centre on Air and Climate Change (ETC/ACC) was established by a contract between the lead organisation Milieu-en Natuurplanbureau (MNP) in the Netherlands and EEA for the years 2007-2010. The ETC/ACC involves 10 organisations and institutions in eight European countries. The technical annex for the 2009 work plan for the ETC/ACC and an implementation plan specify the specific tasks of the ETC/ACC partner organisations with regard to the preparation of the EC inventory. Umweltbundesamt Austria is the task leader for the compilation of the EC annual inventory in the ETC/ACC, including all tasks mentioned above.

The ETC/ACC provides software tools for Member States to compile national GHG inventories and to convert their national inventory from Corinair-SNAP source category codes into the required CRF source categories. The main software tools are CollectER, for compiling and updating national emission inventories, and ReportER, for reporting the emissions in the required format, e.g. CRF. In addition, separate software tools are available to prepare estimates of emissions from agriculture and road transport. These tools are being used by several Member States. The ETC/ACC adapts the tools regularly to the latest changes in reporting requirements. The tools are available at http://etc-acc.eionet.eu.int/.

1.2.5 Eurostat

Based on Eurostat energy balance data, Eurostat compiles annually by 31 March estimates of the EC CO_2 emissions from fossil fuels using the IPCC reference approach. Eurostat compares these estimates with national estimates of CO_2 emissions from fossil fuels prepared by Member States and provides information summarising and explaining these differences. In order to improve the consistency of Member State and Eurostat energy data, a project on harmonisation of energy balances has started between Eurostat and national statistical offices. In addition, Eurostat is leading an EC project aimed at improving estimates of GHG emissions from international aviation.

1.2.6 Joint Research Centre

The Joint Research Centre (JRC) assists in the improvement of methodologies for the land-use, land-use change and forestry (LULUCF) sector. It does so (1) by inter-comparing methodologies used by the Member States for estimating emissions and removals with a focus on LULUCF and (2) by providing EC-wide estimates with various models/methods for emissions and removals with a focus on LULUCF. For this reason, methods using inverse modelling for CH_4 emissions are currently under development. In addition, the JRC is leading a project for improving the methodologies used for estimating GHG emissions from agriculture with a focus on the N_2O emissions of agriculture soils, the source contributing most to the overall uncertainty of the EC inventory.

1.3 A description of the process of inventory preparation

The annual process of compilation of the EC inventory is summarised in Table 1.4 The Member States should submit their annual GHG inventory by 15 January each year to the European Commission’s DG Environment. Then, the ETC/ACC, Eurostat and the JRC perform initial checks of the submitted data up to 28 February. The ETC/ACC transfers the nationally submitted data from the xml-files into the CRF aggregator database which was developped for aggregating the EC submission from MS submissions. From the CRF aggregator the aggregated EC inventory is transferred into the CRF reporter software for preparing the official EC GHG inventory submission.

Table 1.4 Annual process of submission and review of Member States inventories and compilation of the EC inventory

Element	Who	When	What
1. Submission of annual greenhouse gas inventories (complete common reporting format (CRF) submission and elements of the national inventory report) by Member States under Council Decision No 280/2004/EC	Member States	15 January	Elements listed in Article 3(1) of Decision 280/2004/EC as elaborated in Articles 2 to7 in particular: • Greenhouse gas emissions by sources and removals by sinks, for the year n – 2 • And updated time series 1990- year n – 3, depending on recalculations; • Core elements of the NIR Steps taken to improve estimates in areas that were previously adjusted under Article 5.2 of the Kyoto Protocol (for reporting under the Kyoto Protocol)
2. 'Initial check' of Member States' submissions	Commission (incl. Eurostat, the JRC), assisted by the EEA	As soon as possible after receipt of Member State data, at the latest by 1 April	Initial checks and consistency checks (by EEA). Comparison of energy data provided by Member States on the basis of the IPCC Reference Approach with Eurostat energy data (by Eurostat and Member States) and check of Member States' agriculture and land use, land-use change and forestry (LULUCF) inventories by DG JRC (in consultation with Member States).
3. Compilation of draft EC inventory	Commission (incl. Eurostat, the JRC), assisted by the EEA	up to 28 February	Draft EC inventory (by EEA), based on Member States' inventories and additional information where needed.
4. Circulation of draft EC inventory	Commission (DG Environment) assisted by the EEA	28 February	Circulation of the draft EC inventory on 28 February to Member States. Member States check data.
5. Submission of updated or additional inventory data and complete national inventory reports by Member States	Member States	15 March	Updated or additional inventory data submitted by Member States (to remove inconsistencies or fill gaps) and complete final national inventory reports.
6. Estimates for data missing from a national inventory	Commission (DG Environment) assisted by EEA	31 March	The Commission prepares estimates for missing data by 31 March of the reporting year, following consultation with the Member State concerned, and communicate these to the Member States.
7. Comments from Member States regarding the Commission estimates for missing data	Member States	8 April	Member States provide comments on the Commission estimates for missing data, for consideration by the Commission.
8. Final annual EC inventory (incl. Community inventory report)	Commission (DG Environment) assisted by EEA	15 April	Submission to UNFCCC of the final annual EC inventory. This inventory will also be used to evaluate progress as part of the monitoring mechanism.
9. Circulation of initial check results of the EC submission to Member States	Commission (DG Environment) assisted by EEA	As soon as possible after receipt of initial check results	Commission circulates the initial check results of the EC submission as soon as possible after their receipt to those Member States, which are affected by the initial checks.
10. Response of relevant Member States to initial check results of the EC submission	Member States	Within one week from receipt of the findings	The Member States, for which the initial check indicated problems or inconsistencies provide their responses to the initial check to the Commission.
11. Any resubmissions by Member States in response to the UNFCCC initial checks	Member States	For each Member State, same as under the UNFCCC initial checks phase Under the Kyoto Protocol: the resubmission should be provided to the Commission within five	Member States provide to the Commission the resubmissions which they submit to the UNFCCC Secretariat in response to the UNFCCC initial checks. The Member States should clearly specify which parts have been revised in order to facilitate the use for the EC resubmission. As the EC resubmission also has to comply with the deadlines specified in the guidelines under Article 8 of the Kyoto Protocol, the resubmission has to be sent to the Commission earlier than the period foreseen in the guidelines under Article 8 of the Kyoto Protocol, provided that the

Element	Who	When	What
		weeks of the submission due date.	resubmission correct data or information that is used for the compilation of the EC inventory.
12. Submission of any other resubmission after the initial check phase	Member States	When additional resubmissions occur	Member States provide to the Commission any other resubmission (CRF or national inventory report) which they provide to the UNFCCC Secretariat after the initial check phase.

On 28 February, the draft EC GHG inventory and inventory report are circulated to the Member States for review and comment. The Member States check their national data and information used in the EC inventory report and send updates, if necessary, and review the EC inventory report by 15 March. This procedure should assure the timely submission of the EC GHG inventory and inventory report to the UNFCCC Secretariat and it should guarantee that the EC submission to the UNFCCC Secretariat is consistent with the Member State UNFCCC submissions.

The final EC GHG inventory and inventory report is prepared by the ETC/ACC by 15 April for submission to the UNFCCC Secretariat. Resubmissions of the EC GHG inventory and inventory report are prepared by 27 May, if needed. Within five weeks after 15 April, Member States should provide to the Commission any resubmission in response to the UNFCCC initial checks which affects the EC inventory, in order to guarantee that the EC resubmission to the UNFCCC Secretariat is consistent with the Member States' resubmissions. In June the inventory and the inventory report are published on the EEA website (http://www.eea.europa.eu) and the data are made available through the EEA data warehouse (http://dataservice.eea.europa.eu/dataservice).

1.4 General description of methodologies and data sources used

1.4.1 The compilation of the EC GHG inventory

The EC inventory is compiled in accordance with the recommendations for inventories set out in the 'UNFCCC guidelines for the preparation of national communications by parties included in Annex 1 to the Convention, Part 1: UNFCCC reporting guidelines on annual inventories' (FCCC/SBSTA/2004/8), to the extent possible ([11]). In addition, the *Revised IPCC 1996 guidelines for national greenhouse gas inventories* have been applied as well as the IPCC *Good practice guidance and uncertainty management in national greenhouse gas inventories*, where appropriate and feasible. In addition, for the compilation of the EC GHG inventory, Council Decision No 280/2004/EC and the Commission Decision 2005/166/EC.

The EC GHG gas inventory is compiled on the basis of the inventories of the 15 or 27 Member States. The emissions of each source category are the sum of the emissions of the respective source and sink categories of the 15 or 27 Member States. This is also valid for the base year estimate of the EU-15 as fixed in the initial review report. Table 1.5 shows the base year emissions for EU-15 Member States and EU-15 as fixed in the respective initial review reports; Table 1.6 shows the base year emissions for the new EC Member States.

Table 1.5 Base year emissions for EU-15 Member States and EU-15

EU-15 MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions [1] (Tonnes CO_2 equivalents)
Austria	1990	1990	79,049,657
Belgium	1990	1995	145,728,763
Denmark [2]	1990	1995	69,323,336
Finland	1990	1995	71,003,509
France	1990	1990	563,925,328
Germany	1990	1995	1,232,429,543
Greece	1990	1995	106,987,169
Ireland	1990	1995	55,607,836
Italy	1990	1990	516,850,887
Luxembourg	1990	1995	13,167,499
Netherlands	1990	1995	213,034,498
Portugal	1990	1995	60,147,642
Spain	1990	1995	289,773,205
Sweden	1990	1995	72,151,646
United Kingdom [2]	1990	1995	776,337,201
EU-15	1990	1990 (AT, FR, IT) 1995 (other MS)	4,265,517,719

1) Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990.
2) The base year emissions relate to the EC territory of Denmark and the UK.

Source: Initial review reports of the EU-15 Member States (www.unfccc.int)

Table 1.6 Base year emissions for the new Member States

New MS	CO_2, CH_4, N_2O	HFC, PFC, SF_6	Base year emissions [1] (Tonnes CO_2 equivalents)
Bulgaria	1988	1995	132,618,658
Cyprus	Not relevant	Not relevant	
Czech Republic	1990	1995	194,248,218
Estonia	1990	1995	42,622,310
Hungary	1985-87	1995	115,397,149
Latvia	1990	1995	25,909,160
Lithuania	1990	1995	49,414,386
Malta	Not relevant	Not relevant	
Poland	1988	1995	563,442,774
Romania	1989	1989	278,225,022
Slovakia	1990	1990	72,050,764
Slovenia	1986	1995	20,354,042

1) Base-year emissions exclude emissions and removals from the LULUCF sector but include emissions due to deforestation in the case of Member States for which LULUCF constituted a net source of emissions in 1990.

Source: Initial review reports of the new Member States (www.unfccc.int)

Of the EU-15 Member States, 12 Member States have chosen 1995 as the base year for fluorinated gases while Austria, France and Italy have chosen 1990. Therefore, the EU-15 base year estimates for fluorinated gas emissions are the sum of 1995 emissions for 12 Member States and 1990 emissions for Austria, France and Italy. The EU-15 base year emissions also include emissions from deforestation for Ireland, the Netherlands, Portugal and the UK.

The reference approach is calculated for the EU-15 on the basis of Eurostat energy data (see Section 3.6) and the key category analysis (Section 1.5) is separately performed at EU-15 level ([12]).

Since Member States use different national methodologies, national activity data or country-specific emission factors in accordance with IPCC and UNFCCC guidelines, these methodologies are reflected in the EC GHG inventory data. The EC believes that it is consistent with the UNFCCC reporting guidelines and the IPCC good practice guidance to use different methodologies for one source category across the EC especially if this helps to reduce uncertainty and improve consistency of the emissions data provided that each methodology is consistent with the IPCC good practice guidance.

In general, no separate methodological information is provided at EC level except summaries of

([12]) However, the choice of the emission calculation methodology is made at Member State level and is based on the key source analysis of each individual Member State.

methodologies used by Member States. However, for some sectors quality improvement projects have been organised/are ongoing with the aim of further improving estimates at Member State level. These sectors include energy background data, emissions from international bunkers, emissions and removals from LULUCF, emissions from agriculture and waste.

The EU-15 CRF Table Summary 3 in Annex 2 provides information on methodologies and emission factors used by the Member States. These tables have been compiled on the basis of the information provided by the Member States in their CRF Table Summary 3. In addition, information on methods, activity data and emission factors was used which was provided by the Member States in accordance with Annex I of Commission Decision 2005/166/EC. The sector-specific chapters list the methodologies and emission factors used by the Member States for each EC key source.

Annex 12 includes the CRF Table Summary 3 for those Member States that submitted these tables in 2008. Detailed information on methodologies used by the Member States is available in the Member States national inventory reports, which are included in Annex 12. Note that all Member States' submissions (CRF tables and national inventory reports), which are included in Annex 12 and made available at the EEA website, are considered to be part of the EC submission.

Internal consistency of the EC CRF tables

In principle every single EC value is aggregated from the respective value of the EC Member States. However, sometimes there are consistency problems when compiling the EC CRF tables (i.e. the sum of sub-categories is not equal to the category total) in those categories where Member States have difficulties to allocate emissions to the sub-categories. Member States use notation keys like IE or C if they cannot provide an emission estimate for a certain sub-category. At Member State level, the use of the notation keys makes transparent the reason for not providing emission estimates. However, at EU-15 level, the sub-category emission value is the sum of Member States emission values and the information of the notation keys used by some Member States is lost in the EU-15 CRF submission. In order to make this more transparent, the CRF tables now include the values or notation keys reported by the MS as comments. In addition, Annexes 4-10 of this report include the CRF tables for the sectors for each EU-15 Member State. In order to address this problem, some source categories have been reallocated for the EC CRF tables. A second problem is the reporting of Member States in "grey cells" which need to be included in the CRF reporter manually. A third problem occurs where MS report potential fluorinated gas emissions but do not report actual emissions. In these cases the potential emissions are included in the national totals, but they are lost when aggregating the EC actual emissions. Table 1.7 lists the procedures applied.

Table 1.7 Manual changes in the CRF Reporter

CRF Table	Member State	Year	Sector	Source category	Parameter	Manual changes/inclusion in the CRF Reporter
Table1A(a)	MT	1990-2007	Energy	1.A.2.F	CO2	Include MT 1A2F under 1A2F liquid fuels (no fuel split given)
Table1B1	BE	1990-1992	Energy	1.B.1.a.i	AD	Correct BE AD data for Underground Mines
Table1B2	SE	1990-2007	Energy	1.B.2.a.5	N2O	Include SE emissions from 1.B.2.A.5 under 1.B.2.A.6
Table2(1).A-Gs2	ES	1990-2007	Ind. Processes	2.C.1	N2O	Add pollutant N2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	GB	1990-2007	Ind. Processes	2.C.1	N2O	Add pollutant N2O under 2C1 and include emissions from grey cells.
Table2(1).A-Gs2	SE	1990-2007	Ind. Processes	2.D.1	CH4, N2O	Add pollutants CH4, N2O under 2D1 and include emissions from grey cells.
Table2(1).A-Gs2	PL	2005-2007	Ind. Processes	2.D.1	CO2	Add pollutant CO2 under 2D1 and include emissions from grey cells.
Table2(I)s1	DE	1990-2007	Ind. Processes	2.A.1	NOx, NMVOC	Add new gases under 2A1 and include DE emissions
Table2(I)s1	DE	1990-2007	Ind. Processes	2.A.2	NOx, NMVOC, SO2	Add new gases under 2A2 and include DE emissions
Table2(I)s1	SE	1990-2007	Ind. Processes	2.A.2	SO2	Add pollutant SO2 under 2A2 and include emissions from grey cells
Table2(I)s1	PT	1990-2007	Ind. Processes	2.A.6	CH4	Include PT CH4 emissions from grey cells
Table2(I)s1	EU15, EU27	1990-2007	Ind. Processes	2.A.7	CO2, NOx, CO, NMVOC, SO2	Exclude glass production from other non-specified
Table2(I)s1	HU	1990-2003	Ind. Processes	2.B.2	CO2	Add pollutant CO2 under 2B2 and include emissions from grey cells.
Table2(I)s1	EU15, EU27	1990-2007	Ind. Processes	2.B.5	CO2, CH4	Exclude 2.B.5.1 - 2.B.5.5 from other non-specified
Table2(I)s1	PT, BG, CY, MT	1990-2007	Ind. Processes	2.F.9	HFC-P, PFC-P	Make sure that potential emissions are accounted for and include them under 2.F.9
Table2(II)	FR	1990-2007	Ind. Processes	2.E.2	HFC-365mcf	Include FR emissions from HFC-365mcf in CO2 equivalents
Table2(II)	EE	2004-2007	Ind. Processes	2.F.2	HFC-365mcf	Include EE emissions from HFC-365mcf under Unspecified mix of HFCs
Table2(II).E	EU15, EU27	1990-2007	Ind. Processes	2.E.3	PFC-A	Be sure that EUC notation keys are the sum of MS notation keys
Table2.F	FR	2003-2007	Ind. Processes	2.F.2.1	HFC-365mcf	Include FR emissions from HFC-365mcf under Unspecified mix of HFCs
Summary1A	ES	1990-2007	Agriculture	4.F.5	SO2	Add pollutant SO2 under 4F5 and include emissions from grey cells.
Table4.E	EU15, EU27	1990-2007	Agriculture	4.E.1	CH4, N2O	Be sure that EUC notation keys are the sum of MS notation keys
Table4s1	LU, NL	1990-2007	Agriculture	4.A.1	CH4	Add LU, NL mature dairy cattle under dairy cattle
Table4s1	LU, NL	1990-2007	Agriculture	4.B.1	CH4	Add LU, NL mature non-dairy, young cattle under non-dairy cattle
Table4s2	BE	1990-2006	Agriculture	4.D.4	NMVOC	Add BE NMVOC 4D under 4.D.4
Table4s2	ES	1990-2007	Agriculture	4.D	Nox	Include ES emissions from 4.D under 4.G
5(III)	DE	1990-2007	LULUCF	5.G	N2O	Include additional information from 5.G
5(III)	PT	1990-2007	LULUCF	5.G	N2O	Include additional information from 5.G
5(IV)	DE	1990-2007	LULUCF	5.G	CO2	Include additional information from 5.G
5(IV)	NL	1990-2007	LULUCF	5.G	CO2	Include additional information from 5.G
Summary1.A	FR	1990-2007	LULUCF	5.G	NMVOC, SO2	Include additional information from 5.G
Summary1.A	IT	1990-2007	LULUCF	5.G	SO2	Include additional information from 5.G
Table5	FI	1990-2007	LULUCF	5.G	CO2	Include additional information from 5.G
Table5	GB	1990-2007	LULUCF	5.G	CO2	Include additional information from 5.G
Table5	CY	1990-2007	LULUCF	5.G	CO2	Include additional information from 5.G
Table5	FR	1994-2007	LULUCF	5.G	CO2, CH4	Include additional information from 5.G
Table5	LU	1990-2007	LULUCF	5.G	CO2	Include additional information from 5.G
Table6	ES	1990-2007	Waste	6.A.1	N2O	Add pollutant N2O under 6A1 and include emissions from grey cells.
Table6	ES	1990-2007	Waste	6.A.3	N2O, SO2	Add pollutants N2O, SO2 under 6A3 and include emissions from grey cells.

1.4.2 Use of data from EU ETS for the purposes of the national GHG inventories in EU Member States

1.4.2.1 Overview

The ETS data can be used in different ways for the purposes of the national GHG inventories:

1. Reported verified emissions can be directly used in the GHG inventory to report CO_2 emissions for a specific source category. This requires that the coverage of the respective ETS emissions is complete for the respective source category and that ETS activities and CRF source categories follow the same definitions. If ETS emissions are not complete, the emissions for the remaining part of the source category not covered by the EU ETS have to be calculated separately and added to the ETS emissions.

2. Emission factors (or other parameters such as oxidation factors) reported under the EU ETS can be compared with emission factors used in the inventory and they can be harmonised if the EU ETS provides improved information.

3. Activity data reported under the EU ETS can be used directly for the GHG inventory, in particular for source categories where energy statistics face difficulties in disaggregating fuel consumption to specific subcategories, e.g. to specific industrial sectors.
4. Data from EU ETS can be used for more general verification activities as part of national quality assurance (QA) activities without the direct use of emissions, activity data or emission factors.
5. Data from EU ETS can improve completeness of the estimation of IPCC source categories when additional data for source categories become available from EU ETS.
6. ETS data can improve the allocation of industrial combustion emissions to sub-categories under 1A2 Manufacturing Industries and Construction;
7. The comparison of the data sets can be used to improve the uncertainty estimation for the GHG inventories based on the ranges of data reported by installations.

Based on the information submitted in the NIRs in 2009 to the UNFCCC secretariat or the European Commission, 22 from 27 Member States indicated that they used ETS data at least for QA/QC purposes (see Table 1.8). This is a much higher share of Member States than in 2007, where a similar analysis showed that 15 Member States had used ETS data for inventory purposes. 12 Member States indicated to directly use the verified emissions reported by installations under the ETS. 12 Member States used ETS data to improve country-specific emission factors. 7 Member States report that they used activity data (e.g. fuel use) provided under the ETS in the national inventory.

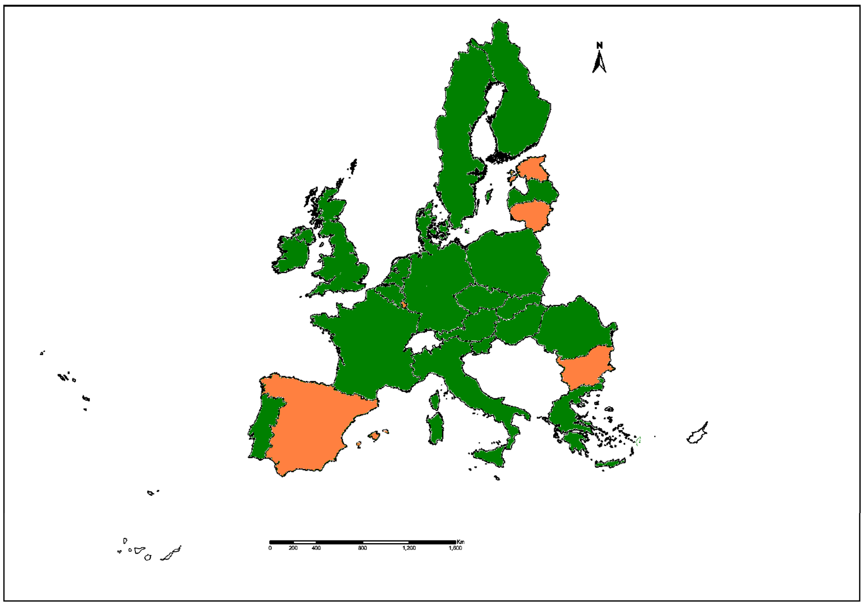
The NIRs for Bulgaria, Estonia, Lithuania and Spain do not provide any information whether ETS data was used for inventory purposes. For these Member States it is unclear whether they checked data consistency in a systematic way. At the EU workshop on data consistency in 2007 Spain reported that data consistency for refineries had been compared and checked. Luxembourg did not provide an updated NIR 2009 during the preparation of this report.

Table 1.8 Use of ETS data for the purposes of the national GHG inventory

Member State	Status of use of ETS data	Use of emissions	Use of Activity data	Use of emission factors	Use for quality assurance
Austria	Used	✓	✓	✓	✓
Belgium	Used	✓		✓	✓
Bulgaria	Not indicated				
Cyprus	Used			✓	✓
Czech Republic	Used	✓		✓	✓
Denmark	Used	✓		✓	✓
Estonia	Not indicated				
France	Used				✓
Finland	Used	✓	✓		✓
Germany	Used				✓
Greece	Used		✓	✓	✓
Hungary	Used	✓		✓	✓
Ireland	Used	✓			✓
Italy			✓	✓	✓
Latvia	Used	✓		✓	✓
Lithuania	Not indicated				
Luxembourg	No NIR available				
Malta	Used	✓			
Netherlands	Used				✓
Poland	Used	✓			
Portugal	Used	✓			✓
Romania	Used				✓
Slovakia	Used		✓	✓	✓
Slovenia	Used		✓	✓	✓
Spain	Not indicated				
Sweden	Used	✓	✓		✓
United Kingdom	Used			✓	✓

Source: NIR submissions to UNFCCC 2009

Figure 1.2 Use of ETS data for inventory purposes in the EU



Notes: Green = NIR provides information how ETS data was used for GHG inventory
Red = no information provided in NIR whether ETS data was used
No NIR 2009 for Luxembourg was available during the preparation of this report.

The following assessment provides a detailed overview of the use of ETS data in all Member States. The information is mainly based on the NIR, as well as on the assessment conducted for this report.

1.4.2.2 Austria

General

The coverage of ETS emissions in relation to total CO_2 emissions is 43% in 2007 and 42% for the years 2005 and 2006.

Verified emissions from EU ETS have complete coverage for

- refineries,
- iron and steel manufacturing industries,
- non metallic mineral industries (cement, glass, bricks and tiles, other ceramic materials),
- pulp and paper manufacturing industries and
- CO_2 emissions from coal combustion.

ETS emissions are used directly, for QA/QC purposes and also AD and EFs are used. Austria provides a comparison of ETS data with equivalent CRF categories in the NIR (Table 1.9). The allocation of ETS emissions to CRF categories was based on NACE codes reported by installations. Few installations could not be allocated to inventory categories (these installations account for 65 Gg CO_2 in 2007). This comparison is very useful for a detailed consistency check between ETS data and inventory data.

Energy

- Austria uses activity data (mass and NCVs) from ETS data for categories 1A1 Energy Industries , 1A2 Manufacturing Industries and Combustion and 1A4a Commercial/ Institutional, remaining CO_2 emissions from sources not included in the ETS are calculated by remaining activity data and country-specific fuel emission factors.
- 1A1a Public Electricity and Heat: Austria uses emission factors from ETS data in combination with country-specific default emission factors for fuel combustion activities not included in the ETS.

Industrial processes

- 2A1 Cement clinker production: CO_2 emissions are taken from ETS for the years 2005-2007.
- 2A2 Lime Production: CO_2 emissions are taken from ETS for the years 2005-2007. The ETS data are consistent with data from the association of the stone and ceramic industry.
- 2A3 Limestone and Dolomite Use: CO_2 emissions are taken from ETS for the years 2005-2007. ETS data cover limestone and dolomite use in the glass, the iron and steel and the chemical industry. Since 2005 ETS background data provided more detailed information on the actual carbon content of limestone and dolomite used. Therefore, the IEFs since 2005 are slightly different to the IPCC default values.
- 2A4 Soda Ash Production and Use: CO_2 emissions reported under the ETS where used in the inventory. These data cover soda ash use in the glass industry. For 2005-2007 ETS background data provided more detailed information on the actual content of soda ash used. Therefore, the IEF since 2005 is slightly different to IPCC default values.
- 2A7 Bricks and Tiles Production: CO_2 emissions reported under the ETS where used in the inventory.
- 2A7 Magnesia Sinter Production: CO_2 emissions reported under the ETS were used in the inventory. The operator reported total CO_2 emissions, which were compared with the ETS data and found to agree with the inventory estimations.
- 2C1 Iron and Steel: Verified CO_2 emissions reported under the ETS were used in the inventory. These data cover CO_2 emissions from pig iron, basic oxygen and electric arc furnace steel. For pig iron production the values for 2005-2007 correspond to the background data given in the ETS

report. Since 2005 the IEF is quite stable, because background data reported under the ETS allowed accounting for reducing agents other than coke. For 2005-2007 detailed information on the carbon mass balance applied by the company to calculate total emissions from pig iron and Basic Oxygen Furnace (BOF) steel were available due to the ETS. Thus it was possible to validate CO_2 emission with this background data.

Table 1.9 Comparison of emissions between ETS data and inventory data for Austria

	Categories	2005 Gg CO2		2006 Gg CO2		2007 Gg CO2	
		ETS	Inventory	ETS	Inventory	ETS	Inventory
Total ETS	CITL data	33,373		32,383		31,751	
Total ETS[1)]	**Austrian NIR**	**33,373**	**78,572**		**77,094**	**31,745**	**73,679**
				32,381			
1.A	**FUEL COMBUSTION ACTIVITIES**	**25,299**	**69,875**	**23,998**	**67,989**	**22,836**	**64,143**
1.A.1.a	Public Electricity and Heat Production	11,482	12,743	10,374	12,048	9,037	10,434
1.A.1.b	Petroleum refining	2,827	2,827	2,830	2,830	2,868	2,868
1.A.1.c	Manufacture of Solid fuels and Other Energy Industries	43	525	50	668	52	627
1.A.2.a	Iron and Steel	5,688	6,450	5,527	6,349	5,596	6,225
1.A.2.b	Non-ferrous Metals	0	220	0	224	0	254
1.A.2.c	Chemicals	665	1,583	623	1,696	592	1,528
1.A.2.d	Pulp, Paper and Print	2,245	2,286	2,153	2,189	2,150	2,191
1.A.2.e	Food Processing, Beverages and Tobacco	316	904	278	941	283	899
1.A.2.f	Other	2,010	4,242	2,139	4,567	2,239	4,570
1.A.4.a	Commercial/Institutional	22	2,250	23	2,936	19	1,952
2	**INDUSTRIAL PROCESSES**	**8,091**	8,697	**8,447**	9,105	**8,974**	9,535
2.A.1	Cement Production	1,797	1,797	1,954	1,954	2,131	2,131
2.A.2	Lime Production	579	579	**581**	**586**	596	596
2.A.3	Limestone and Dolomite Use	267	291	272	296	289	303
2.A.4	Soda Ash Production and use	15	15	16	16	17	17
2.A.7.a	Bricks and Tiles (decarbonizing)	128	128	130	130	130	130
2.A.7.b	Magnesia Sinter Production	310	310	312	312	329	329
2.C.1.a	Steel	763	763	778	778	826	826
2.C.1.b	Pig Iron	4,186	4,186	4,366	4,366	4,598	4,598
2.C.1.e.1	Electric furnace steel plant	45	45	49	49	58	58
	Included elsewhere[2)]	*17*		*63*		*65*	

1.4.2.3 Belgium

General

The coverage of ETS emissions in relation to total CO_2 emissions is 54% in 2006 and 2007 and 53% in 2005. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in the Belgian NIR.

ETS data are generally used for QA/QC purposes in all regions. Detailed information is provided on the detailed use of ETS data for inventory purposes for Flanders and Wallonia, but not for the Brussels region.

In the Flemish region reported sources in the ETS framework are compared with the reported sources in the greenhouse gas emission inventory and completed if necessary. Next to this, the emissions of CO_2 of the most important sources are also compared in these two datasets for the available years and tuned where possible and relevant. Since 2005 ETS data are used directly in Flanders and Wallonia in several source categories.

Energy

- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Wallonia uses since 2005 CO_2 emissions provided by the installations under the ETS.

- 1A2 Manufacturing Industries and Construction: Wallonia uses EFs for solid fuels, blast furnace gas, coke oven gas and waste fuels from ETS reporting. Concerning natural gas, gas oil and residual fuel, the CO_2 emission factors are mainly originated from the IPCC 1996 Guidelines.
- 1A2a Iron and Steel: Wallonia compares information provided by installations under the ETS with energy balance data. Plant specific information from ETS with incomplete coverage is completed with remaining fuel consumption from energy balances.

Industrial Processes

- 2A7 Glass Production: Emissions reported under the ETS are used. Wallonia uses plant-specific emission factors for glass production since 2003 which were verified with the data provided under the ETS. Recalculations for earlier years have been performed by using the same methodologies as used under the ETS (based on C content of raw materials).
- 2A7 Ceramics Production: Flanders and Wallonia use emissions reported under the ETS.
- 2B1 Ammonia Production: Wallonia uses emissions reported under the ETS.
- 2C1 Iron and Steel Production: Wallonia confirmed assumptions on C in purchased pig iron, C in steel produced and C in steel scrap with ETS data. Since 2005 emissions reported under the ETS are directly used.

1.4.2.4 Denmark

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 53% in 2005, 59% in 2006 and 55% in 2007. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided by the MS.

A specific agreement has been signed with the Danish Energy Authority regarding the inclusion of information from ETS in the GHG inventory which ensures access to critical company-specific information.

The use of EU ETS data started in Denmark with the 2008 inventory submission. NERI performs QA/QC checks on the emission reports made by the plants. One of the reports for 2007 was judged by NERI to be incorrect, and therefore not incorporated in the 2007 inventory.

Energy

Fuel combustion

- For stationary fuel combustion data reported under the ETS were for the first time used in the emission inventory for 2006. Some plant specific CO_2 emission factors for coal and residual oil fired power plants were derived from ETS data.
- Plant specific CO_2 emission factors for fuel consumption data from ETS have been applied for cement production which is part of sector 1A2f Industry. The applied fuels are: Coal, residual oil, petroleum coke and waste (biomass and fossil). Plant specific ETS data were utilised for cement production in the 2006 and 2007 emission inventory.

Industrial Processes

- 2A1 Cement Production: Since the year 2005 the CO_2 emission compiled by Aalborg Portland under the ETS are used in the inventory.
- 2A5 Bricks and Tiles Production: Denmark used for the years 2006 and 2007 emission factors have been derived from CO_2 emissions reported by the brickworks to EU-ETS (confidential reports from approximately 20 brickworks) and production statistics (Statistics Denmark, 2008).
- 2A5 yellow bricks and expanded clay products: the CO_2 emission were adapted from the company reports to ETS as the emission factors calculated previously and used until 2005 were found not to be in line with the actual emissions.

- 2A3 CO_2 emission from the refining of sugar Denmark uses CO_2 emissions from ETS from the year 2006.

1.4.2.5 Finland

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 59% in 2005, 66% in 2006 and 64% in 2007. At sectoral level verified emissions from EU ETS have complete coverage for

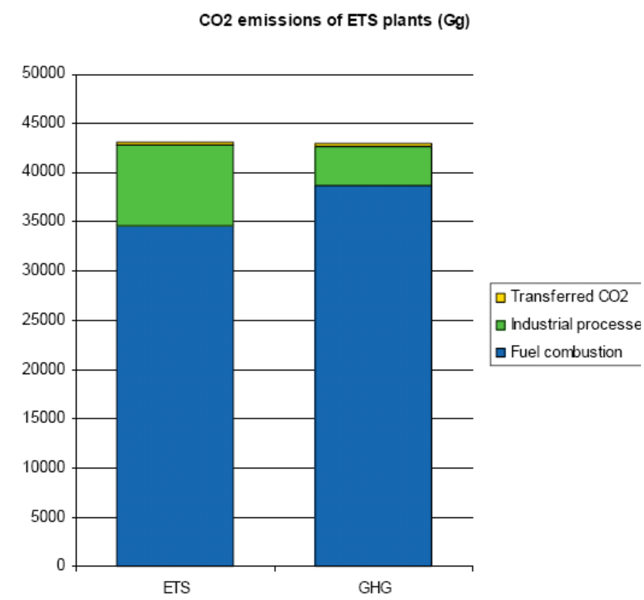
- Cement Production
- Lime production
- Iron and steel production

Finland also indicates how many of the total plants are included in the ETS in other sectors:

- Limestone and Dolomite Use: 19 plants out of 25 covered by ETS
- Glass Production: 4 plants out of 5
- Hydrogen Production: 1 plant out of 5

Finland has performed a detailed comparison of CO_2 emissions from ETS with emissions from similar inventory categories. Total CO_2 emissions taken from the ETS data were 42.4 Tg in 2007. The corresponding amount taken from the GHG inventory data was 42.5 Tg. In the ETS data 0.35 Tg of CO_2 and in the GHG data 0.22 Tg of CO_2 emissions were transferred out of the ETS plants. The reduced amount is different because from the GHG data only part of transferred emissions from forest industry could be reduced due to limitation of permanent CO_2 storage. The difference between the ETS and GHG data due to different accounting of transferred CO_2 is 0.07 Tg or 0.2% of total ETS emissions.

Figure 1.3 CO_2 **emissions of ETS plants compared with corresponding emissions reported in the GHG inventories**



Source: NIR of Finland, submission 2009, p. 73

The checks and comparisons of ETS data and inventory data have been done mostly by manual operations. In the future ETS plants and data will be linked to national inventory system to make automatic checking routines. Thus it is planned to improve the national system in relation to the use of ETS emissions. Within the national inventory system Finland also performed additional checks of verified emissions reported under the EU ETS.

Energy

In the energy sector Finland mainly uses ETS data for identifying missing point sources, checking and verifying fuel consumption data and verifying emission data.

Industrial Processes

- 2A1 Cement Production: The emissions of last three years have been compared with ETS data.
- 2A2 Lime Production: Emissions from 2005 onwards have been calculated using production data reported to the EU ETS, although the total amount of produced lime has checked from industrial statistics. The calculated emission data of all plants have been verified with ETS data (all plants are included in EU Emission Trading Scheme) and emissions have been found to be almost equal. Differences have been arisen because in ETS companies calculate emissions using default emission factors and in the inventory emission factors are based on actual CaO and MgO content of lime.
- 2A3 Limestone and Dolomite Use: The calculated emission data of 19 plants (out of 25) have been verified with ETS data and emissions have been found to be almost equal. A reason for the difference is that in the inventory calculation not all carbonate is assumed to calcinate in the production process. In the verification it was also noticed that one company using dolomite for sulphur dioxide control reports their emissions miscalculated to Energy Market Authority, their emission factor is too small.
- 2A4 Soda Ash Production and Use: The calculated emission data of a plant have been verified with ETS data and emissions have been found to be almost equal (+/-1%). Reason for the small difference is that in the inventory calculation not all carbonate is assumed to be calcinated in the production process.
- 2A7 Glass Production: Activity data for 2007 was collected directly from individual companies and the ETS data. The calculated emission data of 4 plants (out of 5) have been verified with ETS data and emissions have been found to be almost equal (+/-2%). Reason for the small difference is that in the inventory calculation does not assume that all carbonate is calcinated in the production process. In the verification it was also noticed that one company using dolomite reports their emissions miscalculated to Energy Market Authority for year 2007, there seems to be some error in dolomite use data and the emission factor differs from the factor used earlier years.
- 2B5 Hydrogen Production: The calculated emission data of one plant (out of 5) have been verified with ETS data and emissions have been found to be equal.
- 2C1 Iron and steel: From 2005 on, all four iron and steel plants in Finland report to the ETS. From 2007 submission, the GHG inventory has been using the total CO_2 emissions from the ETS data.

1.4.2.6 France

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 32% in 2005, 31% in 2006 and 32% in 2007. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is provided for some categories in the NIR:

- Glass Production: no complete coverage of ETS data.
- Bricks and Tiles Production: 51 out of 140 plants are covered by the ETS

France indicates in a general way that CO_2 emissions in the inventory are consistent with ETS emissions because they are based on the same data sources.

Energy

- 1A1 Energy industry: calculated emissions are verified with the emissions data reported under the ETS.
- 1A1c Manufacture of solid fuels and other energy industries: the CO_2 emissions from ETS are used.

Industrial Processes

- 2A1 Cement Production: France directly uses the specific information reported under the ETS.
- 2A2 Lime Production: ETS data are used for the inventory reporting.
- 2A5 Glass Production: ETS data are used for the inventory reporting. They are completed with the remaining glass production not covered by the ETS. For this part of the production national emission factors are used.
- 2A5 Bricks and Tiles Production: 51 out of 140 plants are covered by the ETS. The emissions from ETS plants are taken directly from the ETS reports. These emissions are complemented based on the remaining national production and emission factors taken from ETS reports.

1.4.2.7 Germany

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 56% in 2005, 55% in 2006 and 58% in 2007. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in the NIR.

In 2006 a research project compared ETS emissions and inventory emissions and developed allocation rules how the ETS emissions should be allocated to inventory categories. Then a formalized procedure was developed for the annual data exchange between ETS authority and the inventory system. ETS data are generally used for verification and QA purposes but not directly in the inventory.

In the CRF table 1s1 (Energy) Germany reports additional source category that include the combustion emissions from source categories covered by the ETS (glass, cement and ceramics). This additional voluntary reporting considerably enhances the comparability of ETS emissions with inventory emissions at sectoral level.

Energy

The NIR generally indicates that ETS data are used for verification purposes. Both systems, the inventory and the ETS, refer to a list of "basic" CO_2 emission factors in the energy sector.

Industrial Processes

- 2A1 Cement Production: EFs between inventory and ETS are consistent.
- 2A3 Limestone and dolomite use: ETS data is used for verification and QA.
- 2A7: Glass Production: emissions were compared with ETS emissions and found to be in agreement.

1.4.2.8 Greece

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 64% in the period 2005-2007. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided systematically, but it is indicated that all iron and steel plants are covered by the ETS.

Greece used AD and EF obtained from reporting under the ETS for the GHG inventory. In addition to the verified emissions provided for the period 2005-2007, data collected for the purposes of the national allocations plans for the ETS installations were collected for the period 2000-2006 and in some cases for the period 1990-2006 and this information was also used as a source for the inventory compilation.

Energy

- For the fuels refinery gas, petroleum coke and PKB/Patent fuels NCVs were obtained from verified reports from installations under the ETS. The ETS EF and AD were combined with remaining production and IPCC default EF to obtain complete emission estimates.

- The CO_2 emissions from the operation of flue gas desulphurization systems (limestone consumption in two power plants): data from verified installation ETS reports were used.
- 1A1b Petroleum Refining: Tier 2 methodology was used with EFs calculated based on plant specific data (ETS reports) and IPCC default EFs for the whole time series.
- 1A1c Manufacture of Solid Fuels and Other Energy Industries: Data collected during the formulation of the NAP for the period 2005 – 2007 and verified ETS reports (for years 2005 - 2007) were used in this inventory. The allocation of the consumption into gas turbines and boilers as taken from ETS reports. The CO_2 EF of natural gas was estimated to comprise emissions from the processing of sour gas cleaning process among with the emissions from combustion. The EF for the processing of sour gas is based on ETS data.
- 1A2 Manufacturing Industries and Construction: ETS data were used for an improved distribution of fuel consumption to different technologies and activities. ETS data was used to improve completeness of subcategories in the inventory. The NIR provides detailed information on 1A2a Iron and Steel, 1A2 b Non-ferrous metals, 1A2c Chemicals, 1A2d Pulp and Paper, 1A2e Food Processing, Beverages and Tobacco and 1A2f Other.
- Energy consumption in Non metallic minerals is disaggregated into energy consumption for cement production (SNAP 030311), lime production (SNAP 030312), ceramics production (SNAP 030319) and glass production (SNAP 030105) according to verified ETS reports of years 2005 - 2007.

Industrial Processes

- CO_2 emissions from the majority of mineral and metal industries are estimated on the basis of country-specific emission factors. These emission factors derive of plant specific activity and emission data in the context of the EU ETS. Plant specific information has been collected through questionnaires for the formulation of the NAP (years 1990-2003) and verified reports under the EU ETS.
- 2A1 Cement Production: For the years 2005-2007 detailed data have been accessed via the verified ETS reports of the plants.
- 2A1 Lime Production: The emissions are estimated making use of plant-specific data provided by the verified reports of the plants under the ETS. According to data received by the ETS, it seems that the main lime industries have significantly increased limestone consumption in 2007, which explains the increasing trend from 2005 to 2007.
- 2A7 Glass Production: Activity data for the period 2001 – 2004 were collected (through questionnaires developed according to the guidelines described in the Commission Decision 2004/156/EC) in the framework of the formulation of the NAP for the period 2005 – 2007, according to the EU Directive 2003/87/EC. The detailed data of 2005-2007 by the verified EU ETS reports have led to the need for recalculation of the time-series in order to ensure consistency.
- 2A7 Ceramics Production: Carbonates consumption data (in the context of the ETS reports) have been used for 2006 and 2007 emissions estimation.
- 2B1 Ammonia Production: The non-energy use of natural gas for ammonia production is reallocated in industrial processes sector as from the 2009 submission, by using data from ETS reports and plant specific information.
- 2C1 Iron and Steel: Data are generally plant specific, deriving from the EU ETS verified reporting of the plants (for the years 2005-2007) and the reporting performed for the NAP formulation in the previous years. Activity data and EF for 2005-2007 are plant specific and are based on the verified reports under the EU ETS context.
- 2C2 Ferroalloys Production: Activity data for 2005-2007 derive of the verified reports of the industry under the EU ETS.

1.4.2.9 Ireland

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 47% in 2005, 46% in 2006 and 45% in 2007. Emissions trading covers approximately 110 installations in Ireland. The ETS data have a complete coverage for of CO_2 estimates for categories 1.A.1 Energy Industries, 2.A.1 Cement Production, 2.A.2 Lime Production, 2.A.3 Limestone and Dolomite Use, 2.A.4 Soda Ash Production and Use and 2.A.7 Bricks and Tiles.

In Ireland the Emissions Trading Unit (ETU) to implement the EC Emissions Trading Directive (2003/87/EC) is a key component of the national system. Information compiled for participants in the ETS under Directive 2003/87/EC is an important source of activity-specific and company-specific data on emissions of greenhouse gases. The data from the monitoring and verification mechanisms administered by the ETU, consolidates and improves the information in relation to a substantial proportion of emissions for the purposes of reporting under the Convention. The returns under the scheme are fully utilised in the national inventory. For the years prior to 2005, data collected from ETS installations for the purposes of the establishment of the national allocations plans are used.

When the allocation to the categories from the ETS raw data to the inventory categories is completed, the output is returned to the ETS administrator for final checking against the source data.

Energy

- CO_2 estimates reported under the ETS for 2007 are used to achieve complete bottom-up results in respect of some important sub-categories in the energy sector.
- The combustion CO_2 emission factors adopted for use by participants in ETS take account of the fact that a very small fraction of fuel carbon may remain unoxidised and IPCC oxidation factors appropriate to solid, liquid and gaseous fuels are applied to compute the emissions.
- 1A1 Energy Industries: The ETS data in respect of the emissions and fuel combustion were used to compile the complete inventory for category 1.A.1. The data from a total of only 19 individual installations – 16 electricity generating stations in 1.A.1(a), one oil refinery in 1.A.1(b) and two peat briquetting plants under 1.A.1(c) – were sufficient to compute the results in this important category. In each of the three sub-categories, the verified CO_2 emission estimates reported by the ETS participants were used directly. However, the corresponding energy use as reported in the CRF is taken from the national energy balance, rather than from the ETS returns, following established practice to always reflect the published national energy data in emission inventories. The resulting implied emission factors (IEFs) reported in the CRF can have large inter annual fluctuations as raised in previous stages of the UNFCCC review process. These IEF fluctuations are a consequence of the difference between energy data reported to the inventory agency through the ETS and that reported by SEI in the national energy balance. The Inventory Agency is working closely with SEI to minimise these differences in future years.
- 1A2 Manufacturing Industry and Construction: Information on fuel consumption in 2007 was obtained from ETS data in respect of a small number of energy intensive industries (e.g. alumina production and cement manufacture) allowing their respective energy use amounts to be incorporated into the national energy balance.

Industrial Processes

- 2A1 Cement Production: ETS emissions from cement installations are used directly to report for category 2.A.1 in Ireland. The annual results incorporate verification of fuel use, limestone use, combustion and process CO_2 estimates pursuant to Decision 2004/156/EC.
- 2A2 Lime Production: Emissions from ETS are used directly in the inventory and have been used to confirm the estimates for previous years of the time-series.
- 2A3 Limestone and Dolomite Use: Up to 2006 Ireland had not reported emissions arising from this activity. Information became available in 2005 to allow for the inclusion of CO_2 emissions associated with the use of carbonates in the manufacture of building bricks and ceramics from individual plants that are included in the ETS. CO_2 emissions reported by individual companies are

used in inventory estimates. A further use of limestone in Ireland is in the production of sugar from sugar beet. Limestone use in sugar production is also taken from information provided by the ETS. In early 2006 the last remaining sugar production plants ceased operation, therefore emissions from this source no longer occur.

- 2A4 Soda Ash Production and Use: Information on activity data and emission estimates for the later years in the time-series have been taken from reporting under the ETS.
- 2A7 Bricks and Tiles: Information on activity data and emission estimates for the later years in the time-series have been taken from reporting under the ETS.

1.4.2.10 Italy

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 46% in 2005, 47% in 2006 and 48% in 2007. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in a systematic way, but the NIR indicates that Lime Production plants are completely covered under the ETS.

The data from the ETS is used to develop country-specific emission factors and to check activity data levels.

As an improvement and QA activity Italy is establishing a unique database where information collected in the framework of different European directives, Large Combustion Plant, EPER and Emissions Trading, are gathered together thus highlighting the main discrepancies in information and detecting potential errors. Even though the database is not completed yet all the figures are considered in an overall approach and used in the compilation of the inventory.

Energy

- 1B2 Oil and Gas: Fugitive CO_2 emissions reported in 1.B.2 refer to fugitive emissions in refineries during petroleum production processes, e.g. fluid catalytic cracking and flaring, and emissions from the production of oil and natural gas. Emissions in refineries have been estimated on the basis of activity data published in the National Energy Balance or supplied by industry and operators especially in the framework of the European emissions trading scheme.

Industrial Processes

- 2A1 Cement Production: Emission factors have been estimated on the basis of detailed information supplied by plants in the ETS and checked with the industrial association. EFs are directly taken from ETS.
- 2A2 Lime Production: Emission factors have been estimated on the basis of detailed information supplied by plants in the ETS and checked with the industrial association.
- 2A3 Limestone and Dolomite Use: Detailed production activity data and emission factors have been supplied under the ETS and relevant data are annually provided by the Italian bricks and tiles industrial association and by the Italian ceramic industrial associations.
- 2A7 Glass Production: CO_2 emissions from glass production have been estimated by production activity data and emission factors estimated on the basis of information supplied by plants under the ETS.
- 2B5 Carbon Black: CO_2 emissions from carbon black production process have been estimated on the basis of information supplied by the Italian production plants in the framework of the national EPER/EPRTR registry and the ETS.
- 2C1 Iron and Steel: From 2000 CO_2 emission and production data have been supplied by all the plants in the framework of the ETS scheme, for the years 2000-2004 disaggregated for sinter, blast furnace and BOF plants, from 2005 specifying carbonates and fuels consumption and related CO_2 emissions. For 2002-2006 data have also been supplied by all the four integrated iron and steel plants in the framework of the European EPER registry not distinguished for combustion and

processes. Emissions reported in the national EPER/E-PRTR registry and for the Emission Trading Scheme are compared and checked.

1.4.2.11 Luxembourg

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 22% in 2005-2007. No NIR 2009 had been provided during the preparation of this report, therefore no further analysis is available for Luxembourg.

1.4.2.12 The Netherlands

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 46% in 2005, 44% in 2006 and 46% in 2007. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in the NIR.

In 2008 a quantitative assessment was made of the possible (in)consistencies in CO_2 emissions between data from ETS, NIR and National Energy Statistics. The figures that were analyzed concerned about 40% of the CO_2 emissions in the Netherlands in 2006 and 2007. The differences could reasonably be explained (e.g. different scope) within the given time available for this action. Recommendations were elaborated for future improvements. One of these implies an annual update comparison as a sector specific QA/ QC action, when new annual data become available. A separate report of the comparison was prepared which is not available in the internet and few direct results from this report are provided in the NIR.[13]

Energy

- A national list of CO_2 emission factors for fuels is compiled for the use in the GHG inventory and for the ETS. This list is provided in Table A2.1 in the NIR.
- 1A1b Petroleum Refineries: For refineries, the high IEF values for CO_2 from liquid fuel for 2002 onwards suggest that also some other CO_2 emissions occur that are not accounted for by the fuel consumption data only. Therefore, the present allocation method for reporting CO_2 emissions from refineries will be evaluated and reconsidered, when another method appears to present the data more transparently. This item will get attention in the ongoing project to improve the data consistency between the Emission Trading System (ETS) and the PRTR system. If in the future part of the CO_2 produced by the gasification and hydrogen plant is sold to external users (for example for industrial applications or for crop fertilization in greenhouse horticulture), this may be monitored separately and allocated accordingly.

Industrial Processes

The CO_2 emissions form industrial processes were part of the study comparing inventory data with ETS data, however no detailed results are provided in the NIR.

1.4.2.13 Portugal

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 52% in 2005, 51% in 2006 and 50% in 2005. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in the NIR.

According to the NIR 2009, Portugal still plans to better integrate data from ETS into the GHG inventory and to streamline the collection of data and emission estimates between the inventory and

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[13] Guis, B., R. de Ridder, P.J. Zijlema, 2009: Verklaring verschillen tussen CO_2-emissies in EU-ETS en andere rapportages, available at SenterNovem, Utrecht.

the ETS. Contacts are being made to implement this plan.

Energy

Fuel consumption data for the islands Madeira and Azores were taken from reports under the ETS.

Industrial Processes

- 2A7 Ceramics Production: EF from ETS are used together with other data sources. A carbonate consumption factor was developed based on the information received under the ETS, and production of construction ceramics and pavement ceramics, which is available from INE's industry surveys IAIT and IAPI, was used to obtain the full time series.
- 2A7 Glass Production: Country specific emission factors were calculated using data from 10 industrial plants in Portugal under the studies for the development of the Allocation Plan for the implementation of the ETS and under the efforts to streamline both inventories.
- 2C1 Iron and Steel: The CO_2 emission factors for Electric Arc Furnace were derived from the reporting of the two iron and steel plants that are included in the ETS.

1.4.2.14 Spain

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 50% in 2005 and 2006 and 51% in 2007.

Spain does not indicate in the NIR that it is using ETS data either directly for inventory or for QA/QC purposes. The use of ETS data for QA/QC procedures and checks in the relevant source category are also not included in the planned improvement activities.

The ETS data for Spain show a considerable difference in scope of installations for the first trading period. The total number of installations that reported verified emissions was 804 in 2005, 1,031 in 2006 and 1,046 in 2007, thus from 2005 to 2006, the coverage expanded by 227 installations. Such opt-ins in 2006 added 7,057 Gg CO_2 emissions to the scope of the ETS in 2006, the opt-ins of installations in 2007 added 1,745 Gg CO_2 emissions in the third year of the first trading period. Due to the inconsistent scope of the ETS over the period 2005-2007, the emission trends between both data sources are not comparable.

1.4.2.15 Sweden

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 37% in 2005 and 2007 and 38% in 2006. The coverage of CO_2 emissions from ETS activities in relation to individual CRF source categories is not provided in a systematic way, but the NIR indicates that ETS data do not cover all plants in the corresponding CRF categories.

For a number of plants in the Energy and Industrial Process sectors, data from the ETS is used in the GHG inventory since it is convenient and since the quality is considered higher than that from data sources used in earlier submissions. For those source categories were ETS data was applied, companies have been contacted and asked to verify and explain the estimations they have reported to the ETS. In case there has been a mismatch between ETS and previous data, the industries have been asked to provide supplementary data. Data for years before 2005 have been taken from the data collection for the preparation of the Swedish National Allocation Plans under the ETS.

As part of the procedure for the inventory submission in 2007, a separate study was performed to verify the quality of all fossil fuel combustion-related CO_2-emissions from the largest plants (in terms of CO_2-emissions) in Sweden in 2005. The verification consisted of a comparison of 63 plant-specific data used for the GHG inventory (energy statistics from the quarterly fuel statistics) with data from the ETS. The results showed that for 21 plants, accounting for about 50 % of the fossil fuel consumption of the 63 plants included in the study, no significant differences between the two data sources were identified. For a number of plants, large differences occurred between the two data sources. In 2007, 19 of these plants were further surveyed in another study. Again, energy statistics (the quarterly fuel statistics) and ETS data by plant were compared and analyzed. The results show that the reported fuel amounts differ slightly between the data sets and since ETS data are verified, they are likely to be more correct. Furthermore, on plant level, the national calorific values and emission factors that are used for the GHG inventory are not fully correct. Another deficiency in the quarterly fuel statistics is that unconventional fuels are often grouped and the emission factors of these fuels are associated with very large uncertainties, since they are not specific for the current fuel and plant. Finally, another problem is that some of those unconventional fuels are incorrectly classified.

Energy

Data from the ETS is used since the 2007 inventory submission and emission year 2005 for a number of plants when the energy statistics are not available or considered to be of too low quality.

- 1A1b Petroleum refining: ETS data is applied for four refinery plants for 2005, 2006 and 2007.
- 1A2e Food Processing, Beverages and Tobacco: ETS data is used for one plant for 2006.
- 1A1a Iron and Steel: CO_2 emissions for 2005 and 2006 from the two largest iron and steel plants in Sweden were given extra attention in submission 2007 and 2008. GHG inventory data, collected by Statistics Sweden, were compared with the ETS data. For 2005, the results showed good coherence (< 5 % difference), whereas for 2006, the results indicate significant differences (> 5 %). It is believed that the divergence occurring for 2006 to a large extent is due to a significantly larger CO_2 emission factor for blast furnace gas in the ETS data. During 2008, a study has been performed concerning emissions from several industry plants, including the two largest iron and steel plants in Sweden. Results show that GHG data could be further improved to be in line with other data sources. The main conclusion is that the emissions need to be reallocated. The reallocation affects CO_2 in CRF 1A1a, 1A1c, 1A2a, 1B1c and 2C1. Moreover, the activity data and CO_2 emissions should be directly obtained from the plants legal environmental reports which may result in an increase in the total emissions of CO_2 from the plants. If approved by the Swedish EPA, the related revisions and recalculations will be implemented in the 2010 inventory submission.
- All Swedish plants that flare gas and are included in the ETS and are accounted for in the inventory. For smaller plants, data might be included but reported in CRF 1A instead of CRF 1B.

Industrial Processes

- In some cases data on CO_2 emissions from the ETS is used for 2005 and later years. From 2005 and onwards, data on the production and use of raw materials have been acquired from the ETS and through direct contacts with the industries. For facilities included in the ETS, ETS data have been used where the estimates are in accordance with IPCC Good Practice Guidance.
- 2A1 Cement Production: Emissions have been estimated based on ETS data as well as direct information from the company. From 2005, data on clinker production and total CO_2 emissions is retrieved from the ETS. The ETS data lack information on emissions from dust.
- 1A3 Limestone and Dolomite Use: Data have been acquired from environmental reports, the ETS and through direct contacts with the companies.
- 2A4 Soda Ash Production and Use: Data on the use of soda ash have been acquired from the ETS and through direct contacts with the reporting companies. The time series is consistent and complete for the major plants, but it has to be noted that some facilities using small amounts of soda ash might be missing in the inventory. According to the comparison with data from other sources, potential deficits in the data are expected to be small.
- 2A7 Light expanded clay aggregates: From 2005 and onwards, the activity and emissions data is acquired through the ETS and the Swedish LECA producer's annual report.
- 2C1 Iron and Steel: In most cases, data from the Swedish enquiry for the Swedish NAP for the ETS could be used for the years 1998-2002. Data for 1990-1997 and 2003-2004 has been collected directly from the plants. From 2005, the equivalent data are acquired from the ETS, environmental reports and through contacts with the companies.

1.4.2.16 United Kingdom

General

The coverage of ETS emissions in relation to total CO_2 emissions (without LULUCF) is 44% in 2005, 46% in 2006 and 47% in 2007. The coverage at more detailed level of installations in UK is shown in Table 1.10

Table 1.10 Coverage of ETS installations under the ETS compared to total number of installations

Sector	Number of installations	
	EU ETS data	UK total
Power stations (fossil fuel, > 75MWe)	61	61
Power stations (fossil fuel, < 75MWe)	21	30
Power stations (nuclear)	12	12
Coke ovens	4	4
Sinter plant	3	3
Blast furnaces	3	3
Cement kilns	4	15
Lime kilns	8	15
Refineries	12	12
Combustion – iron & steel industry	12	200[a]
Combustion – other industry	237	5000[a]
Combustion – commercial sector	23	1000[a]
Combustion – public sector	167	1000[a]

From the 2008 onwards 100% of sector emissions will be covered for several major industrial sectors:

- Power stations;
- Oil refineries;
- Coke ovens;
- Integrated steelworks;
- Cement kilns; and
- Lime kilns.

In UK plant operators which are included in the UK Emission Trading Scheme (UK ETS), or which have a Climate Change Agreement (CCA) could choose to be exempt from the EU ETS. The UK ETS exemptions were valid until the end of 2006, whilst the CCA exemptions were valid until the end of 2007. These exemptions mean that the 2005 to 2007 ETS data gives an incomplete picture of total UK fuels consumed and carbon dioxide emitted by several major industrial sectors and also different trends due to different scope of installations during the period 2005-2007. From the 2008 ETS dataset onwards, all of the major plant opt-outs have ceased, and a more complete picture of fuel use and emissions across heavy industry in the UK will be available.

DECC (UK Government Department of Energy and Climate Change) provides fuel use and fuel characterisation datasets from the ETS for use by the national inventory in the determination of industrial fuel use statistics and the resultant emissions of GHGs from combustion sources.

Energy

- CO_2 emission factors based on ETS reporting are used for the following sectors and fuels:
    - Power Stations – coal – for 2005, 2006, 2007
    - Power Stations – fuel oil – for 2005, 2006, 2007
    - Power Stations – natural gas – for 2005, (interpolated 2006, 2007)
    - Autogenerators – coal – 2005, 2006, 2007
    - Refineries – fuel oil - 2005, (interpolated 2006, 2007)
    - Refineries – Petroleum coke – 2005, 2006, 2007

- 1A1b Petroleum Refining: The main fuels in refineries are fuel oil and OPG and emissions also occur due to the burning off of 'petroleum coke' deposits on catalysts used in processes such as catalytic cracking. In the latter case, emissions in the ETS are not generally based on activity data and emission factors but are instead based on direct measurement of carbon emitted. This is due to the technical difficulty in measuring the quantity of petroleum coke burnt and the carbon content. The emission factors generated from ETS data were generally lower than those obtained using the 2006 GHGI methodology (Table 1.11). Only in the case of petroleum coke is this reversed, but here the EU ETS factors are significantly higher. The emission factors generated for 2005 and 2007 based o ETS data are impossibly high, suggesting that petroleum coke is more than 100% carbon. At the time of inventory compilation, it was not certain whether this was more likely to be due to inaccuracies in DUKES or ETS data. However, due to the large difference in the numbers, a compromise approach was adopted of using the 2006 EU ETS figure in the inventory and an emission factor of 1000 ktonnes/Mtonne for 2005 and 2007. Consultation with the industry and energy statisticians should allow full resolution of this issue for the next version of the inventory. The emission factors for fuel oil are very similar to those generated using the previous inventory methodology. Because of the high percentage of Tier 3 data in 2006 and 2007, the EU ETS data have been used in the inventory, while the 2005 figure has not been used as only 26% Tier 3 coverage was not considered high enough to be representative for the sector. Emission factors for OPG are significantly lower than those generated using the inventory method. However, Tier 3 emission factors are not always used for the majority of emissions, and there was in addition considerable uncertainly regarding the allocation of ETS fuels to the OPG fuel category. The data have therefore not been used in the inventory, but it is hoped that Tier 3 emission factors will be used for a much higher percentage of emissions in future ETS data sets, thereby improving confidence in the data and enabling their future use in the derivation of the inventory estimates.

Table 1.11 EU ETS Data for Fuel Oil, OPG and Petroleum Coke burnt at Refineries (Emission Factors in ktonne / Mtonne for Fuel Oil & Petroleum Coke and ktonne / Mtherm for OPG)

Year	Fuel	% Tier 3	Average Carbon Emission Factor (Tier 3 sites only)	2006 GHGI Carbon Emission Factor
2005	Fuel Oil	26	861.0	879.0
2006		68	873.7	879.0
2007		79	877.4	879.0
2005	OPG	69	1.526	1.644
2006		48	1.507	1.644
2007		60	1.519	1.644
2005	Petroleum Coke	-[a]	1054.2	930.0
2006		-[a]	985.8	930.0
2007		-[a]	1189.8	930.0

[a] It was unclear from the data received how much of the emission was based on a Tier 3 approach.

- 1B2 Fugitive emissions from Oil and Gas: Offshore Emission estimates for the offshore oil & gas industry are based on data provided by the trade organisation, Oil and Gas UK, through their annual emissions reporting mechanism to the UK regulatory agency (the Department of Energy & Climate Change), called the Environmental Emissions Monitoring System (EEMS). This system provides a detailed inventory of point source emissions estimates, based on operator returns for the years 1995-2007. Additional data on CO_2 emissions from some offshore combustion processes has become available via the National Allocation Plan and annual operator emission estimates for sites participating in the ETS In recent years these ETS data have been used by operators to update their EEMS emission estimates for combustion processes, ensuring consistency between EEMS and ETS, and by the Inventory Agency as a useful quality check on time-series consistency of carbon emission factors.

- 1A2a Iron and Steel: Within the iron & steel sector, the ETS reporting format in the UK does not provide a breakdown of emissions for the sectors reported within the inventory; estimates of emissions from coke ovens, blast furnaces and sinter plants are not provided explicitly within the EU ETS. In addition, the scope of reporting of ETS does not cover 100% of iron & steel sites or activities, as some secondary steel processes are excluded from the scope of EU ETS reporting. These two factors make the analysis and comparison of the EU ETS and the inventory estimates much more uncertain. The ETS data has, however, been useful as a quality check for the use of fuels within the iron and steel sector.

- The 2007 ETS data include 63 additional combustion installations compared to 2005-2006 and the scope of the ETS was expanded by 5,088 Gt CO_2 emissions from these installations. This implies an inconsistent trend of ETS emissions relative to inventory emissions.

Industrial Processes

- 2A1 Cement Production: The methodology used for estimating CO_2 emissions from calcination is to use data provided by the British Cement Association (2008), which in turn is based on data generated by UK cement clinker producers for the purposes of reporting to the ETS.
- The 2007 ETS data include 7 additional cement plants compared to 2005-2006 and the scope of the ETS was expanded by 2,689 Gt CO_2 emissions from cement and lime. This implies an inconsistent trend of ETS emissions relative to inventory emissions.
- 2A2 Lime Production: UK currently does not estimate CO_2 emissions from lime production from use of dolomite based on the assumption that all lime is quicklime and that calcination of dolomite is minimal. The NIR indicates that there is potential for the ETS to provide the data in the near future when the lime producers, who are not currently part of the ETS, will soon be required to be.

1.5 Description of key categories

A key category analysis has been carried out according to the Tier 1 method (quantitative approach) described in IPCC (2000). A key category is defined as an emission source that has a significant influence on a country's GHG inventory in terms of the absolute level of emissions, the trend in emissions, or both.

In addition to the key category analysis at EU-15 level, every Member State provides a national key category analysis which is independent from the assessment at EU-15 level[14]. The EU-15 key category analysis is not intended to replace the key category analysis by Member States. The key category analysis at EU-15 level is carried out to identify those categories for which overviews of Member States' methodologies, emission factors, quality estimates and emission trends are provided in this report. In addition, the EU-15 key category analysis helps identifying those categories that should receive special attention with regard to QA/QC at EC level. The Member States use their key category analysis for improving the quality of emission estimates at Member State level.

To identify key categories of the EU-15, the following procedure was applied:

- Starting point for the key category identification for this report were the CRF sectoral report tables and sectoral background data tables (for energy), i.e. CRF Tables 1A(a), 2(I), 3, 4, 5, 6 of the EU-15 GHG inventory. All categories where GHG emissions/removals occur were listed, at the most disaggregated level available at EU-15 level and split by gas.
- A level assessment was carried out for all years between 1990 and 2007 and a trend assessment was performed for 1990 to 2007. The assessment was carried out for emissions excluding LULUCF and including LULUCF.
- The key category analysis excluding LULUCF resulted in the identification of 80 key categories for the EU-15 and cover 97 % of total EU-15 GHG emissions in 2007. The key category analysis

[14] A comparison of the EC key category analysis with the key category analysis of the Member States (without LULUCF) in 2006 showed that most EC key categories are also key categories in the Member States. The Member States' key categories covered 92 % of the emissions of the 78 EC key categories in 2006.

including LULUCF resulted in 87 key categories. The results of the EU-15 key category analysis including LULUCF is presented in Table 1.12.

- In addition to the key category analysis for the EU-15 also a key category analysis for the EU-27 was made. More details related to the key category analysis are included in Annex 1.

In Chapters 3 to 9 for each key category overview tables are presented which include the Member States' contributions to the EU-15 key source in terms of level and trend.

Table 1.12 Key categories for the EU-15 (Gg CO_2 equivalents)

Source category	1990	2007	Level	Trend
1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)	60,436	259,956	L 1990-2007	T
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)	124,580	52,373	L 1990-2007	T
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)	13,334	32,759	L 1990-2007	T
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)	750,839	683,450	L 1990-2007	T
1 A 1 a Public Electricity and Heat Production: Solid Fuels (N_2O)	6,663	6,051	L 1990, 1994, 1996	
1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)	3,846	8,947	L 1997, 1999, 2004-2007	T
1 A 1 b Petroleum refining: Liquid Fuels (CO_2)	98,388	111,336	L 1990-2007	T
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)	16,872	21,590	L 1990-2007	T
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)	72,520	30,900	L 1990-2007	T
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)	16,414	19,164	L 1990-2007	T
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)	7,585	3,962	L 1990-1994	T
1 A 2 a Iron and Steel: Solid Fuels (CO_2)	94,851	67,612	L 1990-2007	T
1 A 2 b Non-Ferous Metals: Gaseous Fuels (CO_2)	2,399	5,303		T
1 A 2 c Chemicals: Gaseous Fuels (CO_2)	28,065	29,808	L 1990-2007	T
1 A 2 c Chemicals: Liquid Fuels (CO_2)	30,573	23,942	L 1990-2007	T
1 A 2 c Chemicals: Other Fuels (CO_2)	3,363	6,708	L 1998-2007	T
1 A 2 c Chemicals: Solid Fuels (CO_2)	8,017	4,697	L 1990-1993	T
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)	10,636	18,912	L 1990-2007	T
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)	9,500	5,305	L 1990-2002	T
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)	12,740	23,918	L 1990-2007	T
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)	14,873	9,476	L 1990-2007	T
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)	5,186	2,253		T
1 A 2 f Other: Gaseous Fuels (CO_2)	104,780	135,182	L 1990-2007	T
1 A 2 f Other: Liquid Fuels (CO_2)	126,184	105,837	L 1990-2007	T
1 A 2 f Other: Other Fuels (CO_2)	3,307	9,348	L 2005-2007	T
1 A 2 f Other: Solid Fuels (CO_2)	120,693	37,010	L 1990-2007	T
1 A 3 a Civil Aviation: Jet Kerosene (CO_2)	16,231	21,695	L 1990-2007	T
1 A 3 b Road Transportation: Diesel oil (CO_2)	266,773	512,570	L 1990-2007	T
1 A 3 b Road Transportation: Diesel oil (N_2O)	2,148	6,366		T
1 A 3 b Road Transportation: Gasoline (CH_4)	3,813	1,008		T
1 A 3 b Road Transportation: Gasoline (CO_2)	362,580	275,067	L 1990-2007	T
1 A 3 b Road Transportation: Gasoline (N_2O)	3,184	4,307	L 1995-2000	
1 A 3 b Road Transportation: LPG (CO_2)	7,296	5,382	L 1990-1991, 1993-2002	
1 A 3 c Railways: Liquid Fuels (CO_2)	8,037	5,818	L 1990-1999	
1 A 3 d Navigation: Gas/Diesel Oil (CO_2)	12,531	12,121	L 1990-2007	
1 A 3 d Navigation: Residual Oil (CO_2)	5,729	7,996	L 2003-2007	T
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)	59,131	92,008	L 1990-2007	T
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)	73,875	44,690	L 1990-2007	T
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)	27,653	2,182	L 1990-1993, 1995, 1997	T
1 A 4 b Residential: Gaseous Fuels (CO_2)	161,917	221,862	L 1990-2007	T
1 A 4 b Residential: Liquid Fuels (CO_2)	169,433	121,735	L 1990-2007	T
1 A 4 b Residential: Solid Fuels (CO_2)	74,538	9,845	L 1990-2007	T
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)	9,723	9,476	L 1990-2007	
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)	56,145	47,611	L 1990-2007	T

Source category	1990	2007	Level	Trend
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)	4,066	751		T
1 A 5 a Stationary: Solid Fuels (CO_2)	4,667	7		T
1 A 5 b Mobile: Liquid Fuels (CO_2)	13,709	6,211	L 1990-1999	T
1 B 1 a Coal Mining:(CH_4)	44,285	8,928	L 1990-2007	T
1 B 2 a Oil:(CO_2)	9,866	9,961	L 1990-2007	
1 B 2 b Natural gas:(CH_4)	26,286	20,315	L 1990-2007	T
1 B 2 c Venting and flaring:(CO_2)	6,510	6,274	L 1992-2001	
2 A 1 Cement Production:(CO_2)	80,357	87,106	L 1990-2007	T
2 A 2 Lime Production:(CO_2)	17,350	17,942	L 1990-2007	
2 A 3 Limestone and Dolomite Use:(CO_2)	5,869	7,392	L 2000-2007	
2 B 1 Ammonia Production:(CO_2)	17,023	16,553	L 1990-2007	
2 B 2 Nitric Acid Production:(N_2O)	37,145	25,925	L 1990-2007	T
2 B 3 Adipic Acid Production:(N_2O)	58,927	8,965	L 1990-2005, 2007	T
2 B 5 Other:(CO_2)	9,951	15,538	L 1990-2007	T
2 B 5 Other:(N_2O)	4,508	1,694		T
2 C 1 Iron and Steel Production:(CO_2)	71,751	68,506	L 1990-2007	
2 C 3 Aluminium production:(PFC)	13,341	1,430	L 1990-1998	T
2 E 1 By-product Emissions:(HFC)	21,158	1,245	L 1990-2003	T
2 E 1 By-product Emissions:(SF_6)	1,559	-		T
2 E 3 Other :(HFC)	4,329	223		T
2 F 1 Refrigeration and Air Conditioning Equipment :(HFC)	89	41,176	L 1997-2007	T
2 F 2 Foam Blowing:(HFC)	332	3,107		T
2 F 4 Aerosols/ Metered Dose Inhalers:(HFC)	67	7,569	L 2000-2007	T
2 F 9 Other:(SF_6)	4,398	3,390	L 1994-1996	
4 A 1 Cattle:(CH_4)	110,522	98,824	L 1990-2007	T
4 A 3 Sheep:(CH_4)	16,375	14,226	L 1990-2007	
4 B 1 Cattle:(CH_4)	21,638	19,095	L 1990-2007	
4 B 13 Solid Storage and Dry Lot:(N_2O)	21,230	18,959	L 1990-2007	
4 B 8 Swine:(CH_4)	19,971	23,613	L 1990-2007	T
4 D 1 Direct Soil Emissions:(N_2O)	110,547	93,386	L 1990-2007	T
4 D 2 Pasture, Range and Paddock Manure:(N_2O)	28,787	25,478	L 1990-2007	
4 D 3 Indirect Emissions:(N_2O)	73,275	60,797	L 1990-2007	T
5 A 1 Forest Land remaining Forest Land:(CO_2)	278,831	307,436	L 1990-2007	T
5 A 2 Land converted to Forest Land:(CO_2)	23,925	47,289	L 1990-2007	T
5 B 1 Cropland remaining Cropland:(CO_2)	27,457	23,735	L 1990-2007	T
5 B 2 Land converted to Cropland:(CO_2)	45,656	39,098	L 1990-2007	T
5 C 1 Grassland remaining Grassland:(CO_2)	18,021	23,336	L 1990-2007	T
5 C 2 Land converted to Grassland:(CO_2)	32,728	28,335	L 1990-2007	T
5 E 2 Land converted to Settlements:(CO_2)	16,438	25,554	L 1990-2007	T
6 A 1 Managed Waste disposal on Land:(CH_4)	128,235	69,607	L 1990-2007	T
6 A 2 Unmanaged Waste Disposal Sites:(CH_4)	11,626	6,346	L 1990-2006	T
6 B 2 Domestic and Commercial Wastewater:(CH_4)	9,238	6,745	L 1990-2004, 2006-2007	
6 B 2 Domestic and Commercial Wastewater:(N_2O)	9,151	9,773	L 1990-2007	

Annex 1 also includes the results of the Tier 2 key category, which was performed this year for the first time following the recommendation from expert review team. It shows that source category N_2O emissions from 4D agricultural soils is by far the largest key category if uncertainties are included (bot for level and trend).

1.6 Information on the quality assurance and quality control plan

1.6.1 Quality assurance and quality control of the European Community

inventory

The European Community GHG inventory is based on the annual inventories of the Member States. Therefore, the quality of the European Community inventory depends on the quality of the Member States' inventories, the QA/QC procedures of the Member States and the quality of the compilation process of the European Community inventory. The Member States and also the European Community as a whole implemented QA/QC procedures in order to comply with the IPCC good practice guidance.

The EC QA/QC programme describes the quality objectives and the inventory quality assurance and quality control plan for the EC GHG inventory including responsibilities and the time schedule for the performance of the QA/QC procedures: Definitions of quality assurance, quality control and related terms used are those provided in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and Guidelines for National Systems under the Kyoto Protocol. The EC QA/QC programme will be reviewed annually and modified or updated as appropriate.

The European Commission (Directorate General for Environment) is responsible for coordinating QA/QC activities for the EC inventory and ensures that the objectives of the QA/QC programme are implemented and the QA/QC plan is developed. The European Environment Agency (EEA) is responsible for the annual implementation of QA/QC procedures for the EC inventory.

The overall objectives of the EC QA/QC programme are:

- to provide an EC inventory of greenhouse gas emissions and removals consistent with the sum of Member States' inventories of greenhouse gas emissions and removals,
- to establish appropriate QA/QC procedures at EC level in order to comply with requirements under the UNFCCC and the Kyoto Protocol,
- to contribute to the improvement of quality of Member States' inventories and
- to provide assistance for the implementation of national QA/QC programmes.

A number of specific objectives have been elaborated in order to ensure that the EC GHG inventory complies with the UNFCCC inventory principles of transparency, completeness, consistency, comparability, accuracy and timeliness.

In the QA/QC plan quality control procedures before and during the compilation of the EC GHG inventory are listed. In addition, QA procedures, procedures for documentation and archiving, the time schedules for QA/QC procedures and the provisions related to the inventory improvement plan are included.

QC procedures are performed at several different stages during the preparation of the European Community inventory. Firstly, a range of checks are used to determine the consistency and completeness of Member States' data so that they may be compiled in a transparent manner at the Community level. Secondly, checks are carried out to ensure that the data are compiled correctly at the Community level to meet the overall reporting requirements. Thirdly, a number of checks are conducted with regard to data archiving and documentation to meet various other data quality objectives.

Based on the EC QA/QC programme a quality management manual was developed which includes all specific details of the QA/QC procedures (in particular checklists and forms). The structure of the EC quality management manual has been developed on the basis of the Austrian quality management manual. The reason for using the Austrian manual as a template for the EC manual is that the EC GHG inventory is compiled by Umweltbundesamt Austria and the implementation of the annual QA/QC procedures are coordinated by Umweltbundesamt Austria. By using the Austrian quality manual as a template for the EC quality manual the EC can benefit from the experience made during the set-up of the Austrian quality management system which is accredited under ISO 1720; procedures and documents from the Austrian system have been taken and adapted according to the need of the EC quality management system.

The EC quality management manual is structured along three main processes (management processes, inventory compilation processes, supporting processes) of the quality management system (Table 1.13).

Table 1.13 Structure of the EC quality management manual

Chapter		Chapter description
Management processes		
ETC 01	EC inventory system	Describes the organisation and responsibilities within the EC GHG inventory system
ETC 02	QA/QC programme	Describes the preparation and evaluation of the EC QA/QC programme by the European Commission
ETC 03	Quality management system	Describes the responsibilities and the structure of the quality management system and gives an overview of the forms and checklists used
ETC 04	Quality management evaluation	Describes the evaluation of the status and effectiveness of the quality management system
ETC 05	Correction and prevention	Describes the procedures for the correction and prevention of mistakes that occur in the EC inventory
ETC 06	Information technology systems	Describes the information technology systems used such as CIRCA, Reportnet and the systems set up at Umweltbundesamt Austria
ETC 07	External communication	Describes the communication with Member States and other persons and institutions
Inventory compilation processes		
ETC 08	QC MS submissions	Describes the quality control activities performed on the GHG inventories submitted by the EC Member States
ETC 09	QC EC inventory compilation	Describes the quality control activities performed during the compilation of the EC GHG inventory including checks of database integrity
ETC 10	QC EC inventory report	Describes the checks carried out during and after the compilation of the EC GHG inventory report
Supporting processes		
ETC 11	Documents	Describes the production, change, proofreading, release and archiving of quality management documents
ETC 12	Documentation and archiving	Describes the procedure for preparing documentation and archiving

The quality checks performed during inventory compilation process are the central part of the quality manual. Quality checks are made at three levels:

Quality control MS submissions

The QC activities of MS submissions include two elements; checking the completeness of the Member States CRF tables and checking the consistency of Member States GHG data. The com-pleteness checks of Member States' submissions are carried out by EEA/ETC-ACC by using a similar status report form as used by the UNFCCC Secretariat. The completed status reports are sent to Member States by 28 February; then Member States can check the status reports and update information, if needed. The status reports of the Member States' submissions are included in Annex 3 of this report.

The consistency checks of Member States data primarily aim at identifying main problems in time series of emissions and implied emissions factors, implied emissions factors across Member States and sub-category sums. For the time series checks the algorithms of the UNFCCC secretariat are used. In addition, the ETC/ACC identifies potential problems by comparison with the previous year's in-ventory submission of the Member States and checks the availability of the CRF tables needed for the compilation of the EC inventory. The results of these checks are documented in the consistency reports and are also sent to the Member States by 28 February, in order to obtain, if needed, revised emission estimates or additional information.

For the sectors energy, industrial processes, agriculture, LULUCF and waste sector-specific checks are performed by the sector experts and documented in sector-specific forms/checklists. In addition, sector experts receive the results of checks with the UNFCCC outlier tool before they are sent to the Member States. The main findings of the sector specific checklists are transferred to/also documented in the consistency reports.

For every updated inventory submission provided by the MS by 15 March follow-up checks are performed and the status reports are completed; for new submissions a consistency report is prepared. In addition it is checked if issues identified in the status reports and in the consistency reports (initial checks), which are relevant for the EC inventory (report) have been clarified by the MS. If this is not the case MS are contacted for clarification.

Quality control EC inventory compilation

After the initial checks of the emission data, the ETC/ACC transfers the national data from the xml-files into the ETC/ACC CRF aggregator database. The version of the data received by ETC/ACC are numbered, in order to be traced back to their source. The ETC/ACC CRF aggregator database is maintained and managed by Umweltbundesamt Austria.

As the EC GHG inventory is compiled on the basis of the inventories of the EC Member States, the focus of the quality control checks performed during the compilation of the EC GHG inventory lays on checking if the correct MS data are used, if the data can be summed-up (same units are used) and that the summing-up is correct. Finally, the consistency and the completeness of the EC GHG inventory is checked. All the checks are carried out for the original submission by 15 April each year and for any resubmission. Two checklists are used for this purpose: 'Inventory preparation/consistency' and 'Data file integrity'.

Quality checks EC inventory report

The checks carried out during and after the compilation of the EC GHG inventory report are specified in the checklist 'EC inventory report'. They cover a.o. checks of data consistency between the inventory and the inventory report, data consistency between the tables and the text, but also checks of the layout.

The circulation of the draft EC inventory and inventory report on 28 February to the EC Member States for reviewing and commenting also aims to improve the quality of the EC inventory and inventory report. The Member States check their national data and information used in the EC inventory report and send updates, if necessary, and review the EC inventory report. This procedure should assure the timely submission of the EC GHG inventory and inventory report to the UNFCCC secretariat and it should guarantee that the EC submission to the UNFCCC secretariat is consistent with the Member States UNFCCC submissions.

Finally, also the detailed analysis of GHG emission trends of the EC and each EC Member State after the submission of the EC inventory to the UNFCCC also contributes to improving the quality of the EC GHG inventory. This analysis is carried out in the annual EC GHG trend and projections report (see EEA, 2008b); the report identifies sectoral indicators, for socio-economic driving forces of greenhouse gas emissions, by using Member States indicator submissions under Council decision 280/2004 or data from Eurostat and from Member States' detailed inventories. In addition, it compares and analyses Member States' emission trends in the EC key sources and provides main explanations, either socio-economic developments or policies and measures, for these trends in some Member States.

EC internal review

A collaborative internal review mechanism is established within the European Community so that all participants (MS, EEA, Eurostat, and JRC) may contribute to the identification of shortcomings and propose amendments to existing procedures. The review activities with experts from Member States are coordinated by the ETC/ACC under Working Group I and take place during the period from April through September each year. The synthesised findings of collaborative reviews provide a basis for the planned progressive development of inventories both at Member state and at EC level.

In 2008, the internal review was a follow-up of the EC initial review assessed the completeness and comparability (consistent allocation) of Member States' emissions in the sector Industrial Processes. In addition, N_2O emissions from road transport were reviewed. In 2007, the internal review focused on the uncertainty estimates by identifying potential outliers of MS uncertainty estimates. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production', 1.B 'Fugitive emissions from fuels', 2.A 'Mineral products', 2B 'Chemical industry', 2C 'Iron and steel production' and fluorinated gases, 2.E 'Production of halocarbons and SF_6' and 2.F 'Consumption of halocarbons and SF_6'. In 2005, the EC internal review was carried out for the first time. In this pilot exercise two Member States experts reviewed the source categories 1A2 'Manufacturing industries' and 1A3 'Transport'.

UNFCCC reviews

In addition, European Community QA procedures aim to build on the issues identified during the independent UNFCCC inventory review of Member States' inventories. Quality assurance procedures based on outcomes of the UNFCCC inventory review consist of the:

(a) Annual compilation of issues identified during the UNFCCC inventory review related to sectors, key source categories and the major inventory principles transparency, consistency, completeness, comparability and accuracy for all Member States;

(b) Identification of major issues from the compilation and discussion of ways to resolve them in Working Group 1 under the Climate Change Committee, including identification and documentation of follow-up actions that are considered as necessary within Working Group 1;

(c) Reviews of the extent to which issues identified through this procedure in previous years have been addressed by Member States;

(d) Ongoing investigations of ways to produce a more transparent inventory for the unique circumstances of the European Community.

Improvement plan

Based on the findings of the UNFCCC reviews, the EC internal review and other recommendations the improvement plan for the EC GHG inventory is compiled before the annual compilation process starts. After the finalisation of the annual EC GHG inventory it is evaluated if the improvements planned have been implemented.

1.6.2 Overview of quality assurance and quality control procedures in place at Member State level

As the EC GHG inventory is based on the annual inventories of the EC Member States, the quality of the EC inventory depends on the quality of the Member States' inventories and their QA/QC procedures. The following Tables 1.14 and 1.15 give an overview of QA/QC procedures in place for the EU-15 Member States and the new Member States at Member State level. The information is taken from the Member State national inventory reports 2007, 2008 and 2009.

Table 1.14 Overview of quality assurance and quality control procedures in place for EU15 MS at Member State level (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Austria	A Quality Management System (QMS) has been designed and implemented to fulfil all requirements of good practice. Since 2006, the unit in the Umweltbundesamt responsible for inventory preparation is accredited according to the Standard ISO/ICE 17020 General Criteria for the operation of various types of bodies performing inspections as "Inspection Body for Emission Inventories". This standard takes into account standards regarding a QMS as set out in the EN/ISO 9000 series and goes beyond: it also provides a clear statement of requirements regarding competence and independence; impartiality, integrity and confidentiality Within the inventory system specific responsibilities for the different emission source/sink categories ("sector experts") are defined. Sector experts collect activity data, emission factors and all relevant information needed for finally estimating emissions. The sector experts are also responsible for the choice of methods, data processing and archiving and for contracting studies, if needed. As part of the quality management system the head of the "Inspection body for GHG inventory" approves the methodological choices. Finally, sector experts perform Quality Assurance and Quality Control (QA/QC) activities. The Austrian Inventory is based on the SNAP nomenclature and has to be transformed into the UNFCCC Common Reporting Format to comply with the reporting obligations under the UNFCCC. In addition to the actual emission data, the background tables of the CRF are filled in by the sector experts, and finally QA/QC procedures as defined in the inventory planning process are carried out before the data are submitted to the UNFCCC. As part of the QMS documentation and archiving procedures a reliable data management system has been established to fulfil the data collecting and reporting requirements. This ensures the necessary documentation and archiving for future reconstruction of the inventory and consequently enables easy access to up-to-date and previously submitted data for the quantitative evaluation of recalculations. As part of the QMS an efficient process is established to grant transparency when collecting and analyzing findings by UNFCCC review experts or any other issues concerning the quality of activity data, emission factors, methods and other relevant technical elements of inventories. Any findings and discrepancies are documented; responsibilities, resources and a time schedule are attributed to each of these in the improvement plan.	Austria's Annual Greenhouse Gas Inventory 1990–2007 Jan 2009 pp. 21-22
Belgium	The overall QA/QC responsibilities on the Belgian GHG inventory are carried out at IRCEL/CELINE, the interregional cell for the environment which is the national inventory agency responsible for international obligations related to air emissions reporting. As a consequence, the quality and assurance controls already carried out within the responsible regions, are supplemented by the QA/QC performed to the national Belgian inventory. After completion of the Belgian greenhouse gas emission inventory by IRCEL/CELINE, the regions and IRCEL/CELINE carry out further quality control checks of the national inventory before the official submission takes place. IRCEL/CELINE is the final responsible for the national inventory, and any change at this stage is conducted only by IRCEL/CELINE, after co-ordination with the relevant regional contacts. Independent audits of the greenhouse gas inventories of the regions and the national inventory have started in the course of 2002 and results became available in 2003. The results of these audits of greenhouse gases inventories showed clearly that the Belgian national inventory is of qualitative good value. Technical working groups are set up since the beginning of 2003 to investigate in detail the implementation of the Good Practice Guidance for the different sectors in Belgium and to harmonise the three regional emission inventories in Belgium as much as possible. All three regions perform their own QC procedures, however Flanders may be the most advanced in documenting and certifying those procedures. Quality control: Completeness: It is the task of IRCEL/CELINE, as the national inventory agency, to identify and keep a detailed record of all sources in Belgium. Its duty is to fill in all necessary "notation keys" for all source categories with no regional estimate on the basis of information provided by the regions and to submit the records to the regions for explanations and approval. The national inventory agency keeps then a written track of all explanations given. Consistency: QC procedures are developed and applied in the three regions. At the national level, the aim is to fully implement them for the key sources from the 2009 submission and on. IRCEL/CELINE, the national inventory agency, is responsible for checking time-series consistency on the national inventory, through trend analysis on emission estimates, activity variables and emission factors. Checks are performed and formalized archiving has to be further developed. Regions are responsible for checking time-series consistencies on their regional inventory, through trend analysis on emission estimates, activity variables and emission factors. Checks are already performed but are not yet fully documented and archived Comparability: The responsibility of IRCEL/CELINE is to identify inconsistencies between regional estimates. The work is primarily focused on the national key sources in order to make the most efficient use of available resources. Transparency: Methods and data are systematically documented to facilitate replication and evaluation of the inventory by users and reviewers. More detailed description of methodologies and activity data was included in the 2008 NIR. Accuracy: As a basis, Tier 1 QC checks are applied at both regional and national levels.	QA/QC PLAN of the Belgian national system for the estimation of anthropogenic GHG emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol Oct 2008 pp. 7-14

MS	Description of the national QA/QC activities	Source
Denmark	The Quality Control (QC) and Quality Assurance (QA) plan for greenhouse gas emission inventories performed by the Danish National Environmental Research Institute is in accordance with the guidelines provided by the UNFCCC (IPCC, 1997), and the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000). The ISO 9000 standards are also used as important input for the plan. The quality planning is based on the following definitions as outlined by the ISO 9000 standards as well as the Good Practice Guidance (IPCC, 2000): • Quality management (QM) Coordinates activity to direct and control with regard to quality. • Quality Planning (QP) Defines quality objectives including specification of necessary operational processes and esources to fulfil the quality objectives. • Quality Control (QC) Fulfils quality requirements. • Quality Assurance (QA) Provides confidence that quality requirements will be fulfilled. • Quality Improvement (QI) Increases the ability to fulfil quality requirements. The QA/QC work is supported by an inventory file system, where all data, models and QA/QC procedures and checks are stored. The QA/QC plan will continuously improve these activities in the future. The Danish Quality Concept foresees quality management, quality planning, quality control, quality assurance and quality improvement. The strategy for process-oriented QC is based on setting up a system for the process of the inventory work. In the Danish Annual EC Greenhouse Gas Report 2009: Inventories 1990-2007 it is stated that theQA/QC programme has not been changed.	Denmark's National Inventory Report 2009, Apr 2009, Section 1.6
Finland	The quality management system is an integrated part of the national system. It ensures that the greenhouse gas inventories and reporting are of high quality and meet the criteria of transparency, consistency, comparability, completeness, accuracy and timeliness set for the annual inventories of greenhouse gases. Statistics Finland has the overall responsibility for the GHG inventory in Finland including the responsibility for co-ordinating the quality management measures at the national level. Statistics Finland compiles and approves the inventory and submits it to the UNFCCC Secretariat and to the European Commission. As a national statistical office Statistics Finland and its Greenhouse gas inventory unit are committed to quality. The quality framework based on the European Statistics Code of Practice and Statistics Finland's Guidelines on Professional Ethics supports the GHG inventory quality management. The expert organisations contributing to the production of emission or removal estimates are responsible for the quality of their own inventory calculations. The quality co-ordinator steers and facilitates the quality assurance and quality control (QA/QC) process, and experts of all calculation sectors implement and document the QA/QC procedures. The inventory working group that consists of participants from all institutes involved in the inventory preparation has been established to advance communication between the inventory unit and the expert organisations in charge of the different sectors. Issues related to QA/QC are discussed in the meetings of the inventory working group and in the bilateral quality meetings between the inventory unit and the expert organisations. An electronic quality manual including e.g. guidelines, plans, templates and checklists is in place and available to all parties of the national inventory system via the Internet. Statistics Finland bears the responsibility for archiving the quality manual and for submissions of annual inventories (CRF tables and NIR). Expert organisations contributing to the sectoral calculation archive the primary data used, internal documentation of calculations and sectoral CRF tables. Statistics Finland co-ordinates the participation of the partners of the national system in the reviews, as well as responses to issues raised by the reviews of the UNFCCC Secretariat. The quality objectives and the planned QC and QA procedures are recorded as the QA/QC plan. The QA/QC plan is a checklist that specifies the QC and QA actions, the schedules for the actions and the responsibilities.The QA/QC plans are written in Finnish. The QA/QC plans are part of the electronic quality manual of the inventory and archived according to the inventory unit's archive formation plan. Quality objectives and QA/QC plans are updated yearly in the spirit of continuous improvement. The QC procedures in use in the Finland´s GHG inventory comply with the IPCC good practice guidance. General inventory QC checks (IPCC GPG 2000, table 8.1 and IPCC GPG LULUCF 2003, table 5.5.1) include routine checks of the integrity, correctness and completeness of data, identification of errors and deficiencies and documentation and archiving of inventory data and quality control actions. In addition to general QC checks, category-specific QC checks including technical reviews of the source categories, activity data, emission factors and methods are applied on a case-by-case basis focusing on key categories and on categories where significant methodological and data revisions have taken place. Results of the QC checks are recorded in internal documents for the calculation and archived in the expert organisations. The quality assurance (QA) activities recorded in the QA/QC plan are performed at the inventory evaluation stage. QA reviews are performed after the implementation of QC procedures to the finalised inventory. The inventory QA system comprises reviews and audits to assess the quality of the inventory and the inventory preparation and reporting process, to determine the conformity of the procedures taken and to identify areas where improvements could be made ISO 9001 certification of the inventory quality management system is under consideration.	GHG Emissions in Finland 1990-2007 National Inventory Report to the European Union Draft Jan 2009 pp.26-30

MS	Description of the national QA/QC activities	Source
France	The national system of emission inventory is established by integrating the usual criteria applicable to quality systems (Systèmes de Management de la Qualité, SMQ). The CITEPA, which has the responsibility of carry out the technical level the national emission inventories set up such a system based on the ISO9001- version 2000. This provision is confirmed by the certificate issued by the AFAQ in 2004. The realization of the national emission inventories is covered by the SMQ through several specific processes set down in the quality manual unpublished. Within this framework, several processes relating to QA/QC of the inventories are integrated in the various processes and procedures implemented, corresponding to the various phases and actions. The global objective of QA/QC is to support the realisation of national inventories and to be conform with the of different national and international requirements by SNIEPA. The set criteria are completeness, accuracy, consistency, comparability, transparency, timeliness and confidentiality. Quality control is integrated in different phases. CITEPA is responsible for the technical coordination and the compilation of the inventory and required to follow quality control procedures, formulate recommendation for improvement and develop the necessary procedures. This corresponds to the accuracy of information, the conformity of methods, adequacy of tools and the format of communication. There are different ways to check these, e.g. check-list, simulation. Quasi all requirements outlined in the Good Practise Guidance are realised. Quality Assurance is assured by reviews, comments and public evaluations. The specific action to assure quality are listed in the NIR.	Inventaire des émissions de gaz à effet de serre en France de 1990 à 2007 Mar 2009, pp.29-31
Germany	The quality system "Qualitässystem Emissionsinventare" (QSE) is built on the requirements of the IPCC Good Practise Guidance (defined in chapter 8), the national requirements in Germany and the internal Structure within Umweltbundesamt (the national Coordination Centre for GHG inventory compilation). QSE covers all steps of the inventory preparation. It was made bindig within Umweltbundesamt by means of the UBA-Hausanordnung 11/2005 (a regulatory framework). QSE regulates responsibilities within the QA/QC system. The quality control checks for Tier 1 (pursuant paragraph 14 (g) of the Guidelines for National Systems) were carried out for 2006 reporting the first time. They were sent as QC check lists to the experts together with the request for data.The minimum requirements according to the QA/QC system for implementation, description and documentation of the QA/QC measures are carried out together with the respective contribution to the inventory. A general description of quality aims is given in the QSE-Handbook (derived from the IPCC Good Practise Guidance). According to the requirements for the IPCC GPG and Paragraph 12 (d) of the Guidelines for National Systems the necessary QA/QC activities should be summarised in a QA/QC plan. The QA/QC plan is combined with the checklist for QA/QC. For 2008 reporting the checklists for sectoral experts were improved. Thus, both the QA/QC plans and QA/QC checklists are an instrument for the inspection of the fulfilment of the international requirements and allow for control over the quality of the inventory. In the quality improvement plan potential for improvement and findings from the independent inventory review are documented. Data are documented in a central archive. Either data are stored in the central archive directly or if for a given reason (e.g. confidentiality of the data) data is not stored in the central archive reference is given to place were the data is stored.	Nationaler Inventarbericht Zum Deutschen Treibhausgasinventar 1990 - 2007 Apr 2009 pp. 62-67 (submitted in German, translated)
Greece	A QA/QC system is being implemented since April 2004. It has been developed by the previous technical consultant (NOA) and is still being used by the National Technical University of Athens. A revision of the system was performed in May 2008, according to the experience gained from 2008 and 2009 submission, resulting in the current version 1.2. The supervision of QA/QC system is performed by the Ministry for the Environment, Physical Planning and Public Works. The system is based on the ISO 9001:2000 standard and its quality objectives, as stated in the quality management handbook, are the following: Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals. Continuous improvement of GHG emissions/removals estimates. Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements. The accomplishment of the above-mentioned objectives can only be ensured by the implementation of the QA/QC procedures included in the plan for: data collection and processing applying methods consistent with IPCC Good Practice Guidance and LULUCF Good Practice Guidance for calculating / recalculating emissions or removals, making quantitative estimates of inventory uncertainty, archiving information and record keeping and compiling national inventory reports The QA/QC system developed covers the following processes QA/QC system management, comprising all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the quality objectives. Quality control that is directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choice in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. Archiving inventory information, comprising activities related to centralised archiving of inventory information and the compilation of the national inventory report. Quality assurance, comprising activities related to the different levels of review processes including the review of input data from experts, if necessary, and comments from the public Estimation of uncertainties, defining procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory Inventory improvement, that is related to the preparation and the justification of anyrecalculations made. All the procedures described there, are followed by both the Ministry for the Environment, Physical Planning and Public Works and the National Technical University of Athens staff members. Furthermore, internal audits took place by Ministry for the Environment, Physical Planning and Public Works/National Technical University of Athens between September and November of 2008 and an audit by an independent local expert is scheduled early in 2009.	Greece – Information under Article 3(1) of the Decision 280/2004/ EC, Jan 2009, pp.19-20

MS	Description of the national QA/QC activities	Source
Ireland	In early 2005, the inventory agency in Ireland commissioned a project with UK consultants to establish formal QA/QC procedures in emission inventories that would meet the needs of the UNFCCC reporting requirements. The project developed a QA/QC system including a documented QA/QC plan and procedures along with a QA/QC manual. The manual provides a general overview to the QA/QC system and guidance on the application of the plan and procedures. The QA/QC plan identifies the specific data quality objectives related to the principles of transparency, consistency, completeness, comparability and accuracy required for Ireland's national inventory and provides specific guidance and documentation forms and templates for the practical implementation of QA/QC procedures. The QA/QC procedures cover such elements as data selection and acquisition, data processing and reporting so that the international requirements under the Kyoto Protocol and Decision 280/2004/EC are met. The manual provides guidance and templates for appropriate quality checking, documentation and traceability, the selection of source data and calculation methodologies and peer review and expert review of inventory data and outlines the annual requirements for continuous improvement for the inventory. The inventory agency used the 2006 reporting cycle to begin implementation of the basic elements of the new approach to QA/QC and its application was substantially completed in delivering the 2007 submission. The system facilitates record keeping related to the chain of activities from data capture, through emissions calculations and checking, to archiving and the identification of improvements. Ireland's calculation spreadsheets in all sectors have been restructured and reorganised to facilitate the QA/QC process and to facilitate more efficient analysis and to ensure ease of transfer of the outputs to the CRF Reporter Tool. This facilitates rapid year-on-year extension of the time-series and efficient updating and recalculation, where appropriate, in the annual reporting cycle. Internal aggregation to various levels corresponding to the CRF tables provides immediate and complete checks on the results. External reviews of the agriculture sector and of the entire ETS results for 2005 were conducted as important new components of quality assurance at the beginning of 2007. Inventory development continues to benefit from the internal review procedures that are ongoing with regard to the EU and its Member States.	Ireland National Inventory Report 2009,GHG emissions 1990-2007 reported to the UNFCCC Mar 2009 pp.16
Italy	ISPRA has elaborated an inventory QA/QC plan which describes specific QC procedures to be implemented during the inventory development process, facilitates the overall QA procedures to be conducted, to the extent possible, on the entire inventory and establishes quality objectives. Particularly, an inventory QA/QC procedures manual has been drawn up which describes QA/QC procedures and verification activities to be followed during the inventory compilation and helps in the inventory improvement. Quality control checks and quality assurance procedures together with some verification activities are applied both to the national inventory as a whole and at sectoral level. Future planned improvements are prepared for each sector, by the relevant inventory compiler. Each expert identifies areas for sectoral improvement based on his own knowledge and in response to inventory UNFCCC reviews and other kind of processes. Checklists are compiled annually by the inventory experts and collected by the QA/QC coordinator. These lists are also registred in the 'reference' database. General QC procedures also include data and documentation gathering. Specifically, the inventory analyst for a source category maintains a complete and separate project archive for that source category; the archive includes all the materials needed to develop the inventory for that year and is kept in a transparent manner. All the information used for the inventory compilation is traceable back to its source. The inventory is composed by spreadsheets to calculate emission estimates; activity data and emission factors. Particular attention is paid to the archiving and storing of all inventory data, supporting information, inventory records as well as all the reference documents. After each reporting cycle, all database files, spreadsheets and official submissions are archived as 'read-only' mode in a master computer. Quality assurance procedures regard some verification activities of the inventory as a whole and at sectoral level. The inventory is presented to a Technical Committee on Emissions (CTE), coordinated by the Ministry for the Environment, Land and Sea, where all the relevant Ministries and local authorities are represented; within this task emission figures and results are shared and discussed. Moreover, at European level, voluntary reviews of the European inventory are undertaken by experts from different Member States for critical sectoral categories. The only official review, apart from those by the UNFCCC, was performed by Ecofys, in 2000, in order to verify the effectiveness of policies and measures undertaken by Italy to reduce GHG emissions to the levels established by the Kyoto Protocol. In this framework an independent review and checks on emission levels were carried out as well as controls on the transparency and consistency of methodological approaches. Comparisons between national activity data and data from international databases are usually carried out in order to find out the main differences and to find explanations to the differences Comparisons between emission estimates from industrial sectors and those published by the industry itself in the Environmental reports are carried out annually in order to assess the quality and the uncertainty of the estimates.	Italian Greenhouse Gas Inventory 1990-2007 National Inventory Report 2009, April 2009, pp.31-35
Luxembourg	As regards quality control, it is worth noticing that Luxembourg has not yet developed a fully operational QA/QC system. However, for verification of the country-specific emission factors the default emission factors of the Revised 1996 IPCC Guidelines for National Greenhouse gas Inventories have been used.	National Inventory Report 1990-2004, May 2007 p.7

MS	Description of the national QA/QC activities	Source
Netherlands	The QA/QC activities generally aim at a high-quality output of the emissions inventory and the National System; these are in line with international QA/QC requirements. Up to and including 2008, PBL maintained an ISO 9001/2000 certification. After December 31st, 2008, PBL will no longer apply for prolongation of this certificate, but use its own quality management system, following the INK guidelines. In practice this will not have much impact on the quality checks and -assurance within PBL. As part of this system PBL will periodically contract consultants to assess the implementation of its quality system and the INK guidelines As part of its National System, the Netherlands has developed and implemented a QA/QC programme. This programme is yearly assessed and updated, if needed. Monitoring protocols were elaborated and implemented in order to improve the transparency of the inventory (including methodologies, procedures, tasks, roles and responsibilities with regard to inventories of greenhouse gases). Transparent descriptions and procedures of these different aspects are described in the protocols for each gas and sector and in process descriptions for other relevant tasks in the National System. The protocols are assessed annually and updated if needed. Inconsistencies in the key category analysis between CRF and NIR were analyzed and removed The ERT recommended providing more information in the NIR report and protocols, that was until now only included in background information. The Netherlands is preparing a update of the protocols; for various sectors this implies that more information will be included in the protocols, as requested by the ERT. This update will be finalized before the NIR 2010. The ERT recommended providing more specific information on sector specific QC activities. A start has been made; this will be further expanded in the NIR 2010 Finally, the Netherlands continues its efforts to include the correct notation keys in the CRF files • General QC checks are performed. To facilitate these general QC checks, a checklist was developed and implemented. A number of general QC checks have been introduced as part of the annual work plan of the PRTR and are also mentioned in the monitoring protocols. • The QC checks included in the work plan, aim at covering issues as consistency, completeness and correctness of the CRF data, among others. • The general QC for the present inventory is largely performed in the PRTR, as an integrated part of the working processes. The PRTR task forces fill in a standard-format database with emission data for 1990–2007. After a first check of the emission files by PBL and TNO for completeness, the (corrected) data are available for the specific task force for checking consistency checks and trend analysis (comparability, accuracy). The task forces have access to information about the relevant emissions in the database. • Several weeks before the dataset is fixed, a trend verification workshop is planned Quality Assurance for the current NIR includes the following activities: A peer and public review on the basis of the draft NIR in January/February 2009. In preparing this NIR, the results of former UNFCCC reviews, including the results of the initial review in 2007 and the review of the NIR 2007 and NIR 2008 in September 2008 have been taken into account to the extent possible As part of the evaluation process of the previous cycle, internal audits were performed through SenterNovem on the use of the protocols and the implementation of QC checks. This year protocols in the 'waste sector' were given special attention and some recommendations on improving transparancy and background information were provided Archiving and documentation: internal procedures are agreed upon for general data collection and the storage of fixed datasets in the PBL database, including the documentation/archiving of QC checks.To improve transparency, the implemented checklists for QC checks have been documented and archived. As part of the QA/QC plan the documentation and archiving system has been further upgraded. SenterNovem (NIE) maintains the national system website and a central archive of relevant national system documents.	Greenhouse Gas Emissions in the Netherlands 1990-2007 National Inventory Report Jan 2009 p. 16-20
Portugal	A Plan for QA/QC has been developed. The Institute for the Environment is the national responsible entity for the Quality Assurance and Quality Control System of the inventory. The conceptualization of the system has been developed under an external consultancy with "Ecoprogresso". The QA/QC system is an integral part of the National System for the Inventory of Emission by Sources and Removal by Sinks of Air Pollutants (SNIERPA). It includes three technical instruments Quality Control and Quality Assurance System (SCGQ) Methodological Development Programme (PDM) Integrated Management System (SIGA) The SCGQ is composed of a Quality Control and Quality Assurance Programme and a Procedures Manual. The first schedules the application of the general (QC1) and specific (QC2) Quality Control as well as Quality Assurance (QA) procedures, described in detail in the manual. The procedures were defined according to Good Practice and Uncertainty Management Guide (IPCC, 2000) and adapted to the specific National Inventory (INERPA) characteristics. Quality Control tier 1 procedures defined in the QA/QC Manual include a series of checklists, which consider basic checks on the accuracy of data acquisition processes (including, e.g, transcription errors) and checks on calculation procedures, data and parameters. It includes also cross-checking among subcategories in terms of data consistency, verification of NIR and CRF tables. Documentation and archiving procedures include checks on information handling which should enable the recalculation of the inventory. QC tier 2 procedures, on the other hand, include technical verifications of emission factors, activity data and comparison of results among different approaches.	Short Portuguese National Inventory Report on Greenhouse Gases, 1990-2007 Jan 2009, pp. 12-13

MS	Description of the national QA/QC activities	Source
Spain	The plan for quality control and assurance is an internal document with the aim to improve the inventory. The quality control and assurance plan is revised periodically and adopted to changes in the procedures of inventory preparation. The objectives of the quality assurance and control plan are Timeliness: to reach this target a time schedule for specific tasks and respective check points are established Completeness Consisitency: A parameter or variable is only introduced once in the data base. This assures that a parameter that is used several times in the inventory is always the same. Consistency of time series is achieved by subjecting primary data to quality control. Outliers in the time series are identified and checked. Comparability: The Spanish Inventory should be comparable with inventories from other countries. To achieve this goal definitions and nomenclature are based on SNAP and CRF. Accuracy: Priority for the use of methods of higher tier is given to key categories Transparency: The reproducibility of the inventory should be granted. For this aim processes that generate emissions, the variables of activities and their origins, the algorithms and emission factors and the estimated emissions are documented in SNAP format. Improvement of the inventory. DGCEA as single national entity of the NIS is responsible for the quality control and quality assurance system. For this task DGCEA receives technical assistance from AED-NDS-TWOBE.	Inventario de Emisiones de gases de efecto invernadero de España, años 1990-2007 Mar 2009, Sec. 1.6 (submitted in Spanish, translated)
Sweden	The Swedish Environmental Protection Agency (Swedish EPA) is responsible for the QA/QC plan for the inventory. The national GHG emissions are compiled by the Swedish Environmental Emission Data (SMED). Other contractors are also involved in the inventory preparations process. The QA/QC plan consists of quality procedures and checklists specified for each reporting CRF-code (or group of codes). The plan is updated annually and lists all quality control steps that must be undertaken during inventory work (Tier 1 and where appropriate Tier 2). The QA/QC plan also includes descriptions of roles and responsibilities, of databases and models and documented procedures for uncertainty and key source analysis, as well as procedures for handling and responding to UNFCCC´s review of the Swedish inventory. The QA/QC plan handles follow-up and improvement by collection of improvement needs from all stages of the annual inventory cycle. This results in a planning document, which is used as a basis for planning and selecting further actions to improve the inventory. Quality assurance: Key sources should be subject to external peer review according to the Tier 2 of the GPG. The new QA/QC system includes national peer reviews by sectoral authorities. The peer reviews include methodology and emissions factors used, as well as comparisons of activity and emission data with other national statistics. The reviewers also identify areas of improvement, which consolidates the basis for improvements in coming submissions. In Sweden's National Inventory Report 2009, general Tier 1 QC measures according to Table 8.1 in IPCC Guidelines and source specific Tier 2 QC measures have been carried out. All QC measures performed are documented in QC checklists for each CRF code or group of codes. After completion of the initial compilation of the inventory, a QC-team reviews all QC checklists. When the reporting tables and the NIR are completed, a quality coordinator performs a final quality control before delivery of the inventory to the Swedish EPA.	National Inventory Report 2009 Sweden Jan 2009 pp.33-35
United Kingdom	The National Atmospheric Emissions Inventory and the UK Greenhouse Gas Inventory are compiled and maintained by AEA, part of AEA Technology plc. The data compilation and reporting for some source sectors of the UK inventory are performed by other contractors (i.e. North Wyke compile the agriculture sector, CEH compile the land use, land use change and forestry sector), but AEA Energy and Environment is responsibleor co-ordinating inventory-wide QA/QC activities. UK emission estimates are prepared via a central database of activity data and emission factors. Numerous QA/QC procedures are built into the data processing system.These include checks before data are entered into the national database of GHG emissions, and when data are extracted from the database. The database contains activity data and emission factors for all the sources necessary to construct the UK GHG inventory. The Inventory has been subject to ISO 9000 since 1994 and is now subject to BS EN ISO 9001:2000. It is audited by Lloyds and the AEA Technology internal QA auditors. The NAEI has been audited favourably by Lloyds on three occasions in the last ten years. The emphasis of these audits was on authorisation of personnel to work on inventories, document control, data tracking and spreadsheet checking, and project management. As part of the Inventory management structure there is a nominated officer responsible for the QA/QC system – the QA/QC Co-ordinator. **Documentation:**Source data received by AEA are logged, numbered and are traceable back to their source from anywhere in the system, using a contacts database, spreadsheet notes and automated system of data referencing within the main NAEI database of activity data and emission factors; **Checking:** AEA's QA/QC system requires that spreadsheet calculations are checked and the checks applied are described. Also the data sources used for calculations must be referenced on the spreadsheet. All spreadsheets are subject to second-person checking prior to data uploading to the NAEI database. Mass balance checks are made to ensure that the total fuel consumptions in the GHG inventory are in accordance with those published in the official UK Energy Statistics from the DBERR. Database output comparisons between different inventory cycles enable the investigation of the effects of recalculations and help identify any data processing errors. A final check is made on the inventory comparing the emissions of the latest year with those of the previous year (within the same version), and a complete time-series check is also conducted for selected key sources. **Recalculations:** Where changes are made to inventory estimation methodologies, or where source data are revised or errors in previous inventories identified, then the full time-series of emissions are recalculated. **Archiving:** At the end of each reporting cycle, all the database files, spreadsheets, on-line manual, electronic source data, paper source data, output files are in effect frozen and archived. An annual report outlining the methodology of the inventory and data sources is produced. Electronic information is stored on hard disks that are regularly backed up. Paper information is also archived. During 2002, the UK implemented a programme of peer reviews by experts outside of the organisation responsible for the estimates. Recommendations from this Peer Review have now been implemented.The second Peer Review on agriculture was carried out in March 2005.	GB Short NIR, Feb 2009 pp. 21-28

Table 1.15 Overview of quality assurance and quality control procedures in place for the new MS at Member State level (NIR descriptions)

MS	Description of the national QA/QC activities	Source
Bulgaria	To assure the quality of information reported to UNFCCC and UNECE, the Minister of Environment and Water has issued an ordinance, regulating the activities related to elaboration and submission of reports to the European Commission and European Environment Agency, the Secretariat to Convention of Long-Range Transboundary Air Pollution (CLRTAP), and the UNFCCC Secretariat. The quality monitoring of the GHG Inventory and the National Inventory Report shall take place in conformity with the following order: The Directorates within the Ministry of Environment and Water – "Climate Change Policy Department", "Air Protection Directorate" and Directorate "Environment Monitoring" within the Environment Executive Agency – declare their expert positions, containing data evaluation from the processed inventory and/or the calculations made. When necessary, the above listed Directorates present proposals for supplementations and/or rectifications The Inventory and/or the calculations, shall be presented to the attention of at least two independent experts. Each organization (data source) solves the quality management issues in accordance with its internal rules and provisions. With some of the sources as the National Statistical Institute, the Statistics Department within Ministry of Agriculture and Food Supplies, etc., those rules follow strictly the international practices. For example, quality assessment/quality control procedures with the National Statistical Institute have been harmonized with the relevant instructions and provisions of EUROSTAT. Strict rules on data processing and storage have been harmonized with international organizations. Some of the large enterprises (GHG emission sources) have well arranged and effective quality management systems. Most of them have introduced quality management systems on the basis of ISO 9001:2000 standard.	Short National Inventory Report of Greenhouse Gas Emissions in Republic Bulgaria 1988-2007 Jan 2009 pp.4
Cyprus	The QA/QC system has been developed on the basis of the IPCC guidelines. The quality objectives used are the following: • Compliance with the IPCC guidelines and the UNFCCC reporting guidelines while estimating and reporting emissions/removals; • Continuous improvement of GHG emissions/removals estimates; • Timely submission of necessary information in compliance with relevant requirements defined in international conventions, protocols and agreements. The QA/QC system developed covers the following processes: • QA/QC system management, comprising all activities that are necessary for the management and control of the inventory agency in order to ensure the accomplishment of the above-mentioned quality objectives. • Quality control that is directly related to the estimation of emissions. The process includes activities related to (a) data inquiry, collection and documentation, (b) methodological choices in accordance with IPCC Good Practice Guidance, (c) quality control checks for data from secondary sources and (d) record keeping. • Archiving of inventory information, comprising activities related to centralized archiving of inventory information and the compilation of the national inventory report. • Quality assurance, comprising activities related to the different levels of review processes including the review of input data from experts if necessary, and comments from the public. • Estimation of uncertainties, defining procedures for estimating and documenting uncertainty estimates per source / sink category and for the whole inventory. • Inventory improvement, that is related to the preparation and the justification of any recalculations made. Data provided by the Statistical Service of Cyprus is characterised by independence, integrity and accountability. Hence, these data are not subjected to any checking.	National Inventory Report 2007 2009 Submission Apr 2009 p. 11

MS	Description of the national QA/QC activities	Source
Czech Republic	The national GHG inventory is a part of client processes provided by the Czech Hydrometeorological Institute that are in compliance with the quality standard ISO 9001 (the Czech Hydrometeorological Institute obtained this certificate in 2007). **Quality control procedures (QC)** QC is designed to provide routine technical checks to measure and control the quality of the inventory, to ensure consistency, integrity, correctness, and completeness of the data and to identify and address errors and omissions. Its scope covers a wide range of inventory processes, from data acquisition and handling and application of the approved procedures and methods to calculation of estimates and documentation. These procedures are performed according to the IPCC Good Practice Guidance, 2000 (GPG). QC procedures are carried out both by sectoral compilers and by the NIS manager. Sectoral compilers concentrate more on activity data and the sector-specific methods used; the NIS manager mostly checks appropriate use of methodologies, provides trend analyses and compares data from other possible sources. After completing the sectoral inventories, the NIS manager performs a final detailed check. In accordance with GPG, all the described procedures correspond mainly to the Tier 1 QC approach. The Tier 2 approach has so far been used only in some specific cases (e.g. in the transport sub-sector, where activity data based on energy statistics are combined with activity data based on transport statistics). Appropriate use of EFs is discussed in a similar way. **Quality assurance procedures (QA)** QA generally consists of independent third-party review activities to ensure that the inventory represents the best possible estimates of emissions and removals and to support the effectiveness of the QC program. Experts from the Slovak Hydrometeorological Institute (responsibility for the GHG inventory in Slovakia) are occasionally invited to check certain part of the Czech inventory. Moreover, sectoral compilers are recommended to find suitable experts to perform QA. As part of the approval process, the MoE also reviews the draft of the GHG inventory. All the procedures are recorded and archived. The results of reviews, together with the findings of the review process performed by an international review team organized by UN FCCC, are utilized in the process of inventory planning for the coming years. The relevant findings are analysed by the NIS manager in cooperation with the sectoral compilers to eliminate possible omissions and imperfections. The Czech inventory team, taking into account the recommendations of the previous review, recognized that sectoral (sector-oriented) QA/QC procedures described in latest NIR should be improved. Therefore the team increased its attention on QA/QC outputs to be more detailed and more specific. For instance, QA procedure of the activity data in the Energy sector will be performed by experts from the Czech Statistical Office. Similarly, the emissions from reducing agents and feedstocks reported under the Industrial processes sector will be compared and harmonized with the emissions from the Energy sector to prevent omission or double counting of the sources. The inventory of mobile sources compiled by the Centre of Transport Research will be checked by our energy experts.	Reporting under the Article 3.1 of Decision No 280/2004/EC Jan 2008 pp. 3-4

MS	Description of the national QA/QC activities	Source
Estonia	All institutions involved in the inventory process ((Estonian Ministry of the Environment) MoE, (Estonian Environment Information Centre) EEIC; (Tallinn University of Technology) TUTand (Estonian Environmental Research Centre) EERC) are responsible for implementing QC procedures to meet the data quality objectives. MoE as the national entity is responsible for overall QC and is in charge of checking on an annual basis that the appropriate QC procedures are implemented internally in TUT, EERC and EEIC. The EEIC has an overall responsibility for QC of the data of the emission inventory. EEIC checks the QC reports of TUT and EERC. When EEIC disagrees with the report then the errors are discussed and changes are made if necessary. Each institution is responsible for reporting on their completion of the QC procedures on an annual basis. This reporting is based on a checklist of general and source-specific QC checks and a textual description of possible recalculations, issues to be followed up before the next submissions, and other relevant information. MoE as the national entity is responsible for the overall QA of the national system, including the UNFCCC reviews and any national reviews undertaken. Also public review is planned for the next cycle. One part of QA is UNFCCC reviews. The reviews are performed by a team of experts (sectoral experts and generalist) from other countries. The review report indicates the specific areas where the inventory is in need of improvements. The sectoral experts send their xml files to the compiler (EEIC) who puts all the sectors together and completes the CRF tables. During that time the numbers are cross-checked in the CRF reporter to make sure that no mistakes were made during the importing process. Also the CRF completeness check is carried out to make sure that all the necessary data is filled. When EEIC has completed the CRF tables, then all data is checked by an independent expert from Tallinn University of Technology. The results of the independent expert will be looked through in collaboration with the experts and EEIC and necessary adjustments will be carried out as a result. All figures on emissions and removals in tables and text are checked to make sure that they are consistent with those reported in the CRF. It is also checked that all methodological changes, recalculations, trends and removals are well explained. Then the sectoral chapters are sent to the compiler who adds the introduction part and puts the draft NIR together. The compiler arranges the different chapters into one uniform document and makes sure that the structure of the report follows the IPCC guidelines. The compiler also double checks the data in the NIR, so that it is consistent with those reported in the CRF. MoE and EEIC, in collaboration with the expert organizations responsible for the inventory calculation sectors, set yearly quality objectives for the whole inventory at the inventory planning stage and designs the QC procedures needed for achieving these objectives. In addition, the expert organizations set their own, sector and/or category specified quality objectives and prepare their QC plans. Estonia's inventory needs to be further developed before it can fulfil the data quality objectives.Estonia is planning a twinning light project in 2009. The project is addressed at improving the implementation of article 3.1 of Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. Potential problems concerning Estonia's Greenhouse Gas Inventory were highlighted during the in-country review of Estonia's Initial Report under the Kyoto Protocol and 2006 Inventory Submission: the status of the legal arrangements, the lack of a quality assurance/quality control plan and the lack of an uncertainty analysis were identified by the UN Review Team as potential problems. All institutions are responsible for archiving the data they collect and the estimates they calculate. But it is necessary to have a central archiving system located at a single location. Estonian Environment Information Centre (EEIC) bears the responsibility of archiving and Estonia's central inventory archive is located there. When the reporting cycle ends and all inventory calculations are finalized all experts send their documentation to the compiler and it is stored in one place.	Greenhouse Gas Emissions in Estonia 1990-2007 Jan 2009 pp. 30-38

MS	Description of the national QA/QC activities	Source
Hungary	QA/QC activities are performed in two levels: based on the ISO 9001 standards and following the IPCC recommendations. **ISO activities:** The Hungarian Meteorological Service introduced the quality management system ISO 9001:2000 in 2002 for the *whole range* of its activities. However, GHG inventory preparation was not among its activities in that time. Therefore, the scope of our ISO accreditation had to be modified and lots of efforts have been made to bring also the national system under the umbrella of the ISO QM system. Several regulatory ISO documents were created. The basic document is the Procedure on the activities of the GHG Division. It contains the basic principles of the inventory preparation and reporting processes, prescribes the obligation of making a QA/QC plan, and regulates the documentation and archiving activities. The QA/QC plan, which is an audited ISO document, consists of the following elements: Specification of the sectoral responsibilities of the core team Nomination of an officer responsible for the QA/QC system: the QA/QC coordinator Documentation Data quality check Reviews Development plan The Hungarian Meteorological Service funds two research projects for the improvement of the inventory Incorporation of ETS data in broader extent for revision of the used EFs and for better sectoral allocation of emissions Training. Having an ISO system in place has an advantage of being subject to regular internal and external audits. During our last external audit the activities of the GHG Division were audited as well. **Other QA/QC activities:** Many elements of the general Tier1 QC procedure are applied. The used parameters and factors, the consistency of data are checked regularly. Completeness checks are undertaken and previous estimates are compared every time. *Activity data:* The major part of the basic data related to key source categories was obtained directly from the plants; therefore, we use the latest and most reliable data. Where such data were not available, those from the Central Statistical Office were used. In order to prepare an inventory of appropriate quality, the data were checked in several ways (e.g., production plant and professional association). The results were controlled by comparing the time series. In order to ensure data accuracy, cross-checks were performed. In response to our request, several data suppliers made declarations as regards quality assurance systems in place during the collection of the data. However, only a few of them could provide factual information on the reliability of the data supplied. *Emission factors:* The emission factors were selected in accordance with the Revised 1996, the GPG and the new 2006 Guidelines. The quality of the inventory has been greatly improved by the use of national factors in a greater extent. *Checking:* The results of the calculations and the implied emission factors are checked and considerable differences, if any, are revised again. The modifications and improvements from the previous year are documented and recorded in the NIR. The work continues to refine the used QA/QC procedures and implement further elements.	NIR for 1985-2007, Hungary (Draft Excerpts) Jan 2009, pp. 20-22

MS	Description of the national QA/QC activities	Source
Latvia	The implementation of Quality Assurance and Quality Control (QA/QC) procedures in the development of national GHG inventory is required by IPCC GPG 2000. According to legislation act No. 157 all institutions involved in inventory process are responsible for implementing QC procedures. Mainly Tier 1 General Inventory Level QC procedures outlined in Table 8.1 of IPCC GPG 2000 are used. As legislation act becamevalid only beginning of 2009 many of determined actions will be implemented for inventory 2010. New legislation act determines: -) the quality objectives for GHG inventory; -) QA/QC plan that has been prepared to improve transparency, comparability, and completeness of GHG inventory. In the QA/QC plan quality control procedures to be used before and during the compilation of GHG inventory are described. -) tasks and responsibilities of involved institutions; -) check-list and procedure description for independent experts for quality assurance of GHG inventory. For submission 2009, many of quality control procedures were done according to LEGMA internal QA/QC program. MoE as national entity is responsible for overall QC procedures and quality assurance of national system, including UNFCCC reviews. LEGMA is responsible for coordination of the whole process of annual greenhouse gas inventory and has an overall responsibility for QC. For submission 2009, QC activities were carried out at the various stages of the inventory compilation process - processing, handling, documenting, cross checking, and recalculations. These activities are implemented by sectoral experts and inventory compiler. QC system includes various activities set to ensure transparent data flow through all inventory process: • Assumptions and criteria for the selection of activity data and emission factors are documented; • Transcription errors in data input and references; • Correctness of calculations of emissions; • Correctness of emission parameters, units, conversion factors; • Integrity of database files; • Consistency in data between source categories. For submission 2009: -)The sectoral experts sent XML files to NIC (LEGMA) who imports all data together in CRF Reporter. NIC performed cross-checking for all sectors to verify that no mistakes occurred during import process as well as CRF completeness and recalculations checks were carried out. -) The sectoral experts prepared relevant chapters of NIR and sent to NIC. NIC prepared NIR according to UNFCCC reporting guidelines. Sectoral experts before sending NIR to NIC checked if all information is consistent with CRF. It is checked if recalculations and methodological changes are explained in NIR. -) Experts in LEGMA prepared quality control procedures by using special check-list according to LEGMA internal QA/QC program. After review the check-lists were sent to relevant experts and NIC. Then findings were introduced in GHG inventory. All these QC forms were archived; -) LSFRI "Silava" checked data according to QC procedures that was outlined in IPCC GPG. MoA reviewed prepared inventory regarding LULUCF. Corrections were sent to NIC and LSFRI "Silava" for including in the inventory; -) For Transport sector quality control was done by LEGMA and MoT. Findings were documented and introduced in emission evaluation. Detailed source specific QA/QC descriptions are included under each sub sector. *Quality assurance procedures implemented* The draft of National inventory report was sent to CSB, MoE, MoA, MoT til 20 of January for checking and approving. Received corrections were implemented in the GHG report. On 28 February the draft EC consistency report of inventory was received. The possible corrections were elaborate in inventory. UNFCCC reviews reports indicated the issues where inventory need of improvements. The possible improvements were elaborate in inventory. The improvement plan for GHG inventory is compiled based on the finding of the UNFCCC, EC, internal reviews and other recommendations. Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process. According to legislation act No. 157 MoE is responsible for ensuring QA procedures for GHG inventory.	MM submission, March 2009

MS	Description of the national QA/QC activities	Source
Lithuania	The Quality Assurance and Quality Control (QA/QC) Plan has been prepared in order to improve transparency, consistency, comparability and completeness of Lithuania's GHG inventory. The QA/QC Plan describes the quality objectives of the GHG inventory, the national system for inventory preparation, tasks and responsibilities. A description is provided of various formal procedures already implemented in the development of the GHG inventory and of planned improvements. The Center for Environmental Policy is responsible for co-ordination and implementation of the Plan. Quality Assurance (QA) activities include planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the quality control (QC) program. Analysts of the inventory must adopt adequate procedures for development and modification of the spreadsheets to minimise emission calculation errors. Checks ensure compliance with the established procedures as well as allow detecting the remaining errors.The analysts must ensure data consistency in the databases and spreadsheets. Confirm that respective data processing steps have been correctly represented in the spreadsheets Confirm that data relations have been properly presented Clearly distinguish between the input data and the calculated data in the spreadsheets The managers of sectors shall present the spreadsheets with the input data, calculation results and descriptions of the respective chapters of the NIR to the Manager of the Inventory and to the Manager of Quality Control. Quality control involves the following: **Evaluation of the data collection procedure, to establish** whether: the necessary methods, activity data and emission factors (i.e. those in conformity withthe IPCC Good Practice Guidance) have been used the calculations have been made correctly all time series data has been provided and calculated the data and results for the current year have been compared with the data and results of the previous years The inventory documentation must be sufficiently comprehensive and clear for independent experts to be able to obtain and review the references used and to restore the emission calculations. Complete and accessible documentation of the methods, data and data sources, spreadsheets, telephone recordings and other data contacts is very important for compilation and provision of a correct and exhaustive inventory. the notes and comments contain all necessary information on the data sources, calculation methods, etc. **Evaluation of the emission calculation, to establish**: consistency of the emission factors used correctness of the emission parameters, units, conversion factors used correctness of the data transferred from spreadsheets to CRF tables correctness of repeated calculations. **Evaluation of the preparation of respective chapters of the National Inventory Report, to establish:** integrity of the structures of the inventory data completeness of the inventory consistency of time series whether the emission estimates have been compared with previous estimates whether the data tables of the National Inventory Report correspond to the text whether all necessary information on the data sources, assumptions and calculation methodology have been provided The results of the check are recorded in a verification-data correction protocol. Inventory data as well as background information on activity data and emission factors are archived by the Center for Environmental Policy. Backups of each year data and supportive material are kept as a separate CD	National GHG Emission Inventory Report 2008 of the Republic of Lithuania, Reported inventory 1990-2007, Dec 2008 pp. 19-23
Malta	A standardized Quality Assurance/Quality Control system within the national inventory system is needed. This need is addressed in the ongoing development of the system in general. A QA/QC system will be developed to ensure the quality and reliability of the activity data, emission factors and emission estimates, in line with the principles of transparency, accuracy, consistency, comparability and completeness. It is important to highlight that in the absence of a standard QA/QC system, an effort has still been made to ensure as high a level of quality and reliability as possible. A priority task has been to ensure that the best available sources of data have been used, especially where these have been verified (for example data on fuel consumption in power generation plants for the most recent years has been derived from verified emission reports that local installations are obliged to submit pursuant to Directive 2003/87/EC4).	National Greenhouse Gas Emissions Inventory Report for Malta 1990 - 2007 Mar 2009, p.13

MS	Description of the national QA/QC activities	Source
Poland	The national entity – National Emission Centre– which is responsible for preparation of GHG inventories, is also responsible for coordination and implementing the QA/QC activities. The National Emission Centre is located in the Institute of Environmental Protection (IEP), and since 2006 included within structure of the National Administrator of Emission Trading System situated in the Institute. Each IPCC sector undergoes detail QC procedure which is carried out firstly by the responsible person for the respective category/subcategory. Further, checks are made by an additional National Emission Centre expert. Depending on methodology used for emission estimation within categories Tier 1 or Tier 2 check procedures are carried out. The extended QC procedure for checking the correctness of emissions estimations is used for these categories where country specific emission factors are established. Source of activity data used for estimation of GHG emissions and removals come mostly from the Central Statistical Office (GUS) and Agency of Energy Market (ARE) undergoing internal revision and checking process of published data. If necessary specific data are collected from collaborating individual experts and research institutions. Additionally to QC procedures conducted as part of Tier 1 for all IPCC categories an extended QC procedure is carried out (Tier 2 methods) for the key categories within such sectors like energy, industrial processes, agriculture and waste. Source category–specific QC procedures include expert personal reviews of activity and emission factor data, and methods especially extensively used for the energy sector responsible for majority of CO_2 emissions in Poland. As a first part of QA procedures external reviewers from R&D Institutes, Branch Associations, Industrial Chambers, individual plants as well as independent experts verify the inventory assumptions and results. The direct contact is initiated for exchanging comments and setting the proper data. The final approval of Polish GHG inventory is made by the Department Global Environmental Problems and Climate Change in the Ministry of Environment. Additional verification for entire inventory results is made using CRF-Reporter as well as NIR files. For archiving procedures and internal documentation associated with particular aspects of inventory preparation, check and reporting the Data Management Manual has been elaborated in National Emission Centre.	Annex to Poland's Report under Art. 3.1.f to the Decision 280/2004/EC, Mar 2008 and Republic of Poland Report for the European Commission fulfilling obligations under Article 3.1 of Decision 280/2004/EC Jan 2009 p.3
Romania	Romania established the QA/QC Procedure based on the UNFCCC and Kyoto Protocol's provisions related to the GHG Inventory and the national system, the IPCC 1996 and IPCC GPG 2000 provisions, and to the Governmental Decision no. 1570/2007 establishing the National System for the estimation of the anthropogenic GHG emissions levels from sources and removals by sinks. QA/QC activities are both described within the QA/QC Programme and within the QA/QC Procedure related to the NGHGI, approved by the NEPA's President Decision no. 24/2009. The documents comprise information on: - the national authority responsible for the coordination of QA/QC activities; - the objectives envisaged within the QA/QC framework; - the QA/QC Plan; - the QC procedures; - the QA procedures According to the provisions of the Governmental Decision no.1570/2007 establishing the national system and to those in the NEPA's President Decision no. 24/2009, NEPA represents the competent authority responsible with the implementation of the QA/QC activities under the NGHGI. For this purpose, NEPA is performing the following activities: - ensures that specific QA/QC objectives are established; - develops and regularly updates a QA/QC plan; - implements the QA/QC procedures Considering the provisions of relevant regulations, NEPA designated a QA/QC coordinator. The overall objective of the QA/QC programme is to develop the NGHGI in line with the requirements of the IPCC 1996, IPCC GPG 2000 and IPCC GPG 2003 and with the provisions of the Decision 280/2004/EC of the European Parliament and of the Council and Decision 166/2005/EC of the European Commission. Romania's QA/QC plan closely follows the definitions, guidelines and processes presented in Chapter 8 – Quality Assurance and Quality Control of the IPCC GPG 2000. The QA/QC plan constitutes the heart of the QA/QC procedures. It outlines the current and planned QA/QC activities. The specific QA/QC activities are performed during all stages of the inventory preparation. The QA/QC plan will be reviewed periodically if needed and can be modified as appropriate when changes in processes occur or based on the advice from independent reviewers. The QA/QC plan is intended to ensure the fulfillment of the NGHGI principles in Romania. The objectives of the plan include: - applying greater QC effort for key source categories and for those source categories where data and methodological changes have occurred recently; - periodically checking the validity of all information as changes in reporting, methods of collection or frequency of data collection occur; - conducting the general procedures outlined in QC procedures (Tier 1) on all parts of the inventory over a complete exercise; - balancing efforts between development and implementation of QA/QC procedures and continuous improvement of inventory estimates; - customizing the QC procedures to the resources available and the particular characteristics of Romania's greenhouse gas inventory; - confirming the national statistical institute and other agencies supplying activity data to NEPA have implemented QC procedures	National Inventory Report of Romania – March 2009

MS	Description of the national QA/QC activities	Source
Slovakia	SNE still tries to improve quality of greenhouse gas emission inventory according to the IPCC 2000 Good Practice Guidelines and IPCC 2005 GPG in LULUCF in accordance with principles of consistency, transparency, comparability, accuracy and in the framework of QA/QC. A draft to improve quality of process of estimating emissions in particular sector is worked out each year. The first analyses of the 2006 IPCC Guidelines and its implications to the accuracy were done during last inventory preparation. Several improvements were implemented in energy, agriculture and waste sector. The Slovak Hydrometeorological Institute is a company which has build and introduced the quality management system according the requirements of the EN ISO 9001:2000 standard of conformity for the following activities: • Monitoring of the determinants characterising the state of air and waters on the Slovak territory. • Assessment, archiving and interpretation of data and information on the state and regime of air and waters. • Providing data and information on the state and regime air and waters. • Study and description of the atmosphere and hydrosphere phenomena. • Education and training within the activity of institute. National experts responsible for inventory compilation collect partial reports, controls, and comments and publish them in the sectoral reports. National expert fills in the database of a used programme module „CRF Reporter“ and provides these data to the UNFCCC and to the European Commission. Extent and requirements for quality management system (QMS) have already been defined and practical application is expected in a short time after completing necessary steps in the area of organisational arrangements and data archiving system. At present a project was completed which was aimed at providing software to archive methodological procedures, database of input and output data in particular IPCC sectors, including the publishing of information in accordance with requirements of 20/CP.7. The emission estimates elaborated for individual sectors by external consultants are controlled and recalculated at the Department of Emissions (Slovak Hydrometeorological Institute). Activity data for major sources are compared with national statistics and with previous year's submitted data (e.g. change in fuel base, respectively fuel quality characters, technology, separation technique, etc.).A quality management system (QMS) has been designed to achieve the objectives of good practice guidance, namely to improve transparency, consistency, comparability, completeness and confidence in national inventories of emissions estimates.	Slovak Republic, National Inventory Report 2009 Apr 2009, pp.29-31

MS	Description of the national QA/QC activities	Source
Slovenia	In 2009 the Republic of Slovenia has developed and mostly implemented a Quality Assurance and Quality Control plan as recommended by IPCC Good Practice Guidelines (IPCC 2000). QA/QC plan is a part of the Manual of Procedures, which has already been elaborated in 2005 and was updated in 2009. In beginning of 2009 a QA/QC manager within the inventory agency has been designated. The general part of this system is incorporated into Oracle database (ISEE – "Emission inventory" information system) which has been established in the end of 2008. The main purpose of ISEE is: • to enable collection and archiving of activity data, emission factors and other parameters including description of sources from 1980 on for other pollutants, and from 1986 on for GHG emissions. • to calculate GHG and other pollutant emissions • to automatically fill in reporting tables (CRF Reporter) During developing of database the following QC have been performed: • Check methodological and data changes resulting in recalculations • Completeness checks • Check of activity data, emission factor and other parameters • Check of emission estimates The QA/QC checks not performed in the database: • Documentation and archiving • Uncertainty QA generally consists of independent third-party review activities to ensure that the inventory represents the best possible estimates of emissions and removals and to support the effectiveness of the QC program. In the past we have performed only one peer-review. In 2006 during preparation of our Forth NC Report, we have got many useful comments from team preparing our Forth National Communication Report. Although those comments were not presented as official report, we have accepted many suggestions and corrected some mistakes. We are planning to make sectoral review of our inventory on the yearly base – each year one sector. In March 2009 the peer review of Slovenian inventory has been performed for energy sector. QA/QC procedures made by other institutions (Slovenian Forestry Institute and Agricultural Institute of Slovenia) are described in the relevant chapters in the NIR (LULUCF, Agriculture). The data based on forest statistics are produced by the Slovenian forestry service, Slovenian forestry institute and Statistical office of Slovenia. Data based on agricultural statistics are mainly from Statistical office of Slovenia and from Agricultural Institute. All data were checked. Statistical Office of Slovenia is our main data provider. In 2005 the European Statistics Code of Practice was adopted what brings considerable changes to SORS QA/QC system. The main pillars (factors) of quality are defined and thoroughly described in the Medium-term Programme of Statistical Surveys 2008-2012 (http://www.stat.si/doc/drzstat/SPSR-ang.pdf). The strategic directions from the Medium-term Programme of Statistical Surveys are in detail presented in the Total Quality Management Strategy 2006-2008 (http://www.stat.si/doc/drzstat/kakovost/TQMStrategy_2006_eng.doc). Approving of the inventory Before inventory is reported to the EU, EEA or UNFCCC Secretariat it going through the process of approving. The institution defined for approval is the Ministry of Environmental and Spatial Planning.	Slovenia's National Inventory Report 2009 Apr 2009 p. 20-22

1.6.3 Further improvement of the QA/QC procedures

One of the most important activities for improving the quality of national and EC GHG inventories is the organisation of workshops and expert meetings under the EC GHG Monitoring Mechanism. In September 2004 a 'Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems' was organised. The Workshop facilitated the exchange of experience of Member States in the implementation of Quality Control (QC) and -Assurance (QA) procedures and the implementation of the National Inventory System. The workshop brought together experts from 17 Member States, the European Commission (DG ENV, JRC), EEA, ETC/ACC and an observer from the UNFCCC secretariat. For details of the workshop see the workshop report available on the website of the ETA/ACC:
http://air-climate.eionet.eu.int/docs/meetings/040902_GHG_MM_QAQC_WS/meeting040902.html

A number of other workshops and expert meetings have been organised in recent years with a focus on sector-specific quality improvements. Table 1.16 lists the most important workshops.

Table 1.16Overview of workshops and expert meetings organised under the EC GHG Monitoring Mechamism

Workshop/expert meeting	Date and venue
Technical workshop on LULUCF reporting issues under the Kyoto Protocol	13-14 November 2008, JRC, Ispra, Italy
Workshop on the implications of the implementation of the 2006 IPCC Guidelines for national GHG inventories	30 - 31 October 2008, EEA, Copenhagen, Denmark
2nd workshop on data consistency between National GHG inventories and reporting under the EU ETS	13-14 September 2007, EEA, Copenhagen, Denmark
Expert meeting on the estimation of CH_4 emissions from solid waste disposal sites with the First Order Decay method	8-9 March 2006, EEA, Copenhagen, Denmark
Workshop on data consistency between National GHG inventories and reporting under the EU ETS	9-10 February 2006, EEA, Copenhagen, Denmark
Training workshop on the use of CRF Reporter for the experts of the European Community	12-13 September 2005, EEA, Copenhagen, Denmark
EU workshop on uncertainties in greenhouse gas inventories	5-6 September 2005, Helsinki, Finland
Workshop on Inventories and projections of greenhouse gas emissions from waste	2-3 May 2005, EEA, Copenhagen, Denmark
Expert meeting on improving the quality of. greenhouse gas emission inventories for category 4D	21-22 October 2004, JRC, Ispra, Italy
Workshop on quality control and quality assurance of greenhouse gas inventories and the establishment of national inventory systems	2-3 September 2004, EEA, Copenhagen, Denmark
Workshop on emissions of greenhouse gases from aviation and navigation	17-18 May 2004, EEA, Copenhagen, Denmark
Enlargement Training Workshop on Emission Inventory Improvement and Uncertainty Assessment	27-28 November 2003, JRC, Ispra, Italy
2003/06/24 Workshop on energy balances and energy related GHG emision inventories	24-25 June 2003, EEA, Copenhagen, Denmark
Workshop on Inventories and Projections of GHG and Ammonia Emissions from Agriculture	27-28 February 2003, EEA, Copenhagen, Denmark

All the workshop reports are available at the website of the EEA/ETC-ACC: http://air-climate.eionet.eu.int/meetings/past_html

1.7 Uncertainty evaluation

The EU-15 Tier 1 uncertainty analysis was made on basis of the Tier 1 uncertainty estimates of the Member States. Uncertainties were estimated for seven sectors 'Stationary fuel combustion', 'Transport', 'Fugitive emissions', Industrial processes', 'Agriculture', 'LULUCF' and 'Waste'. Within these sectors the available MS uncertainty estimates were grouped by source categories. Then for each source category a range of uncertainty estimates was calculated: the lower bound of the range was calculated by assuming that all uncertainty estimates within a source category are uncorrelated; the upper bound of estimates was calculated by assuming that all uncertainty estimates within a source category are correlated. Then a single uncertainty estimate was calculated for each source category based on the assumption that MS uncertainty estimates are correlated if they use Tier 1 methods and/or default emission factors. After having calculated the uncertainty estimates for each source category, the uncertainty estimates for the sectors and for total GHG emissions were calculated.

Estimation of trend uncertainty: The EC uncertainty estimate is rather complicated due to potential correlations between MS uncertainties. Therefore, an analytical method, which allows more flexibility than IPCC Tier 1, was compiled.

Trend in MS n category x was defined as

$$Trend_{n,x} = E_{n,x}(t)-E_{n,x}(0) \qquad (1)$$

Where E(t) denotes emissions in the latest inventory year and E(0) emissions in the base year.

Variance for each MS and source category was calculated by using the perceptual uncertainty estimates reported by MS, and assuming normal distributions. Uncertainties in trends of different MS and source categories were then calculated using first order approximation of error propagation.

The assumptions of correlation between years (0 and t) and between different MS are important for the estimation of trend uncertainty. However, there is not enough information about strengths of different correlations. Effect of correlation was tested both with the analytical method developed, and by using MC simulation, where Normal distribution was used in all the cases to ensure comparability with analytical estimates. Table 1.17 presents an example of such comparison made in 2006. The source category chosen for the example is 4D, N_2O emissions from agricultural soils, as this category has a major effect on inventory uncertainty in most MS. Both the effects of correlations between years and between Member States were tested.

Table 1.17 Trend uncertainty for EU-15 emissions of N_2O from agricultural soils by using different assumptions of correlation estimated using Monte Carlo simulation

Years correlate	MS correlate	Trend uncertainty
YES	YES	-27 to +26
YES	NO	±13
NO	YES	-294 to +292
NO	NO	-116 to +115

Note: "YES" denotes full correlation between years or Member States. Trend uncertainty is presented as percentage points.

The results of the comparison revealed that assumption on correlation between years has much larger effect on trend uncertainty than the assumption on correlation between MS. In the IPCC GPG 2000, it is suggested to assume that emission factors between years are fully correlated, and activity data are independent. However, in the EC uncertainty estimate, it is assumed that activity data uncertainties also correlate to some extent between years, because typically the same data collection methods are used each year.Therefore, for simplicity, in EC uncertainty estimate it was decided to assume that emissions between years are fully correlated, even though this may underestimate trend uncertainty to some extent.

In the example in Table 1.16, uncertainty decreased when correlation between MS was added to the correlation between years. However, this is not always the case; in another example considering EU-15 MS estimates for 1A1a CO_2, uncertainty was ±0.2% when it was assumed that years correlate and MS estimates are independent. When a correlation between MS was added, the uncertainty decreased to ±0.1%.

Correlation between MS is difficult to quantify, especially in case of trend uncertainty, where correlation between different MS in different years should also be quantified. Furthermore, effect of correlation on uncertainty (increasing or decreasing) depends on the direction and magnitude of trend for each MS and each source category. Therefore, a simple conservative assumption cannot be made. Therefore, for simplicity, it was assumed in trend uncertainty estimate that MS are independent[15].

In general, the caveats of the method used are the same as in IPCC Tier 1, i.e. the result gives the most reliable results when uncertainties are small, and it assumes normal distributions even though this cannot actually be the case when uncertainties are >100%. However, these issues do not seem to have any major effect on the results, as can be seen from Table 1.18, where waste sector uncertainties are

[15] When the correlation assumptions were simplified, IPCC Tier 1 method could also have been used

presented both with analytical method and Monte Carlo simulation. When uncertainty increases, also the difference between the two methods increases.

Table 1.18 Comparison of trend uncertainty estimates for EU-15 Waste Sector using the modified Tier 1 method and Monte Carlo simulation (Tier 2). Trend uncertainty is presented as percentage points

Sector	GHG	Tier 1	Tier 2
6A. Landfills	CH_4	±12	±12
6B. Wastewater	CH_4	±27	-28 to +27
6B. Wastewater	N_2O	±9	±9
6C. Waste incineration	CO_2	±7	±7
6C. Waste incineration	CH_4	±23	-23 to +24
6C. Waste incineration	N_2O	±18	±18
Waste Other	CH_4	±990	-976 to +993
Total Waste Sector		±11	±11

Note: Trend uncertainty is presented as percentage points.

Furthermore, trend uncertainty was calculated as in Equation 1, and the resulting confidence intervals were divided by base year estimate (best estimate) to obtain the relative change. The results would have been somewhat different, if trend uncertainty were calculated as in Equation 2:

$$Trend_{n,x} = [E_{n,x}(t)-E_{n,x}(0)]/ E_{n,x}(0) \qquad (2)$$

However, the effect of the choice between Eq 1 and 2 depends also on the direction and magnitude of trend in different MS, and without further consideration it cannot be stated whether choice of Eq 1 yielded a conservative estimate or not.

Lack of knowledge of different correlations, and many assumptions make the interpretation of EC trend uncertainty difficult, and therefore it should not be compared with uncertainty estimates of other countries. However, trend uncertainty calculations are internally consistent, and therefore the results can be used e.g. to assess which categories are the most important sources of trend uncertainty in the EC inventory.

Table 1.19 shows the main results of the uncertainty analysis for the EU-15. The lowest level uncertainty estimates are for stationary fuel combustion (1 %) and transport (2 %), the highest estimates are for agriculture (45 % - 102 %). For agriculture a range of level uncertainties is provided depending on the assumption on N_2O emissions from soils. The lower bound assumes that all MS uncertainty estimates of N_2O from agricultural soils are uncorrelated, the upper bound assumes that all uncertainty estimates are correlated. Overall level uncertainty estimates including LULUCF of all EU-15 GHG emissions is calculated to be between 5.4 % and 10.5 %, and excluding LULUCF slightly lower between 4.6 % and 10.1 %.

With regard to trend uncertainty estimates the lowest uncertainty estimates are for stationary fuel combustion (+/- 0.4 percentage points), the highest estimates are for agriculture (9 percentage points). Overall trend uncertainty (excluding LULUCF) of all EU-15 GHG emissions is estimated to be 1.2 percentage point.

More detailed uncertainty estimates for the source categories are provided in Chapters 3-8.

Table 1.19Tier 1 uncertainty estimates of EU-15 GHG emissions

Source category	Gas	Emissions 1990	Emissions 2007	Emission trends 1990-2007	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
Fuel combustion stationary	all	2 460 749	2 318 619	-6%	1%	0.4
Transport	all	698 690	863 981	24%	2%	1
Fugitive emissions	all	97 247	50 436	-48%	22%	22
Industrial processes	all	372 437	332 326	-11%	4%	4
Agriculture	all	418 905	371 482	-11%	68% (45%-102%)	8
LULUCF	all	-216 593	-259 416	20%	41%	-
Waste	all	171 149	104 645	-39%	18%	9
Total (incl LULUCF)	**all**	**4 002 585**	**3 782 074**	**-6%**	**7.3% (5.4% -10.5%)**	**-**
Total (excl LULUCF)	**all**	**4 219 177**	**4 041 490**	**-4%**	**6.7% (4.6% -10.1%)**	**1.2**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points;
Uncertnty estimates include for Spain 2006 data.

In September 2005 a workshop on uncertainties in greenhouse gas inventories was organised in Helsinki (Finland). The aim of the workshop was to share information and experience on uncertainty assessment, to discuss needs for further guidance, and to improve comparability of uncertainty estimates across different Member States. The main objectives were to help Member States to compile/improve uncertainty estimates and to help develop the uncertainty assessment of the EC inventory. The workshop brought together experts from 16 Member States, the European Commission (DG ENV, JRC), ETC-ACC, as well as from Norway and Russia. UNFCCC secretariat sent their statement in a written form to the workshop. The workshop produced recommendations on the following topics: a) EC Uncertainty assessment and implications on Member State uncertainty assessment and b) Uncertainty assessment at Member State level (see workshop report http://air-climate.eionet.eu.int/meetings/past_html).

Tables 1.20 (EU-15) and 1.21 (new MS) give an overview of information provided by Member States on uncertainty estimates in their national inventory reports 2009 and presents summarised results of these estimates. For some Member States, either a national inventory report was available, which did not include quantitative uncertainty analysis, or no national inventory report was available at all.

Table 1.20 Overview of uncertainty estimates available from EU-15 Member States

Member State	Austria		Belgium	Denmark	Finland	France	Germany	Greece	
Citation	NIR Mar 2009, pp.47-54		NIR Mar 2009, pp. 19-26	NIR Mar 2009 pp.51-54	NIR Mar 2009, pp. 30-32	NIR, March 2009, pp. 31-32	NIR Jan 2009 , pp. 95-97 + 564-572	NIR, March 2009, pp. 31-32	
Method used	Tier 1, Tier 2		Tier 1	Tier 1	Tier 1 + Tier 2	Tier 1	Tier 1	Tier 1	
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes (Annex 6)		Yes (Annex 3)	Yes	Yes (Annex 5) Detailed uncertainty and sensitivity analyses performed for key categories.	Yes (Annex 7)	Yes: Annex 8	Yes (Annex IV)	
Years and sectors included	emissions: 2007; trends: 1990-2007; almost all categories (e. L.)		emissions: 2007; trends: 1990-2007; all categories, (i. L.)	emissions: 2007; trend BY-2007; almost all categories (i.L.)	emissions: 2007; trends: 1990-2007; all categories (i. L.)	emissions: 2006; trends: 1990-2006; all categories	emissions: 2007; trends: 1990-2007; all categories (i.L.)	emissions: 2007; trends: 1990-2007; almost all categories	
Uncertainty (%)	Tier 1	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1 (e. L.)
CO_2				3.1%				4.5%	3.6%
CH_4				23%				54.9%	55.9%
N_2O				47%				80.8%	81.0%
F-gases				48%				184%	184%
Total	4.0%	5.7%	7.6%	5.8%	22.6%	i. L.: 23% e. L.: 18.0%	9.7%	18.5%	7.4%
Uncertainty in trend (%)	Tier 1	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
CO_2				±2.4 % points					
CH_4				±10.3% points					
N_2O				±13% points					
F-gases				±66% points					
Total	2.1%	2.3%	2.8%	2.5% points	14.9% points	i. L.: 4.7% e. L.: 2.9%	12.97%	13.2%	9.0%

Member State	Ireland	Italy	Luxembourg	Netherlands	Portugal	Spain	Sweden	United Kingdom	
Citation	NIR Mar 2009, pp. 17-23	NIR Apr 2009, pp. 35-36	MM submission 2009	NIR Mar 2009 p. 29-32	NIR Mar 2009, pp.13-15	NIR Mar 2009, pp. 44-45	NIR Jan 2009, p.35-37	NIR Mar 2009, pp. 67-68, MM submission	
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1, Tier 2	
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes	Yes (Annex 1)	Yes (Tier 1 table)	Yes (Annex 7)	Yes (Annex B)	Yes (Annex 7)	Yes (Annex 7)	Yes (Annex 7)	
Years and sectors included	emissions: 2007; trend: 1990-2007; all categories (e.L.)	emissions: 2007; trend: BY-2007; all categories	emissions: 2007, trend: 1990-2007; allmost all categories (e.L.)	emissions: 2007; trend: 1990-2007; all categories (e.L.)	emissions and trends: BY-2007; all categories (i.L.)	emissions: 2006; trend: BY-2006; all categories (e. L.)	emissions: 1990 and 2007; trends: 1990-2007; almost all categories (e. L.)	emissions: 1990, 2007; trend: BY -2007, all categories	
Uncertainty (%)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 2 (incl. LULUCF)
CO_2	1.2%			3%	5% (e.L.)	-	5.4% (1990) 5.4% (2007)		
CH_4	2.1%			25%	27.5% (e.L)	-	2.8% (1990) 1.9% (2007)		
N_2O	5.4%			50%	97.3% (e.L.)	-	5.3 % (1990) 5.1% (2007)		
F-gases	0.2%			50%	66.2%		0.2% (1990) 0.4% (2007)		
Total	6.0%	i. L.: 6.4% e. L.: 3.3%	3.1%	5%	8.7% (i.L.)	11.4%	8.0% (1990) 7.7% (2007)	i. L.: 15.8% e. L.: 15.7%	15% (1990) 13% (2007)
Uncertainty in trend (%)	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 2
CO_2	1.8%			2 % points					
CH_4	2.0%			10 % points					
N_2O	2.8%			15 % points					
F-gases	0.2%			9 % points					
Total	3.8%	i. L.: 5.3% e. L.: 2.6%	2.6%	3 % points	13.2%	5.7%	6.4%	i. L.: 2.40%; e. L.: 2.43%	2.8%

Table 1.21 Overview of uncertainty estimates available from new Member States

Member State	Bulgaria	Cyprus	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Romania	Slovakia	Slovenia
Citation	NIR, March 2009, pp. 11-12	NIR, April 2009, pp. 11-12	NIR Mar 2009 pp. 23-27 + Uncertainty Table	NIR Mar 2009	NIR, March 2009, p. 24	NIR Apr 2009, p.23	NIR, Dec 2008, p. 19	NIR, March 2009, p. 14	NIR, March 2009, p. 14	NIR, March 2009, p. 42	NIR, March 2009, pp. 25-27	NIR Apr 2009, p. 20
Method used	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
Documentation in NIR (according to Table 6.1/6.2 of GPG)	Yes, Tier 1 table	Yes (Annex 2)	Yes	Yes (Annex 7)	Yes, Tier 1 table	Yes (Annex 7)	Yes: Annex 2	Yes: Annex 2	Yes (Annex 5)	Yes (Annex 7)	Yes (Annex 2)	Yes (Annex 7)
Years and sectors included	emissions: 2007; BY-2007; all categories (e. L.)	emissions: 1990-2007; trends: 1990-2007; most categories (i.L.)	emissions: 2007; trend: 1990- 2007; all categories (e. L.)	emissions: 1990; all categories	emissions: 2007; trend: BY-2007; all categories (e. L)	emissions: 2007; trend: 1990-2007; almost all categories	emissions: 2007; trends: BY-2007, allmost all categories (e. L.)	emissions: 2007; trends: BY-2007, allmost all categories (i. L.)	emissions: 2007 ; all sources	emissions: 2007; trend: 1989 to 2007; all categories	emissions 1990 and 2007; trend: 1990-2007; almost all categories	emissions: 1986, 2007; trend: 1986-2007; all categories
Uncertainty (%)	Tier 1	Tier 1 (2007)	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1 (i. L.)	Tier 1 (i. L.)
CO_2					2-4%	3.6% (e.L.)	1.9%		3.3%			
CH_4					15-25%	16% (e.L)	2.7%		20.3%			
N_2O					80-90%	22% (e.L.)	7.7%		47.9%			
F-gases									HFC 44.7% PFC 20% SF6 100%			
Total	13.4%	8.4%	6.3%	i. L.: 21.2%; e. L.: 18.3%	5.1%	i. L.: 22.9%; e. L.: 5%	8.4%	3.8%		e. L.: 15.9% i. L.: 29.3%	2007: 14%	8.5% (1986) 7.3% (2007)
Uncertainty in trend (%)	Tier 1		Tier 1		Tier 1					Tier 1	Tier 1 (i. L.)	Tier 1 (i. L.)
CO_2						1.5%						
CH_4						7%						
N_2O						14%						
F-gases												
Total	4.1%	51.4%	3.1%	i. L.: 25.7%; e. L.: 8.6%	2.3%	i. L.: 13.1%; e. L.: 2.3%	2.2%	3.3%		e. L.: 5.6%; i. L.: 11.4%	8.0%	6.2%

1.8 General assessment of the completeness

1.8.1 Completeness of Member States' submissions

The EC GHG inventory is compiled on the basis of the inventories of the EC Member States. Therefore, the completeness of the EC inventory depends on the completeness of the Member States' submissions.

Tables 1.22 and 1.23 summarise timeliness and completeness of the Member States' submissions in 2009. It shows that GHG inventories for 2007 were submitted by all 27 Member States before 31 March 2009. All Member States submitted all or almost all tables (i.e. more than 90 %) of the CRF tables for 1990–2007. The completeness of national submissions with regard to individual CRF tables can be found in the status reports in Annex 3.

Table 1.22Date, mode and content of submissions of EU-15 Member States in 2009

MS	Submission date	Submission mode	Content
AT	15/01/2009	CDR	CRF 1990-2007, XML, short NIR, annex I key categories, annex II indicators, SEF tables
AT	17/02/2009	CDR	uncertainties
AT	12/03/2009	CDR	NIR, SEF table, uncertainty
AT	16/03/2009	CDR	Annex V of NIR (questionnaire)
AT	15/04/2009	CDR	CRF 1990-2007, XML, NIR, KP LULUCF, SEF tables
BE	15/01/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables, annex I key categories, annex II indicators, recalculations
BE	03/02/2009	CDR	annex I key categories
BE	13/03/2009	CDR	CRF 1990-2007, XML, NIR
BE	15/04/2009	CDR	CRF 1990-2007, XML, NIR
BE	15/04/2009	CDR	NIS
DE	12/01/2009	CDR	CRF 1990-2007, XML
DE	14/01/2009	CDR	annex I key categories, annex II indicators
DE	15/01/2009	CDR	NIR, SEF tables
DE	02/03/2009	CDR	CRF 1990-2007, XML
DE	08/04/2009	CDR	SEF tables
DK	15/01/2009	CDR	CRF 1990-2007, XML, uncertainties, annex I key categories, annex II indicators, short NIR
DK	12/03/2009	CDR	SEF tables
DK	13/03/2009	CDR	CRF 1990-2007, XML, NIR, uncertainties
DK	20/04/2009	CDR	SEF tables
DK	15/04/2009	CDR	CRF 1990-2007, XML
DK	15/04/2009	CDR	DK + Greenland: CRF 1990-2007, XML
DK	15/04/2009	CDR	DK + Greenland + Faroe Islands: CRF 1990-2007, XML
DK	15/04/2009	CDR	DK + Greenland: Summary table 2
DK	15/04/2009	CDR	Faroe Islands: Summary table 2
DK	15/04/2009	CDR	Greenland: Summary table 2
DK	15/04/2009	CDR	NIR
ES	26/01/2009	CDR	SEF tables
ES	12/03/2009	CDR	CRF 1990-2007, XML, NIR (spanish), annex I key categories, annex II indicators, uncertainties
FI	15/01/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables, uncertainties, annex I key categories, annex II indicators
FI	13/03/2009	CDR	CRF 1990-2007, XML, NIR, key categories, indicators, uncertainties, SEF tables
FI	09/04/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables, SIAR Report
FR	15/01/2009	CDR	CRF 1990-2007, Kyoto tables 1990-2007
FR	10/02/2009	CDR	SEF tables
FR	12/02/2009	CDR	XML (entire France)
FR	17/02/2009	CDR	annex I key categories, annex II indicators
FR	13/03/2009	CDR	CRF + XML France+Kyoto, NIR
FR	09/04/2009	CDR	SEF tables
GB	15/01/2009	CDR	CRF 1990-2007, XML, annex I key categories, annex II indicators, SEF tables, recalculations

MS	Submission date	Submission mode	Content
GB	10/02/2009	CDR	CRF 1990-2007, XML
GB	11/02/2009	email	NIR, uncertainties
GB	13/03/2009	CDR	CRF 1990-2007, XML, NIR
GB	15/04/2009	CDR	NIR, SEF tables, SIAR Report
GR	19/01/2009	CDR	CRF 1990-2007, XML, SEF tables, short NIR
GR	17/02/2009	email	uncertainties
GR	20/03/2009	CDR	CRF 1990-2007, XML, NIR, SEF table
IE	15/01/2009	CDR	CRF 1990-2007, XML, SEF tables, annex I key categories, annex II indicators
IE	13/03/2009	CDR	CRF 1990-2007, XML, NIR, SEF table, uncertainty
IE	08/04/2009	CDR	Art. 3.3, 3.4
IE	09/04/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables, SIAR report
IE	09/04/2009	CDR	Art. 3.3, 3.4
IT	16/01/2009	NFP	SEF tables
IT	23/02/2009	NFP	CRF 1990-2007, XML
IT	15/03/2009	NFP	CRF 1990-2007, XML, annex I key categories, annex II indicators
IT	16/04/2009	NFP	CRF 1990-2007, XML, NIR
LU	02/02/2009	CDR	CRF 1990-2007, XML
LU	02/03/2009	CDR	annex II indicators
LU	02/03/2009	CDR	key source analysis
LU	02/03/2009	CDR	SEF tables
LU	02/03/2009	CDR	annex I key category information
LU	02/03/2009	CDR	uncertainties
LU	15/05/2009	CDR	CRF 1990-2007, XML
NL	15/01/2009	CDR	CRF 1990-2007, XML, annex I key categories, annex II indicators, NIR
NL	15/01/2009	email	SEF tables
NL	15/03/2009	CDR	CRF 1990-2007, XML, NIR
NL	23/04/2009	CDR	CRF 1990-2007, XML, NIR
PT	15/01/2009	CDR	SEF tables
PT	15/01/2009	CDR	CRF tables 1990-2007, XML, short NIR, annex I key categories, annex II indicators
PT	20/03/2009	CDR	CRF tables 1990-2007, XML upload failed
PT	01/04/2009	CDR	NIR
SE	15/01/2009	CDR	CRF 1990-2007, XML, NIR, annex I key categories, annex II indicators, SEF tables
SE	16/01/2009	CDR	CRF 1990-2007, XML
SE	10/02/2009	CDR	CRF 1990-2007, XML
SE	15/04/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables, SIAR Reports

Table 1.23 Date, mode and content of submissions of new Member States in 2009

MS	Submission date	Submission mode	Content
BG	15/01/2009	CDR	CRF 1988-2007, XML, short NIR, uncertainties, annex I key categories, annex II indicators, SEF tables
BG	13/03/2009	CDR	CRF 1988-2007, XML, NIR
CY	31/03/2009	CDR	CRF 1990-2007, XML
CY	10/04/2009	CDR	NIR
CY	23/04/2009	CDR	NIR
CZ	15/01/2009	CDR	CRF 1990-2007, short NIR, annex I key categories
CZ	19/01/2009	CDR	XML
CZ	21/04/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables, KP LULUCF
EE	15/01/2009	CDR	CRF 1990-2007, XML, draft NIR, SEF tables, annex I key categories
EE	13/03/2009	CDR	CRF 1990-2007, XML
EE	13/03/2009	CDR	NIR, key category information, indicators, uncertainties

MS	Submission date	Submission mode	Content
EE	08/05/2009	CDR	NIR
EE	19/05/2009	CDR	indicators
HU	16/01/2009	CDR	CRF 1985-2007, XML, draft NIR, uncertainties, annex I key categories
HU	19/03/2009	CDR	CRF 1985-2007, XML, NIR, annex I key categories, uncertainties
HU	16/04/2009	CDR	CRF 1985-2007, XML, NIR, uncertainties
HU	15/05/2009	email	Annex II indicators
LT	14/01/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables
LT	11/05/2009	CDR	CRF 1990-2007, XML, NIR
LT	20/05/2009	CDR	Annex I key categories, annex II indicators
LV	13/01/2009	CDR	CRF 1990-2007, XML, short NIR, annex I key categories, annex II indicators, SEF tables
LV	13/03/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables
LV	15/04/2009	CDR	CRF 1990-2007, XML, NIR, SEF tables
MT	15/01/2009	CDR	CRF 1990-2007, XML
MT	13/03/2009	CDR	CRF 1990-2007, XML, NIR, annex I key category information, annex II indicators, uncertainty
PL	15/01/2009	CDR	CRF 1988-2007, XML, SEF tables, annex I key categories, annex II indicators, short NIR, recalculations
PL	16/03/2009	CDR	CRF 1988-2007, XML, NIR
PL	21/05/2009	CDR	CRF 1988-2007, XML, SEF
RO	15/01/2009	CDR	CRF 1989-2007, XML
RO	15/01/2009	CDR	NIS, annex I key categories, annex II indicators, uncertainties, recalculations
RO	15/01/2009	CDR	responses to ERT
RO	15/01/2009	CDR	responses to ERT
RO	14/03/2009	CDR	CRF 1989-2007, XML, NIR, SEF tables
RO	14/04/2009	CDR	CRF 1989-2007, XML, NIR, SEF tables
SI	15/01/2009	CDR	Annex II indicators
SI	15/01/2009	CDR	CRF 1986-2007, XML, NIR, annex I key categories, SEF tables
SI	15/03/2009	CDR	CRF 1986-2007, XML, NIR, annex I key categories, annex II indicators, SEF table
SI	15/04/2009	CDR	CRF 1986-2007, XML, NIR, SEF tables
SK	15/01/2009	CDR	CRF 1990-2007, XML, NIR, NIS, uncertainties
SK	15/01/2009	CDR	NIR, annex I key categories, annex II indicators
SK	15/03/2009	CDR	NIR
SK	15/03/2009	CDR	Annex II indicators
SK	15/03/2009	CDR	CRF 1990-2007, XML
SK	08/04/2009	CDR	SEF tables
SK	15/04/2009	CDR	NIR

1.8.2 Data gaps and gap-filling

The EC GHG inventory is compiled by using the inventory submissions of the EC Member States. If a Member State does not submit all data required for the compilation of the EC inventory by 15 March of a reporting year, the Commission prepares estimates for data missing for that Member State. In the following cases gap filling is made:

- To complete specific years in the GHG inventory time-series for a specific Member State
  - for the most recent inventory year(s);
  - for the base year;
  - for some years of the time series from 1990 to the most recent year.
- To complete individual source categories for individual Member States that did not estimate specific source categories for any year of the inventory time series and reported 'NE'. Gap filling methods are used for major gaps when it is highly certain that emissions from these source categories exist in the Member States concerned;
- To provide complete CRF background data tables for the European Community when some

Member States only provided CRF sectoral and summary tables. (In this case, the gap filling methods are used to further disaggregate the emission estimates provided by Member States.)

- To enable the presentation of consistent trends for the EC.

For data gaps in Member States' inventory submissions, the following procedure is applied by the ETC/ACC in accordance with the implementing provisions under Council Decision No 280/2004/EC for missing emission data:

- If a consistent time series of reported estimates for the relevant source category is available from the Member State for previous years that has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, extrapolation of this time series is used to obtain the emission estimate. As far as CO_2 emissions from the energy sector are concerned, extrapolation of emissions should be based on the percentage change of Eurostat CO_2 emission estimates if appropriate.
- If the estimate for the relevant source category was subject to adjustments under Article 5.2 of the Kyoto Protocol in previous years and the Member State has not submitted a revised estimate, the basic adjustment method used by the expert review team as provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' ([16]) is used without application of the conservativeness factor.
- If a consistent time series of reported estimates for the relevant source category is not available and if the source category has not been subject to adjustments under Article 5.2 of the Kyoto Protocol, the estimation should be based on the methodological guidance provided in the 'Technical guidance on methodologies for adjustments under Article 5.2 of the Kyoto Protocol' without application of the conservativeness factor.
- The Commission prepares the estimates by 31 March of the reporting year, following consultation with the Member State concerned, and communicates the estimates to the other Member States. The Member State concerned shall use the estimates referred to for its national submission to the UNFCCC to ensure consistency between the Community inventory and Member States' inventories.

The methods used for gap filling include interpolation, extrapolation and clustering. These methods are consistent with the adjustment methods dscribed in UNFCCC Adjustment Guidelines (Table 1) and in the IPCC GPG 2000.[17]

Gap filling in GHG inventory submissions 2009

GHG inventory estimates for 2007 are available for all EC Member States; PFC emissions are not available from Bulgaria and Malta for 1990-2007 (Table 1.24). Member States affected by gap filling have the opportunity to provide feedback and incorporated the estimates in their national submissions.

Table 1.24 Overview of missing data by April 2008

Member State	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Bulgaria					1990-2007	
Malta					1990-2007	

On the basis of the general approaches mentioned above the following concrete methodologies were developed for each sector/gas:

[17] ETC ACC technical note on gap filling procedures , December 2006

Estimates at the beginning or at the end of a time series

Fuel combustion related GHG emissions (CO_2, CH_4, N_2O of sector 1A):

The percentage change from Eurostat CO_2 emission estimates was used for extrapolation, where available

If there were no Eurostat CO_2 emission estimates available linear trend extrapolation was used.

Other sectors:

Linear trend extrapolation was used, where no striking dips or jumps in the time series were identified. In general the trend extrapolation was made on basis of the time series 2000-2004.

Previous year values were used where striking dips or jumps in the time series were identified.

Estimates for years within a time series

Linear interpolation between the years available was used

Estimates if no time series is available (only relevant for fluorinated gases):

HFCs:

Emissions were estimated for 2F1 'Refrigeration and air conditioning equipment' on basis of average per capita emissions of either a set of similar countries (if available) or on basis of one single country (if a set of similar countries was not available). Population data was used from Eurostat.

PFCs:

It was checked if aluminum production occurs in the relevant countries, which was not the case. For other PFC emissions no estimates were prepared because of lack of data.

SF6:

Emissions were estimated for 2F7 'Electrical equipment' on basis of average emissions per electricity consumption of either a set of similar countries (if available) or on basis of one single country (if a set of similar countries was not available). Data on electricity consumption was used from Eurostat.

As there is no primary aluminium production neither in Bulgaria nor in Malta no gap filling was made for this GHG inventory submission.

1.8.3 Data basis of the European Community greenhouse gas inventory

The 2009 EC GHG inventory data consist of GHG submissions of the Member States to the European Commission in 2009; no gap filling was needed. Tables 1.25 to 1.28 show the data basis of the 2009 EC GHG inventory.

Table 1.25 Data basis of CO_2 emissions excluding LULUCF (Tg)

EC Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	62	64	67	67	67	66	66	70	72	78	78	79	78	74
Belgium	119	123	128	122	128	123	124	124	123	127	127	123	119	115
Denmark	53	61	74	65	60	58	53	55	54	59	54	50	58	53
Finland	57	58	64	62	59	59	57	62	64	72	68	56	68	66
France	396	393	406	400	421	410	406	412	404	410	414	417	407	397
Germany	1,036	923	945	914	907	880	884	901	886	889	880	852	867	841
Greece	83	87	89	94	99	98	103	106	105	110	110	111	110	114
Ireland	32	35	37	38	41	42	45	47	46	45	46	48	47	47
Italy	435	445	439	443	454	460	463	468	471	486	489	490	486	475
Luxembourg	12	9	9	9	8	8	9	9	10	11	12	12	12	12
Netherlands	159	171	178	171	173	168	170	175	176	180	181	176	173	173
Portugal	44	53	50	54	58	65	64	65	69	65	67	70	65	63
Spain	228	255	243	262	271	296	308	311	330	334	351	368	358	366
Sweden	56	58	62	57	57	55	53	54	55	56	55	53	53	52
United Kingdom	589	550	573	549	552	542	550	562	545	556	557	554	552	543
EU-15	**3,360**	**3,286**	**3,363**	**3,308**	**3,355**	**3,328**	**3,354**	**3,422**	**3,411**	**3,477**	**3,488**	**3,459**	**3,452**	**3,391**
Bulgaria	86	66	65	63	55	51	50	52	49	54	53	54	55	59
Cyprus	4	5	6	6	7	7	8	8	7	8	8	8	8	8
Czech Republic	164	131	139	132	124	121	127	129	125	126	127	126	129	130
Estonia	37	18	19	19	17	16	16	16	15	17	17	17	16	19
Hungary	72	62	63	61	60	60	58	60	58	62	60	61	60	58
Latvia	19	9	9	9	8	8	7	7	7	8	8	8	8	9
Lithuania	36	15	16	15	16	14	12	13	13	13	14	14	15	16
Malta	2	2	2	2	2	2	2	2	2	3	3	3	3	3
Poland	369	366	375	369	341	329	321	317	306	317	317	320	331	328
Romania	172	130	136	121	107	92	95	100	106	111	112	106	111	111
Slovakia	62	44	42	41	42	41	40	42	40	41	41	41	40	38
Slovenia	15	15	16	16	16	15	15	16	16	16	16	17	17	17
EU-27	**4,400**	**4,150**	**4,251**	**4,163**	**4,152**	**4,084**	**4,106**	**4,184**	**4,158**	**4,252**	**4,264**	**4,234**	**4,244**	**4,187**

Table 1.26 Data basis of CH_4 emissions in CO_2 equivalents (Tg)

EC Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	9	9	8	8	8	8	8	8	7	7	7	7	7	7
Belgium	10	10	9	9	9	9	8	8	8	7	7	7	7	7
Denmark	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Finland	6	6	6	6	6	6	6	5	5	5	5	5	5	5
France	66	68	68	65	64	64	63	62	60	59	57	56	56	55
Germany	98	80	77	73	68	68	64	61	57	53	49	46	44	43
Greece	9	9	9	9	9	9	9	9	9	8	8	8	8	8
Ireland	13	14	14	14	14	14	14	13	13	14	13	13	13	13
Italy	42	44	44	45	44	44	44	43	42	41	40	40	38	38
Luxembourg	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	26	24	23	23	22	21	20	19	18	18	18	17	17	17
Portugal	10	11	11	12	12	12	11	12	13	13	13	13	13	13
Spain	29	32	33	34	35	36	37	38	38	38	38	38	39	39
Sweden	7	7	7	7	6	6	6	6	6	6	6	6	6	5
United Kingdom	104	91	88	84	79	74	69	64	61	55	53	51	50	49
EU-15	**436**	**411**	**406**	**394**	**385**	**376**	**366**	**354**	**344**	**331**	**320**	**314**	**309**	**305**
Bulgaria	20	16	16	15	14	14	13	12	12	13	13	12	12	12
Cyprus	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Czech Republic	19	14	14	13	13	12	12	12	12	12	12	12	12	12
Estonia	3	2	2	2	2	2	2	2	2	2	2	2	2	2
Hungary	11	9	9	9	9	9	9	9	9	9	9	9	9	9
Latvia	4	2	2	2	2	2	2	2	2	2	2	2	2	2
Lithuania	6	4	4	4	3	3	3	3	3	3	3	3	3	3
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poland	50	46	45	46	45	44	41	40	39	40	39	39	40	39
Romania	41	31	31	28	25	25	25	25	26	27	26	26	27	26
Slovakia	5	4	4	4	5	5	4	4	5	5	5	5	5	5
Slovenia	2	2	2	2	2	2	2	2	2	2	2	2	2	2
EU-27	**596**	**542**	**536**	**520**	**506**	**495**	**482**	**467**	**458**	**447**	**434**	**427**	**423**	**416**

Table 1.27 Data basis of N_2O emissions in CO_2 equivalents (Tg)

EC Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	6	7	6	6	7	7	6	6	6	6	6	6	6	6
Belgium	11	12	12	12	12	12	12	11	11	10	10	10	9	8
Denmark	11	9	9	9	9	9	8	8	8	8	7	7	6	7
Finland	8	7	7	7	7	7	7	7	7	7	7	7	7	7
France	95	93	94	95	87	81	80	77	75	72	70	69	67	66
Germany	70	67	68	65	52	48	48	50	50	52	55	56	53	56
Greece	12	11	11	11	11	11	11	11	11	10	10	10	10	9
Ireland	9	10	10	10	11	11	10	10	9	9	9	9	8	8
Italy	37	39	38	39	39	40	40	40	39	39	40	38	33	32
Luxembourg	0	1	1	1	1	1	1	1	1	0	1	1	1	1
Netherlands	20	22	21	21	21	20	19	18	17	17	17	17	17	16
Portugal	6	6	6	6	6	6	6	6	6	6	6	6	6	5
Spain	28	27	30	29	30	32	33	31	30	32	31	30	30	30
Sweden	9	8	9	8	8	8	8	8	8	8	8	8	8	7
United Kingdom	65	54	53	54	53	43	42	39	38	37	38	36	35	34
EU-15	**387**	**371**	**375**	**374**	**354**	**334**	**331**	**323**	**315**	**313**	**314**	**309**	**295**	**292**
Bulgaria	11	6	6	6	5	5	5	5	5	5	5	5	4	5
Cyprus	0	0	0	0	0	1	1	1	1	1	1	1	1	1
Czech Republic	12	8	8	8	8	8	8	8	8	7	8	8	7	7
Estonia	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Hungary	15	9	10	9	10	9	10	10	10	9	10	10	10	9
Latvia	4	1	1	1	1	1	1	1	1	1	1	2	2	2
Lithuania	7	3	4	4	4	4	4	4	5	5	5	5	5	6
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poland	38	31	30	31	30	30	30	30	28	28	28	29	30	31
Romania	28	19	18	18	16	15	15	15	14	15	17	17	16	15
Slovakia	6	4	4	4	4	3	4	4	4	4	4	4	4	4
Slovenia	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EU-27	**513**	**455**	**460**	**458**	**434**	**411**	**409**	**403**	**392**	**391**	**394**	**389**	**375**	**374**

Table 1.28 Data basis of actual HFCs, PFCs and SF_6 emissions in CO_2 equivalents (Gg)

Member State		1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	HFC	23	267	347	427	495	542	596	694	781	863	897	908	861	861
	PFC	1,079	69	66	97	45	64	72	82	87	102	126	125	136	183
	SF_6	503	1,139	1,218	1,120	908	684	633	637	641	594	513	286	480	410
Belgium	HFC	439	439	527	639	779	817	952	1,083	1,303	1,467	1,512	1,496	1,601	1,765
	PFC	1,753	2,335	2,217	1,211	669	348	361	223	82	209	306	141	152	172
	SF_6	1,662	2,205	2,121	526	271	122	112	129	112	100	84	84	75	81
Denmark	HFC	A,NE,NO	218	329	324	411	503	605	647	672	695	749	795	815	840
	PFC	A,NE,NO	1	2	4	9	12	18	22	22	19	16	14	16	15
	SF_6	44	107	61	73	59	65	59	30	25	31	33	22	36	30
Finland	HFC	0	29	77	168	245	319	502	657	463	652	695	864	748	904
	PFC	0	0	0	0	0	28	22	20	13	15	12	10	15	8
	SF_6	94	69	72	76	53	52	51	55	51	42	23	20	40	23
France	HFC	3,657	3,468	5,618	5,964	6,169	7,149	8,172	8,833	9,868	11,261	11,901	12,900	13,828	14,288
	PFC	4,293	2,562	2,338	2,425	2,846	3,529	2,487	2,191	3,477	3,218	2,180	1,430	1,167	920
	SF_6	2,022	2,244	2,286	2,214	2,331	2,020	1,848	1,487	1,329	1,326	1,491	1,321	1,194	1,079
Germany	HFC	4,369	6,463	5,843	6,380	6,950	7,192	6,471	7,880	8,784	8,615	9,224	9,978	10,516	11,098
	PFC	2,708	1,750	1,714	1,368	1,471	1,240	781	717	787	849	820	707	569	528
	SF_6	4,785	7,220	6,932	6,905	6,705	5,314	5,082	4,950	4,241	4,384	4,559	4,898	5,510	5,567
Greece	HFC	935	3,254	3,749	3,969	4,381	5,063	3,819	3,308	3,381	2,942	2,942	2,628	597	666
	PFC	258	83	72	165	204	132	148	91	88	77	71	71	71	59
	SF_6	3	4	4	4	4	4	4	4	4	4	4	6	8	10
Ireland	HFC	1	45	76	132	191	197	230	251	277	350	386	435	507	498
	PFC	0	75	103	131	62	196	305	296	212	229	182	168	148	131
	SF_6	35	83	102	132	94	69	56	69	70	119	67	96	69	73
Italy	HFC	351	671	450	756	1,182	1,524	1,986	2,550	3,100	3,796	4,515	5,267	5,956	6,701
	PFC	1,808	491	243	252	270	258	346	451	424	498	348	353	282	288
	SF_6	333	601	683	729	605	405	493	795	740	468	502	465	406	428
Luxembourg	HFC	14	14	20	26	31	37	43	51	59	67	75	83	87	87
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	3	3	3	3	3	3	4	4	4	4	4	4	4	4
Netherlands	HFC	4,432	6,020	7,678	8,300	9,341	4,859	3,829	1,469	1,541	1,377	1,507	1,358	1,566	1,738
	PFC	2,264	1,938	2,155	2,344	1,829	1,472	1,582	1,489	2,187	621	286	266	257	327
	SF_6	217	301	312	345	329	317	319	323	283	243	246	238	202	214
Portugal	HFC	A,NE,NO	55	77	110	152	209	304	391	498	610	687	787	852	941
	PFC	NA,NE	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	0	6	6	6	6	6	6	6	7	7	8	7	8	8
Spain	HFC	2,403	4,645	5,197	6,126	5,809	7,164	8,170	5,284	3,892	5,033	4,680	5,006	5,550	5,837
	PFC	883	833	797	820	769	704	412	240	264	267	272	244	248	249
	SF_6	67	108	115	130	139	175	205	183	207	208	254	272	324	340
Sweden	HFC	4	127	205	313	386	489	565	612	664	709	770	797	826	855
	PFC	377	343	303	280	272	291	241	236	261	258	254	257	245	248
	SF_6	107	127	108	153	99	102	94	111	104	69	81	142	111	150
United Kingdom	HFC	11,386	15,575	16,938	19,536	17,571	11,049	9,945	10,677	11,003	11,343	9,938	10,121	9,927	9,558
	PFC	1,401	471	493	417	412	396	498	420	315	271	337	256	301	216
	SF_6	1,030	1,239	1,267	1,226	1,262	1,426	1,798	1,425	1,509	1,324	1,127	1,108	874	793
EU-15	HFC	40,917	35,725	41,292	47,133	53,171	54,095	47,114	46,188	44,389	46,287	49,781	50,476	53,423	54,237
	PFC	15,009	11,575	10,950	10,504	9,514	8,859	8,671	7,273	6,478	8,220	6,633	5,210	4,043	3,608
	SF_6	14,329	14,418	15,456	15,290	13,642	12,870	10,764	10,764	10,209	9,327	8,922	8,998	8,969	9,341
Bulgaria	HFC	A,NE,NO	3	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO
	PFC	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO
	SF_6	0	1	1	2	2	2	2	2	3	3	4	4	5	3
Cyprus	HFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	0	1	74	73	69	136	53	21
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Czech Republic	HFC	NA,NO	1	101	245	317	268	263	393	391	590	600	594	872	1,606
	PFC	NA,NO	0	4	1	1	3	9	12	14	25	17	10	23	20
	SF_6	78	75	78	95	64	77	142	169	68	101	52	86	83	76
Estonia	HFC	NA,NO	26	31	37	48	57	71	86	87	93	106	119	140	145
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0	0
	SF_6	0	3	4	3	3	3	3	2	1	1	1	1	1	1
Hungary	HFC	NA,NO	2	2	45	125	347	206	281	404	499	526	518	607	615
	PFC	271	167	159	161	193	210	211	199	203	190	201	209	2	2
	SF_6	40	70	69	68	68	127	140	107	120	162	178	201	244	172
Latvia	HFC	A,NE,NO	0	1	2	4	6	8	9	11	13	17	22	40	51
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	0	0	0	1	1	1	1	2	3	4	5	8	7	9
Lithuania	HFC	NA,NO	1	2	2	3	3	4	5	6	9	12	15	19	24
	PFC	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
	SF_6	0	0	0	0	0	0	0	0	0	2	1	1	1	1
Malta	HFC	0	2	5	8	11	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO
	PFC	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO	A,NE,NO
	SF_6	0	2	2	2	2	2	2	2	2	2	2	2	2	2
Poland	HFC	A,NE,NO	16	38	115	172	218	603	1,018	1,486	1,912	2,147	3,018	2,844	3,327
	PFC	A,NE,NO	252	236	249	251	240	249	270	287	278	285	260	270	277
	SF_6	0	31	25	24	25	25	24	24	24	22	23	28	30	32
Romania	HFC	A,NE,NO	0	1	1	3	3	3	4	4	6	9	7	23	16
	PFC	2,116	1,774	1,769	390	417	415	413	429	445	472	513	570	610	626
	SF_6	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Slovakia	HFC	NA,NO	22	38	61	41	65	76	82	102	132	153	172	199	227
	PFC	271	114	35	35	25	14	12	16	14	22	20	20	36	25
	SF_6	0	10	11	11	12	13	13	14	15	15	16	17	17	17
Slovenia	HFC	NA,NO	29	27	33	27	24	31	39	50	64	80	96	112	131
	PFC	257	286	240	194	149	106	106	106	116	119	120	124	116	92
	SF_6	10	12	12	12	13	16	16	16	17	18	18	19	19	19
EU-27	HFC	40,917	35,827	41,537	47,682	53,920	55,086	48,379	48,106	47,005	49,678	53,499	55,173	58,332	60,399
	PFC	17,924	14,168	13,392	11,535	10,550	9,845	9,670	8,304	7,557	9,326	7,790	6,403	5,098	4,649
	SF_6	14,457	14,621	15,657	15,507	13,832	13,135	11,108	11,102	10,462	9,657	9,222	9,365	9,379	9,676

1.8.4 Geographical coverage of the European Community inventory

Tables 1.29 and Table 1.30 show the geographical coverage of the Member States' national inventories. As the EU-15 and the EU-27 inventories are the sum of the Member States' inventories, the EC inventories cover the same geographical area as the inventories of the Member States.

Table 1.29 Geographical coverage of the EU-15 inventory

Member State	Geographical coverage
Austria	Austria
Belgium	Belgium consisting of Flemish Region, Walloon Region and Brussels Region
Denmark	Denmark (excluding Greenland and the Faeroe Islands)
Finland	Finland including Åland Islands
France	France and the overseas departments (Guadeloupe, Martinique, Guyana and Reunion). Note that the EC GHG inventory excludes the French overseas territories (New Caledonia, Wallis and Futuna, French Polynesia, Mayotte, Saint-Pierre and Miquelon)
Germany	Germany
Greece	Greece
Ireland	Ireland
Italy	Italy
Luxembourg	Luxembourg
Netherlands	The reported emissions have to be allocated to the *legal territory* of The Netherlands. This includes a 12-mile zone from the coastline and also inland water bodies. It excludes Aruba and The Netherlands Antilles, which are self-governing dependencies of the Royal Kingdom of The Netherlands. Emissions from offshore oil and gas production on the Dutch part of the continental shelf are included.
Portugal	Mainland Portugal and the two Autonomous regions of Madeira and Azores Islands. Includes also emissions from air traffic and navigation bunkers realized between these areas.
Spain	Spanish part of Iberian mainland, Canary Islands, Balearic Islands, Ceuta and Melilla
Sweden	Sweden
United Kingdom	England, Scotland, Wales and Northern Ireland. Note that the EC GHG inventory excludes emissions from the UK Crown Dependencies (Jersey, Guernsey and the Isle of Man) and the UK Overseas Territories.

Table 1.30 Geographical coverage of the new Member States

Member State	Geographical coverage
Bulgaria	Bulgaria
Cyprus	Cyprus
Czech Republic	Czech Republic
Estonia	Estonia
Hungary	Hungary
Latvia	Latvia
Lithuania	Lithuania
Malta	Malta
Poland	Poland
Romania	Romania
Slovakia	Slovakia
Slovenia	Slovenia

1.8.5 Completeness of the European Community submission

National inventory report

The EC GHG submission provides GHG emission data for EU-27 and for EU-15. All chapters and annexes of this report refer to EU-15 and to EU-27, but the level of detail for the information provided varies, e.g. the Chapters 3-9 include more detailed information for the EU-15 Member States. In any case, all the detailed information provided in previous reports for the EU-15 is also available in this report.

The EC NIR follows the outline of the UNFCCC reporting guidelines with the exception of the annexes. The main reason for this is the nature of the EC inventory being the sum of Member States' inventories. Therefore the main purpose of the annexes is to make transparent the EC emission estimates by providing the basic basic Member States tables for every CRF table. Table 1.31 provides explanations for not including the annexes as required by the UNFCCC reporting guidelines.

Table 1.31 Explanations for exclusion of annexes as outlied in the UNFCCC reporting guidelines

Annex required in the UNFCCC reporting guidelines	Comment
Annex 1: Key categories	This annex is included in the EC NIR
Annex 2: Detailed discussion ofmethodology and data for estimating CO_2 emissions from fossil fuel combustion	Due to the nature of the EC inventory being the sum of Member States' inventories detailed methodologies for estimating CO_2 emissions from fossil fuel combustion are included in Member States' NIRs. However, summary information on methodologies used by Member States is provided in the EC NIR for the EC key sources.
Annex 3: Other detailed methodological descriptions for individual source or sink categories (where relevant)	Due to the nature of the EC inventory being the sum of Member States' inventories detailed methodological descriptions for other source or sink categories are included in Member States' NIRs. However, summary information on methodologies used by Member States is provided in the EC NIR for the EC key sources.
Annex 4: CO_2 reference approach and comparison with sectoral approach, and relevant information on the national energy balance	Information on the reference approach is included in the EC NIR. Due to the nature of the EC inventory being the sum of Member States' inventories there is no national energy balance which could be included in this annex.
Annex 5: Assessment of completeness and (potential) sources and sinks of greenhouse gas emissions and removals excluded	Information on completeness as reported by Member States in CRF Table 9 is included in the EC NIR in Table 1.20. In addition, for the EC key sources explanations for the NE are included in the sector chapters of the NIR, where relevant.
Annex 6: Additional information to be considered as part of the NIR submission (where relevant) or other useful reference information	The EC considers the Member States CRF and NIR as part fo the EC submission.
Annex 7: Tables 6.1 and 6.2 of the IPCC good practice guidance	Due to the nature of the EC inventory EC uncertainties are not estimated on basis of uncertainties of emission factors and activity data (see chapter 1.7). Therefore no Table 6.1 can be provided for the EC. Tier 2 uncertainty analysis has not yet been carried out.
Annex 8: Other annexes - (Any other relevant information – optional).	

CRF tables in Annex 2

The European Community cannot provide all data in the sectoral background tables. The main reasons for not completing all sectoral background data tables are: (1) limited data availability partly due to confidentiality issues; and (2) the use of different type of activity data by Member States. Latter is due to the fact that the Member States are responsible for calculating emissions. If they use country-specific methods they may also use different types of activity data (e.g. cement or clinker production). At EU-15 level these different types of activity data cannot be simply added up. As at EU-15 level no emissions are calculated directly on the basis of activity data, the documentation of very detailed background data seems to be of lower importance. All the details for the calculation of the emissions are documented in the Member States' CRF tables, as part of their national GHG inventories, which also form part of the EC GHG inventory submission (see Annex 12, which is available at the EEA website http://www.eea.eu.int) and in the sector annexes.

Table 1.32 provides an overview of sectoral report and sectoral background tables available in Annex 2, an explanation for each table which is not filled in at EU-15 level and activity data provided for the calculation of implied emission factors. Further information is provided in the relevant sector chapters.

Table 1.32 Inclusion of CRF tables in Annex 2

Table	Included in Annex 2	Comment
Energy		
Table 1	Yes	
Table 1.A (a)	Yes	
Table 1.A (b)	Yes	
Table 1.A (c)	Yes	
Table 1.A (d)	Yes	
Table 1B1	Yes	
Table 1B2	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; overview table for 1B2b included in the NIR
Table 1.C	Yes	
Industrial processes		
Table 2(I)	Yes	
Table 2(II)	Yes	
Table 2(I). A-G	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; overview tables for large key sources included in the NIR

Table	Included in Annex 2	Comment
Table 2(II). C,E	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies; limited data availability; confidentiality issues
Table 2(II). F	Yes	For those MS which did not provide Table 2(II).F emissions are allocated to the sub-categories according to the aggregated average allocation of those MS which provided Table 2(II).F.
Solvent use		
Table 3	Yes	
Table 3. A-D	No	Type of activity data used by the MS varies
Agriculture		
Table 4	Yes	
Table 4. A	Yes	
Table 4. B(a)	Yes	
Table 4. B(b)	Yes	
Table 4. C	Yes	
Table 4. D	Yes	
Table 4. E	Yes	
Table 4. F	Yes	
LUCF		
Table 5	Yes	
Table 5. A	Yes	
Table 5. B	Yes	
Table 5. C	Yes	
Table 5. D	Yes	
Table 5. E	Yes	
Table 5. F	Yes	
Table 5 (I)	Yes	
Table 5 (II)	Yes	
Table 5 (III)	Yes	
Table 5 (IV)	Yes	
Table 5 (V)	Partly	Emissions are included, activity data is not estimated because type of activity data used by the MS varies
Waste		
Table 6	Yes	
Table 6. A, C	Partly	Emissions and some activity data are included
Table 6. B	Partly	Emissions are included, activity data is not estimated because of limited data availability
Summary Tables		
Summary 1.A	Yes	
Summary 1.B	Yes	
Summary 2	Yes	
Summary 3	Yes	
Other Tables		
Table 7	Yes	
Table 8(a)	Yes	
Table 8(b)	Partly	It is indicated in which MS recalculations were performed. In addition, the explanations for recalculations are provided in the EC NIR for the EC key sources together with the contribution of every MS to the EC recalculations. Summary information is also provided in Chapter 10 (Tables 10.1 and 10.2).
Table 9	No	Information on completeness is included in the NIR for the EC key sources explanations for the NE and IE are included in the sector chapters of the NIR, where relevant. For the 2010 submission the EC inventory team plans to provide a more detiled overview tables.
Table 10	Yes	

Table 1.33 provides for specific sectoral background tables an overview of activity data used by Member States in order to explain why this acitivity data cannot be reported at EU-15 level.

Table 1.33 Activity data reported by Member States in CRF background data tables

Table	Source category		Activity data reported by MS
Table 1B2	1. B. 2. a. Oil (3)		
		I.Exploration	number of wells drilled crude oil number of wells drilled/tested
		ii. Production	Oil throughput PJ of oil produced Crude oil and NGL production Crude oil produced Oil and gas produced

Table	Source category		Activity data reported by MS
		iii.Transport	oil loaded in tankers PJ Loaded Crude oil imports Transport of crude oil Offshore loading of oil only
		iv.Refining / Storage	Oil refined (SNAP 0401) PJ oil refined crude oil & products kt oil refined Refinery input (crude oil and NGL) Refery input: crude oil, NGL crude oil & products Oil refinery throughput
		v. Distribution of Oil Products	Gasoline Consumption (SNAP 0505) kt oil refined Domestic supply of gasoline Oil products
		vi.Other	Transfer loss gas works gas onshore loading of oil only
	1. B. 2. b. Natural Gas		
		i.Exploration	natural gas number of wells drilled/tested
		ii. Production (4) / Processing	Gas throughput PJ gas produced natural gas from crude oil extraction Natural gas production Mm3 gas produced
		iii.Transmission	Pipelines length (km) total amount of gas consumed PJ gas consumed Length of transmission pipeline Mm3 gas transported gas transported PJ gas (NCV) Pressure levelling losses
		iv.Distribution	Distribution network length consumption distribution net PJ gas distributed via local networks PJ gas consumed Length of distribution mains Mm3 gas transported
		v. Other Leakage	PJ gas consumed t of natural gas released from pipelines
	1. B. 2. c. Venting(5)		
		i.Oil	PJ oil produced kt oil refined Crude oil and NGL production
		ii. Gas	PJ gas produced Sour Natural gas production
		iii.Combined	
	Flaring		
		i.Oil	PJ gas consumption kt oil refined Consumed Crude oil and NGL production Mm3 gas consumption oil produced Refinery gas other liquid fuels
		ii. Gas	PJ gas consumption natural gas Natural gas production quantity of gas flared
		iii.Combined	
Table 2(I)	2.A Mineral products		
		1. Cement production	Clinker production Cement production
		2. Lime production	Lime produced Lime and dolomite production Production of lime and bricks

Table	Source category		Activity data reported by MS
			Limestone consumed
		3. Limestone and dolomite use	Limestone and dolomite used Limestone consumption Clay, shale and limestone use Carbonates input to brick, tiles, ceramic production
		4. Soda ash production	Soda ash production
		4. Soda ash use	Soda ash use Use of soda
		5. Asphalt roofing	Roofing material production Bitumen consumption
		6. Road paving with asphalt	Asphalt production Bitumen consumption Asphalt used in paving Asphalt liquefied
	2B Chemical industry		
		1. Ammonia production	Ammonia production Natural gas consumption
		2. Nitric acid production	Nitric acid production Nitric acid production: Medium pressure plants
	2C Metal production		
		1. Iron and steel production	
		Steel	Steel production Crude steel production Production of secondary steel
		Pig iron	Iron production Production of primary iron Pig iron production
		Sinter	Sinter production Sinter consumption
		Coke	Coke production Coke consumption Coke consumed in blast furnace
		2. Ferroalloys production	Ferroalloys production Laterite consumption Use of coal and coke electrodes
		3. Aluminium production	Aluminium production Primary aluminium production
Table 2(II) C	C.PFCs and SF_6 from MetalProduction		
		PFCs from aluminium production	Aluminium production Primary aluminium production
		SF_6 used in Aluminium and Magnesium Foundries	
		Aluminium foundries	Cast aluminium Consumption of aluminium foundries SF_6 consumption
		Magnesium foundries	Cast magnesium Consumption Mg-Production SF_6 consumption
Table 4D	1. Direct soil emissions		
		3. N-fixing crops	Nitrogen fixed by N-fixing crops Dry pulses and soybeans produced Area of cultivated soils
		4. Crop residues	Nitrogen in crop residues returned to soils Dry production of other crops
Table 5(V)	A. Forest land		Area burned (ha) Biomass burned (kg dm)
	B. Cropland		Area burned (ha) Biomass burned (kg dm)
	C. Grassland		Area burned (ha) Biomass burned (kg dm)
	E. Settlements		Area burned (ha) Biomass burned (kg dm)

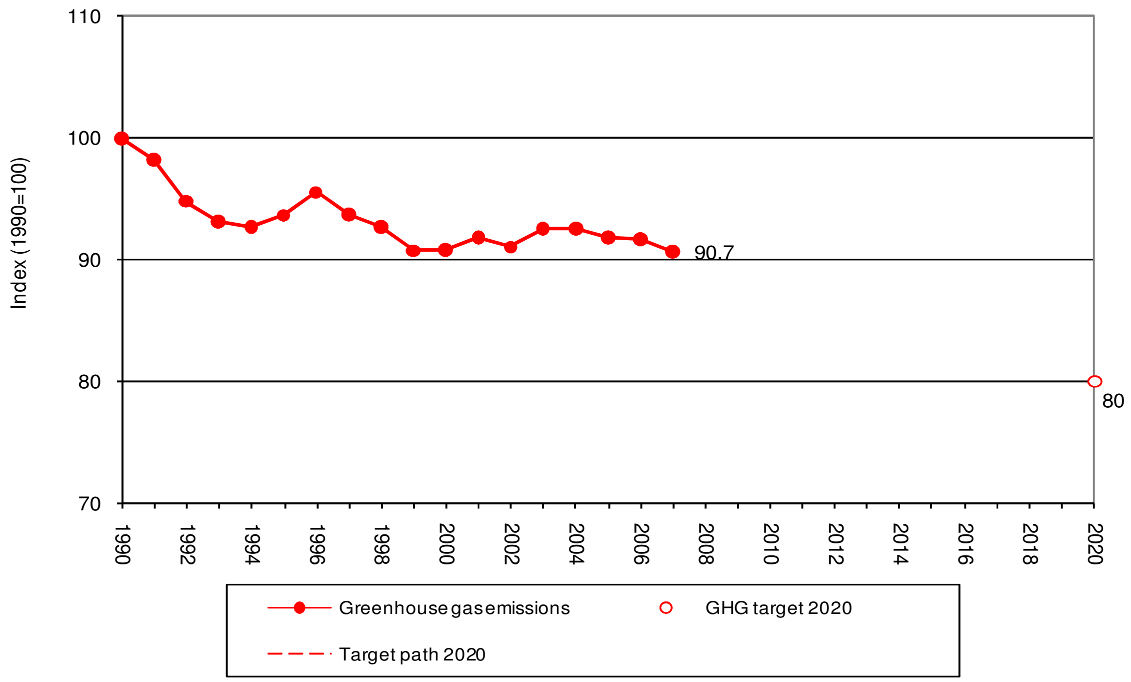
2 European Community greenhouse gas emission trends

This chapter presents the main GHG emission trends in the EC. Firstly, aggregated results are described for EU-27 and EU-15 as regards total GHG emissions and progress towards fulfilling the EC Kyoto target (for EU-15 only). Then, emission trends are briefly analysed mainly at gas level and a short overview of Member States' contributions to EC GHG trends is given. Finally, also the trends of indirect GHGs and SO_2 emissions are also presented for EU-15 only.

2.1 Aggregated greenhouse gas emissions

EU-27: In March 2007 the EC made a firm independent commitment to achieve at least a 20 % reduction of greenhouse gas emissions by 2020 compared to 1990[18]. Total GHG emissions, without LULUCF, in the EU-27 decreased by 9.3 % between 1990 and 2007 (519 million tonnes CO_2 equivalents). Emissions decreased by 1.2 % (-59 million tonnes CO_2 equivalents) between 2006 and 2007 (Figure 2.1).

Figure 2.1 **EU-27 GHG emissions 1990–2007 (excl. LULUCF)**



Notes: GHG emission data for the EU-27 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

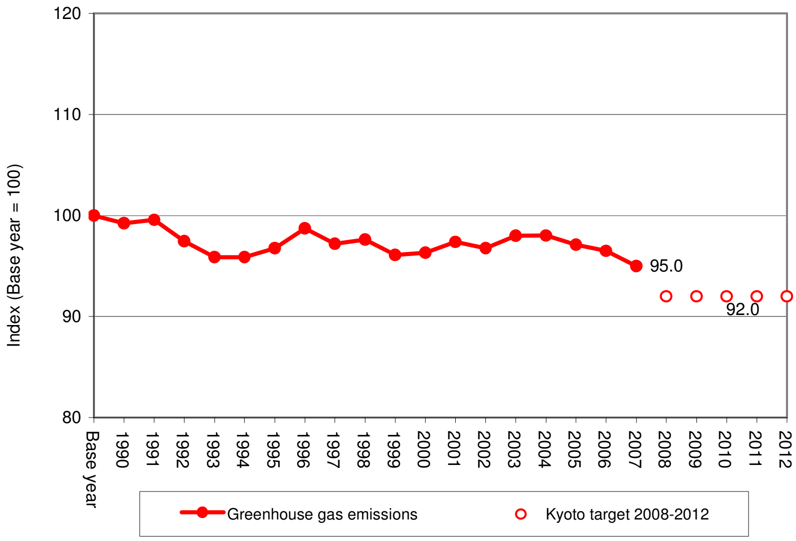
EU-15: In 2007 total GHG emissions in the EU-15, without LULUCF, were 4.3 % (181 million tonnes CO_2 equivalents) below 1990. Emissions decreased by 1.6 % (64 million tonnes CO_2 equivalents) between 2006 and 2007.

Under the Kyoto Protocol, the EC agreed to reduce its GHG emissions by 8 % by 2008–12 compared

[18] All emission information for EU-27 in this report uses 1990 as the starting point when addressing emission reductions. EU-27 does not have a common target under the Kyoto Protocol in the same way as EU-15.

to ‘base year’[19]. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms. Emissions (i.e. domestic) in 2007 were 5.0 % or 214 million tonnes CO_2 equivalents lower than emissions in the base year (Figure 2.2).

Figure 2.2 EU-15 GHG emissions 1990–2007 compared with target for 2008–12 (excl. LULUCF)



Notes: GHG emission data for the EU-15 as a whole refer to domestic emissions (i.e. within its territory) and do not include emissions and removals from LULUCF; nor do they include emissions from international aviation and international maritime transport. CO_2 emissions from biomass with energy recovery are reported as a Memorandum item according to UNFCCC Guidelines and not included in national totals. In addition, no adjustments for temperature variations or electricity trade are considered. The global warming potentials are those from the 1996 revised IPCC Guidelines for National Greenhouse Gas Inventories.

Following the UNFCCC reviews ofMember States' ‘initial reports’ during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol,the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent. The EU-15 would need to reduce greenhouse gas emissions by about 341 million tonnes, on average between 2008-2012, on the basis of the 2009 greenhouse gas inventory in order to meet its 8% Kyoto target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

Main trends by source category, 1990-2007

In 1990 EU-15 was responsible for 76.1% of EU-27’s total GHG emissions. In 2007 EU-15 was responsbile for 80.3% of EU-27 emissions. Between 1990 and 2007 emissions in the EU-27 decreased more than in the EU-15.. Table 2.1 shows the source categories contributing the most to changes in greenhouse gas emissions between 1990 and 2007.

Table 2.1: EU27/EU-15: Overview of Top decreasing/increasing source categories 1990-2007 (+/- 20 Million tonnes CO_2 equivalents)

Source category	EU-27	EU-15
	Million tonnes (CO_2 eq.)	
Road transport (CO_2 from 1A3b)	+200.7	+156.9
Consumption of Halocarbons (HFC from 2F)	+60.4	+54.2
Production of Halocarbons HFC from 2E)	-25.6	-25.6
Manfacture of solid fuels (CO_2 from 1A1c)	-34.9	-38.5
Enteric Fermentation (CH_4 from 4A)	-35.6	-13.3
Iron and steel production (CO_2 from 1A2a+2C1)	-47.7	-32.1
Adipic acid production (N_2O from 2B3)	-50.9	-50.0
Public Electricity and Heat Production (CO_2 from 1A1a)	-58.8	+79.4
Solid Waste Disposal (CH_4 from 6A)	-57.0	-64.4

[19] Following the UNFCCC reviews of Member States' ‘initial reports’ during 2007 and 2008 and pursuant to Article 3, Paragraphs 7 and 8 of the Kyoto Protocol, the base-year emissions for the EU-15 have been fixed to 4 265.5 Mt CO_2 equivalent.

Source category	EU-27	EU-15
	Million tonnes (CO_2 eq.)	
Fugitive Emmissions (CH_4 from 1B)	-66.8	-45.8
Agricultural Soils (N_2O from 4D)	-67.0	-32.8
Manufacturing industries (excl. iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-137.5	-66.7
Households and services (CO_2 from 1A4)	-141.1	-84.2
Total change 1990-2007	**-519.0**	**-180.9**

Notes: As the table only presents sectors that has increased/decreased equal or more than 20 Mt CO_2 equivalents the sum for each country grouping EU-27/EU-15 does not neccsarily match the total change listed at the bottom of the table

Main trends by source category, 2006-2007

Between 2006 and 2007, relative emission decreases in the EU-15 (-1.6 %) were only a little higher than in the EU-27 (-1.2 %). This was mainly due to larger increases of CO_2 emissions from public electricity and heat production and road transport, and less emission decreases from manufacturing industries in the EU-27 (Table 2.2).

Table 2.2: EU-27/EU-15: Overview of Top decreasing/increasing source categories 2006-2007 (+/- 3 Million tonnes CO_2 equivalents)

Source category	EU-27	EU-15
	Million tonnes (CO_2 eq.)	
Public Electricity and Heat Production (CO_2 from 1A1a)	+15.0	+10.7
Road transport (CO_2 from 1A3b)	+5.3	+1.7
Cement production (CO_2 from 2A1)	+4.5	+2.0
Consumption of Halocarbons (HFC from 2F)	+4.4	+3.1
Manufacture of Solid Fuels (CO_2 from 1A1c)	+3.6	+1.0
Fugitive Emmissions (CH_4 from 1B)	-3.1	-2.2
Iron and steel production (CO_2 from 1A2a+2C1)	-3.8	-2.2
Manufacturing industries (excl. iron and steel) (Energy-related CO_2 from 1A2 excl. 1A2a)	-4.7	-8.2
Households and services (CO_2 from 1A4)	-79.1	-66.8
Total change 2006-2007	**-59.4**	**-64.0**

Notes: As the table only presents sectors that has increased/decreased equal or more than 3Mt CO_2 equivalents the sum for each country grouping EU-27/EU-15 does not neccsarily match the total change listed at the bottom of the table

EU-15 – main reasons for emission changes 2006-2007

The 64.0 million tonnes (CO_2 equivalents) decrease in GHG emissions between 2006-2007 was mainly due to:

- Lower CO_2 emissions from households and services[20] (-66.8 million tonnes or -10.8 %). The use of fossil fuels (i.e. oil, gas and coal) decreased further (-10.1 %), particularly in households, mainly due to a lower number of heating degree days. Germany reported the highest emission decrease (-22.9 %); several reasons can be identified: (1) lower number of heating degree days (warmer winter) (-7.1 %), (2) fuel tax increased in 2007, therefor stocks were filled in 2006, (3) the nominal end-use price of gas for households increased sharply in 2007. These reasons might also be relevant for other EU-countries.
- Lower CO_2 emissions from manufacturing industries (excl. Iron and steel) (8.3 million or -1.9 %) tonnes, mainly in Italy, the UK and Spain.

[20] It includes emissions from fuel combustion in commercial and institutional buildings, and all emissions from fuel combustion in households. It also includes a smaller source category covering fuel-combustion emissions from agriculture, forestry and fishing. It should be noted that greenhouse gas emissions from households and services do not include indirect emissions. That is, greenhouse gas emissions resulting from the production of heat and electricity which is supplied to households and services are included under public electricity and heat production. Direct combustion emissions from households are outside the EU ETS.

- Lower CH_4 fugitive emissions (2.2 million tonnes or -6.5 %) mainly in the UK and Germany, due to reduced coal mining activity, and improvements to the gas distribution network.
- Less emissions in the iron and steel production due to reduced energy use are mainly caused by Germany (2.2 million tonnes or 1.4 %).

Substantial increases in GHG emissions between 2006-2007 took place in the following source categories:

- CO_2 emissions from Public Electricity and Heat Production (+10.7 million tonnes or +1.0 %)

  Countries show diverse trends for the last year. CO_2 emissions from public electricity and heat production increased mainly in Germany, Spain, Greece and the Netherlands due to higher electricity production in conventional thermal power plants. Decreases are reported by Finland, Denmark and the UK. Denmark had lower electricity production from coal and higher imports and lower exports; Finland had reduced electricity production from coal and made more use of hydropower; the reported reductions of the UK are mainly due to a further fuel shift from coal to gas. In the EU-15 the use of liquid fuels decreased by -21 %, while the use of solid fuels is constant and the use of gaseous fuels increased by 8 %. These trends are reflected in emission trends.
- Increases in HFC from the consumption of halocarbons (+3.1 million tonnes or +6.1 %) stems from Refrigeration and Air Conditioning. France, Germany and Italy report the highest increases.

EU-27 – main reasons for emission changes 2006-2007

Between 2006 and 2007, decreases in the EU-27 were mainly due to:

- CO_2 households and services (-79.1 million tonnes or -10.9 %).
  Reductions in the EU-27 were higher than in the EU-15 due to substantial decreases in Poland, Hungary and the Czech Republic. In these countries the use of solid, gaseous and liquid fuels decreased, which corresponds to the warmer weather conditions in 2007.
- CO_2 from manufacturing industries excl. iron and steel (-4.7 million tonnes or -0.9 %).
  The decrease is mainly due to EU-15 Member States, several new Member States report increases in emissions, the highest increase is reported by the Czech Republic.
- CO_2 from iron and steel production (-3.8 million tonnes or -1.8 %)
  The Czech Republic reported an emission decrease even higher than the EU-15 decrease.
- Fugitive CH_4 emissions from energy supply (-3.1 million tonnes or -4.4 %)
  The decrease in the EU-27 is mainly due to the EU-15, as well as reduction reported by the Czech Republic and Poland.

Substantial emission increases were due to:

- CO_2 from public electricity and heat production (+15.0 million tonnes or +1.1 %)
  The increase is caused by the EU-15, as well as emission increases reported by Bulgaria, Czech Republic and Estonia due to increased electricity generation from conventional thermal power plants. Poland and Slovakia reported decreases due to increased electricity imports.
- CO_2 from road transportation (+5.3 million tonnes or +0.6 %)
  The highest increases are reported by Slovakia, Lithuania, the Czech Republic and Slovenia apart from EU-15 Member States, mostly due to increased use of diesel oil.
- Higher CO_2 emission from cement production (+4.5 million tonnes or +4.4 %)
  Beside the increasing effect of the EU-15, Poland reported a major increase in emissions from cement production.
- Increases in HFC from the consumption of halocarbons (+4.4 million tonnes or +7.8 %) stems from Refrigeration and Air Conditioning. From the new Member States, Poland and Czech Republic report the highest increases.
- Higher CO_2 emissions from the manufacture of solid fuels (+3.6 million tonnes or +5.4 %)
  Poland contributed most to this increase in emissions.

Overview of GHG emissions in EC Member States

Table 2.3 Greenhouse gas emissions in CO_2 equivalents (excl. LULUCF) and Kyoto Protocol targets for 2008–12

MEMBER STATE	1990 (million tonnes)	Kyoto Protocol base year [(a)] (million tonnes)	2007 (million tonnes)	Change 2006–2007 (million tonnes)	Change 2006–2007 (%)	Change 1990-2007 (%)	Change base year–2007 (%)	Targets 2008–12 under Kyoto Protocol and "EU burden sharing" (%)
Austria	79.0	79.0	88.0	-3.6	-3.9%	11.3%	11.3%	-13.0%
Belgium	143.2	145.7	131.3	-5.3	-3.9%	-8.3%	-9.9%	-7.5%
Denmark	69.1	69.3	66.6	-4.4	-6.2%	-3.5%	-3.9%	-21.0%
Finland	70.9	71.0	78.3	-1.6	-2.0%	10.6%	10.3%	0.0%
France	562.6	563.9	531.1	-10.6	-2.0%	-5.6%	-5.8%	0.0%
Germany	1215.2	1232.4	956.1	-23.9	-2.4%	-21.3%	-22.4%	-21.0%
Greece	105.6	107.0	131.9	3.8	2.9%	24.9%	23.2%	25.0%
Ireland	55.4	55.6	69.2	-0.5	-0.7%	25.0%	24.5%	13.0%
Italy	516.3	516.9	552.8	-10.2	-1.8%	7.1%	6.9%	-6.5%
Luxembourg	13.1	13.2	12.9	-0.39	-2.9%	-1.6%	-1.9%	-28.0%
Netherlands	212.0	213.0	207.5	-1.0	-0.5%	-2.1%	-2.6%	-6.0%
Portugal	59.3	60.1	81.8	-2.9	-3.4%	38.1%	36.1%	27.0%
Spain	288.1	289.8	442.3	9.3	2.1%	53.5%	52.6%	15.0%
Sweden	71.9	72.2	65.4	-1.5	-2.2%	-9.1%	-9.3%	4.0%
United Kingdom	771.1	776.3	636.7	-11.2	-1.7%	-17.4%	-18.0%	-12.5%
EU-15	**4232.9**	**4265.5**	**4052.0**	**-64.0**	**-1.6%**	**-4.3%**	**-5.0%**	**-8.0%**
Bulgaria	117.7	132.6	75.5	4.2	5.9%	-35.8%	-43.0%	-8.0%
Cyprus	5.5	Not applicable	10.1	0.2	1.6%	85.3%	Not applicable	Not applicable
Czech Republic	194.7	194.2	150.8	1.7	1.2%	-22.5%	-22.4%	-8.0%
Estonia	41.9	42.6	22.0	2.8	14.8%	-47.5%	-48.3%	-8.0%
Hungary	99.2	115.4	75.9	-2.9	-3.7%	-23.5%	-34.2%	-6.0%
Latvia	26.7	25.9	12.1	0.4	3.5%	-54.7%	-53.4%	-8.0%
Lithuania	49.1	49.4	24.7	1.9	8.1%	-49.6%	-49.9%	-8.0%
Malta	2.0	Not applicable	3.0	0.07	2.3%	45.7%	Not applicable	Not applicable
Poland	459.5	563.4	398.9	-0.4	-0.1%	-13.2%	-29.2%	-6.0%
Romania	243.0	278.2	152.3	-1.6	-1.0%	-37.3%	-45.3%	-8.0%
Slovakia	73.3	72.1	47.0	-2.0	-4.1%	-35.9%	-34.8%	-8.0%
Slovenia	18.6	20.4	20.7	0.2	0.7%	11.6%	1.8%	-8.0%
EU-27	**5564.0**	**Not applicable**	**5045.1**	**-59.4**	**-1.2%**	**-9.3%**	**Not applicable**	**Not applicable**

([a]) The base year under the Kyoto Protocol for each Member State and EU-15 is further outlined in Table 1.4 and 1.5. As Cyprus, Malta and EU-27 do not have targets under the Kyoto Protocol and they do not have applicable Kyoto Protocol base years .

2.2 Emission trends by gas

EU-27: Table ES.4 gives an overview of the main trends in EU-27 GHG emissions and removals for 1990–2007. The most important GHG by far is CO_2, accounting for 83 % of total EU-27 emissions in 2007 excluding LULUCF. In 2007, EU-27 CO_2 emissions without LULUCF were 4 187 Tg, which was 4.8 % below 1990 levels. Compared to 2006, CO_2 emissions decreased by 1.3 %.

Table 2.4 Overview of EU-27 GHG emissions and removals from 1990 to 2007 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Net CO_2 emissions/removals	4.057	3.755	3.838	3.753	3.741	3.669	3.714	3.758	3.722	3.793	3.819	3.783	3.794	3.771
CO_2 emissions (without LULUCF)	4.400	4.150	4.251	4.163	4.152	4.084	4.106	4.184	4.158	4.252	4.264	4.232	4.243	4.187
CH_4	602	547	541	525	505	494	481	466	457	446	433	426	422	416
N_2O	513	455	460	458	434	411	409	403	392	391	394	389	375	374
HFCs	28	41	47	54	55	48	47	46	49	53	54	58	59	63
PFCs	20	14	13	11	10	10	8	8	9	8	6	5	5	4
SF_6	11	16	15	14	13	11	11	11	10	9	9	9	10	10
Total (with net CO_2 emissions/remova	**5.230**	**4.827**	**4.915**	**4.813**	**4.758**	**4.643**	**4.671**	**4.692**	**4.638**	**4.700**	**4.717**	**4.671**	**4.665**	**4.638**
Total (without CO2 from LULUCF)	**5.573**	**5.223**	**5.328**	**5.223**	**5.169**	**5.059**	**5.062**	**5.118**	**5.074**	**5.159**	**5.162**	**5.119**	**5.114**	**5.054**
Total (without LULUCF)	**5.564**	**5.213**	**5.318**	**5.214**	**5.159**	**5.049**	**5.053**	**5.109**	**5.066**	**5.150**	**5.153**	**5.111**	**5.104**	**5.045**

EU-15: Table ES.5 gives an overview of the main trends in EU-15 GHG emissions and removals for 1990–2007. Also in the EU-15 the most important GHG is CO_2, accounting for 84 % of total EU-15 emissions in 2007. In 2007, EU-15 CO_2 emissions without LULUCF were 3 391 Tg, which was 0.9 % above 1990 levels. Compared to 2006, CO_2 emissions decreased by 1.8 %.

Table 2.5 Overview of EU-15 GHG emissions and removals from 1990 to 2007 in CO_2 equivalents (Tg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Net CO_2 emissions/removals	3.138	3.024	3.080	3.025	3.077	3.037	3.087	3.135	3.111	3.156	3.190	3.156	3.158	3.126
CO_2 emissions (without LULUCF)	3.360	3.286	3.363	3.308	3.355	3.328	3.354	3.422	3.411	3.477	3.488	3.459	3.452	3.391
CH_4	436	411	406	394	385	376	366	354	344	331	320	314	309	305
N_2O	387	371	375	374	354	334	331	323	315	313	314	309	295	292
HFCs	28	41	47	53	54	47	46	44	46	50	50	53	54	57
PFCs	17	11	11	10	9	9	7	6	8	7	5	4	4	3
SF_6	11	15	15	14	13	11	11	10	9	9	9	9	9	9
Total (with net CO_2 emissions/remova	**4.016**	**3.873**	**3.934**	**3.870**	**3.891**	**3.813**	**3.848**	**3.873**	**3.834**	**3.866**	**3.888**	**3.845**	**3.828**	**3.793**
Total (without CO2 from LULUCF)	**4.239**	**4.136**	**4.218**	**4.153**	**4.170**	**4.104**	**4.114**	**4.160**	**4.134**	**4.187**	**4.187**	**4.148**	**4.122**	**4.058**
Total (without LULUCF)	**4.233**	**4.128**	**4.210**	**4.146**	**4.163**	**4.098**	**4.108**	**4.154**	**4.127**	**4.180**	**4.180**	**4.141**	**4.116**	**4.052**

Figure 2.3 CO_2 emissions without LULUCF 1990 to 2007 in CO_2 equivalents (Tg) and share of largest key source categories in 2007 for EU-15

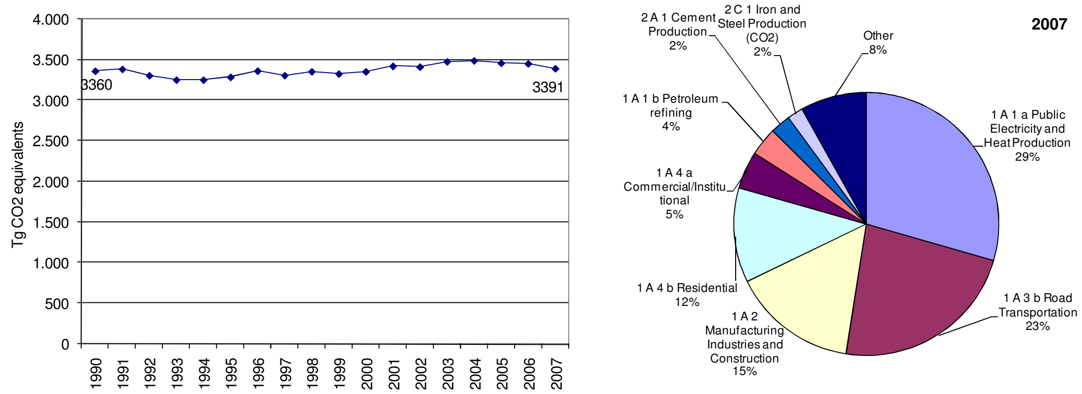
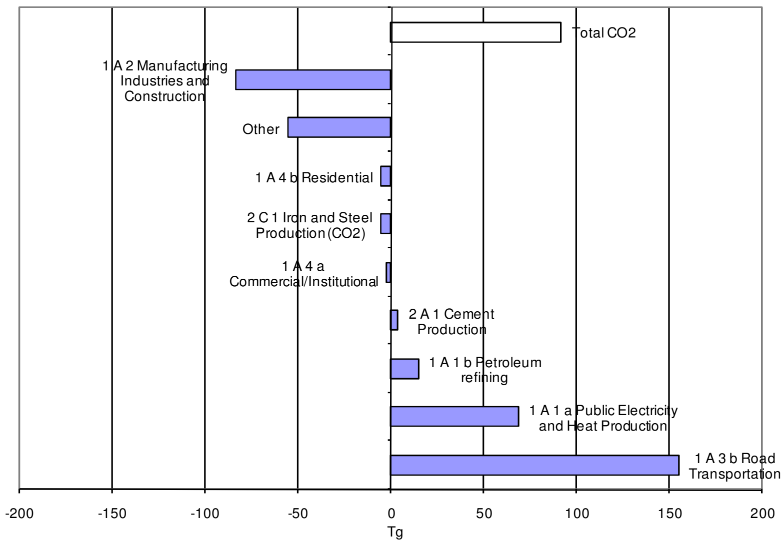


Figure 2.4 Absolute change of CO_2 emissions by large key source categories 1990 to 2007 in CO_2 equivalents (Tg) for EU-15



CH_4 emissions account for 7.5 % of total EU-15 GHG emissions and decreased by 30 % since 1990 to 305 Tg CO_2 equivalents in 2007 (Figure 2.5). The two largest key sources account for 55 % of CH_4 emissions in 2007. Figure 2.6 shows that the main reasons for declining CH_4 emissions were reductions in solid waste disposal on land and coal mining.

Figure 2.5 CH_4 emissions 1990 to 2007 in CO_2 equivalents (Tg) and share of largest source categories in 2007 for EU-15

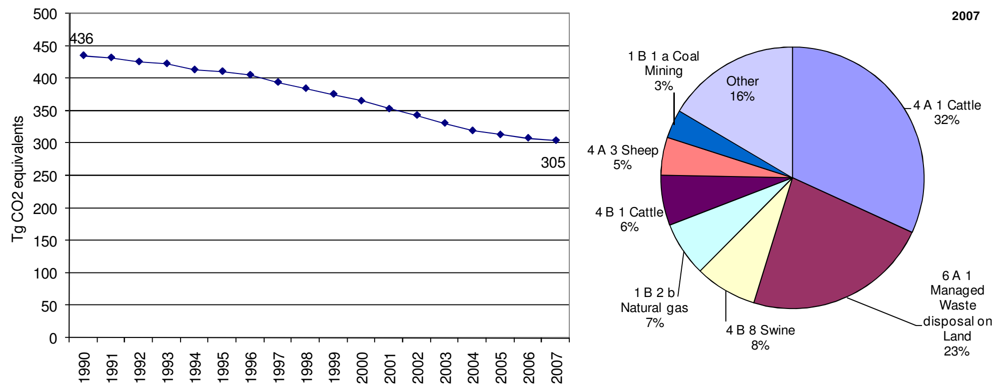
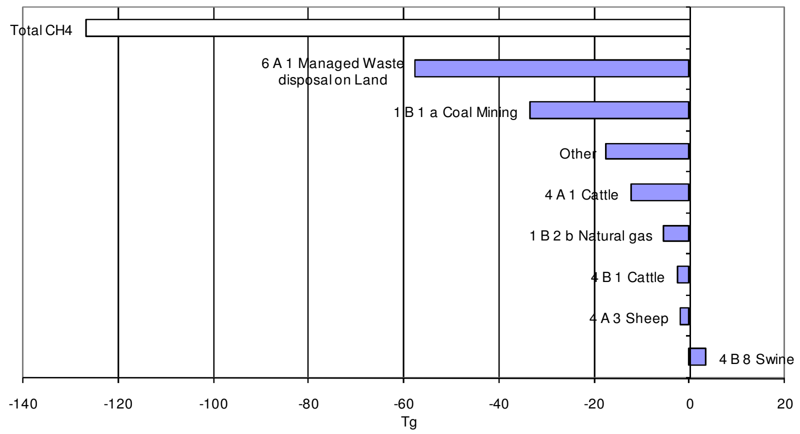


Figure 2.6 Absolute change of CH_4 emissions by large key source categories 1990 to 2007 in CO_2 equivalents (Tg) for EU-15



N_2O emissions are responsible for 7 % of total EU-15 GHG emissions and decreased by 24.5 % to 293 Tg CO_2 equivalents in 2007 (Figure 2.7). The two largest key sources account for about 53 % of N_2O emissions in 2007. Figure 2.8 shows that the main reason for large N_2O emission cuts were reduction measures in the adipic acid production.

Figure 2.7 N_2O emissions 1990 to 2007 in CO_2 equivalents (Tg) and share of largest source categories in 2007 for EU-15

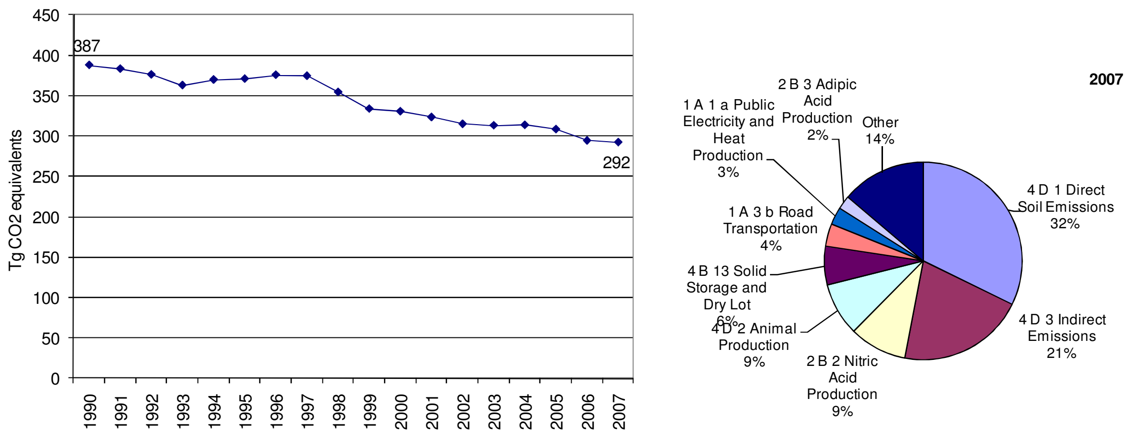
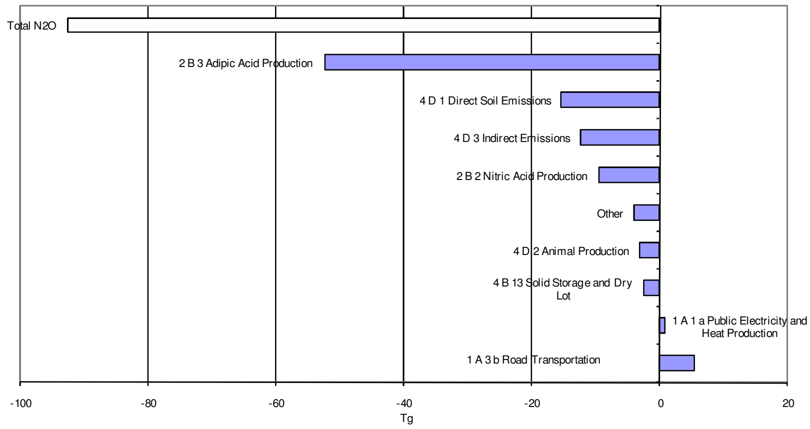


Figure 2.8 **Absolute change of N_2O emissions by large key source categories 1990 to 2007 in CO_2 equivalents (Tg) for EU-15**



Fluorinated gas emissions account for 1.5 % of total EU-15 GHG emissions. In 2007, emissions were 69 Tg CO_2 equivalents, which was 24 % above 1990 levels (Figure 2.9). The two largest key sources account for 85 % of fluorinated gas emissions in 2007. Figure 2.10 shows that HFCs from consumption of halocarbons showed large increases between 1990 and 2007. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). On the other hand, HFC emissions from production of halocarbons decreased substantially. The decrease started in 1998 and was strongest in 1999 and 2000.

Figure 2.9 **Fluorinated gas emissions 1990 to 2007 in CO_2 equivalents (Tg) and share of largest source categories in 2007 for EU-15**

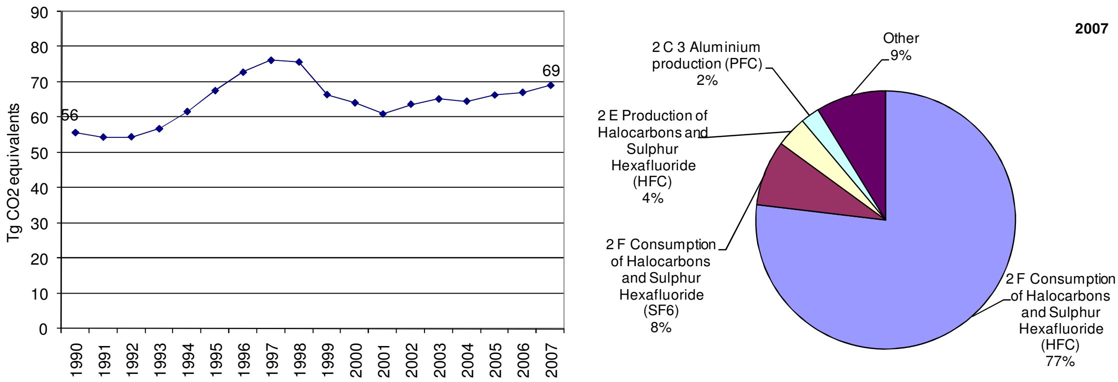
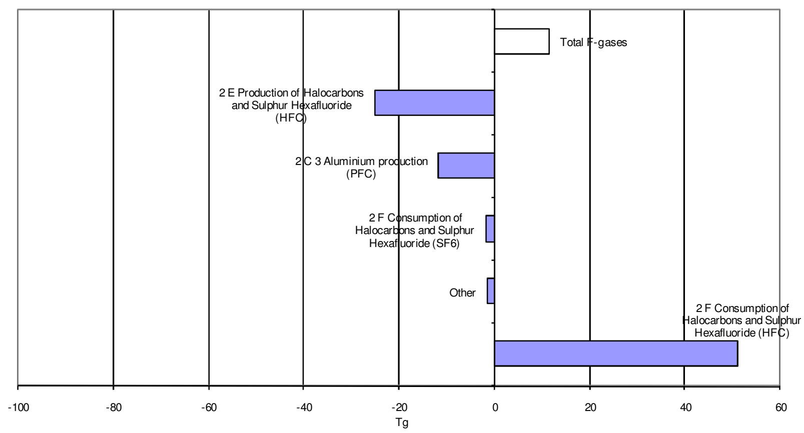


Figure 2.10 **Absolute change of fluorinated gas emissions by large key source categories 1990 to 2007 in CO_2 equivalents (Tg) for EU-15**



2.3 Emission trends by source

EU-27: Table ES.6 gives an overview of EU-27 GHG emissions in the main source categories for 1990–2007. The most important sector by far is Energy (i.e. combustion and fugitive emissions) accounting for 79 % of total EU-27 emissions in 2007. The second largest sector is Agriculture (9.2 %), followed by Industrial Processes (8.5 %).

Table 2.6 Overview of EU-27 GHG emissions in the main source and sink categories 1990 to 2007 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	4.277	4.032	4.142	4.037	4.024	3.964	3.970	4.053	4.023	4.109	4.106	4.066	4.068	3.999
2. Industrial Processes	478	456	452	460	432	393	405	393	390	401	412	420	417	430
3. Solvent and Other Product Use	16	14	14	14	14	14	14	13	13	13	13	12,405	13	12
4. Agriculture	579	504	506	507	505	501	493	485	479	474	473	466	463	462
5. Land-Use, Land-Use Change and Fore	-334	-385	-403	-400	-401	-406	-383	-417	-427	-450	-436	-439	-440	-407
6. Waste	213	207	203	196	184	178	172	164	160	154	149	146	144	141
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/remova	**5.230**	**4.827**	**4.915**	**4.813**	**4.758**	**4.643**	**4.671**	**4.692**	**4.638**	**4.700**	**4.717**	**4.671**	**4.665**	**4.638**
Total (without LULUCF)	**5.564**	**5.213**	**5.318**	**5.214**	**5.159**	**5.049**	**5.053**	**5.109**	**5.066**	**5.150**	**5.153**	**5.111**	**5.104**	**5.045**

EU-15: Table 2.7 gives an overview of EU-15 GHG emissions in the main source categories for 1990–2007. More detailed trend descriptions are included in Chapters 3 to 9.

Table 2.7 Overview of EU-15 GHG emissions in the main source and sink categories 1990 to 2007 in CO_2 equivalents (Tg)

GHG SOURCE AND SINK	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	3.257	3.178	3.263	3.195	3.238	3.213	3.228	3.299	3.284	3.343	3.345	3.313	3.301	3.233
2. Industrial Processes	372	371	369	378	357	325	330	321	320	325	331	332	325	332
3. Solvent and Other Product Use	14	12	12	12	12	12	12	11	11	11	10	10,432	10	10
4. Agriculture	419	402	406	407	407	406	403	394	389	385	383	377	373	371
5. Land-Use, Land-Use Change and Fore	-217	-255	-276	-276	-271	-284	-260	-280	-294	-314	-292	-296	-288	-259
6. Waste	171	165	161	153	148	141	136	129	123	117	112	109	107	105
7. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total (with net CO_2 emissions/remova	**4.016**	**3.873**	**3.934**	**3.870**	**3.891**	**3.813**	**3.848**	**3.873**	**3.834**	**3.866**	**3.888**	**3.845**	**3.828**	**3.793**
Total (without LULUCF)	**4.233**	**4.128**	**4.210**	**4.146**	**4.163**	**4.098**	**4.108**	**4.154**	**4.127**	**4.180**	**4.180**	**4.141**	**4.116**	**4.052**

2.4 Emission trends by Member State

Table 2.8 gives an overview of Member States' contributions to the EC GHG emissions for 1990–2007. Member States show large variations in GHG emission trends.

Table 2.8 Overview of Member States' contributions to EC GHG emissions excluding LULUCF from 1990 to 2007 in CO_2 equivalents (Tg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	79	81	84	83	82	81	81	85	87	93	92	93	92	88
Belgium	143	149	154	145	151	144	145	145	143	146	146	142	137	131
Denmark	69	76	90	80	76	73	68	69	69	74	68	63	71	67
Finland	71	71	77	76	72	72	70	75	77	85	80	69	80	78
France	563	556	571	565	578	562	557	558	549	552	552	554	542	531
Germany	1.215	1.085	1.105	1.068	1.042	1.010	1.008	1.025	1.006	1.007	997	969	980	956
Greece	106	110	113	118	123	123	127	128	128	131	131	132	128	132
Ireland	55	59	61	63	66	67	69	71	69	69	69	70	70	69
Italy	516	530	523	529	540	546	550	555	556	570	574	574	563	553
Luxembourg	13	10	10	10	9	9	10	10	11	12	13	13	13	13
Netherlands	212	225	233	226	227	215	214	216	215	217	218	212	209	208
Portugal	59	70	68	71	76	84	82	84	89	84	86	89	85	82
Spain	288	319	312	333	343	372	386	386	403	410	426	441	433	442
Sweden	72	74	77	73	73	70	68	69	70	70	70	67	67	65
United Kingdom	771	712	733	708	704	671	674	677	656	661	658	653	648	637
EU-15	**4.233**	**4.128**	**4.210**	**4.146**	**4.163**	**4.098**	**4.108**	**4.154**	**4.127**	**4.180**	**4.180**	**4.141**	**4.116**	**4.052**
Bulgaria	118	89	87	84	74	69	69	69	66	72	71	71	71	76
Cyprus	5	7	7	7	8	9	9	9	9	9	10	10	10	10
Czech Republic	195	153	160	153	145	141	147	149	145	146	147	146	149	151
Estonia	42	21	22	21	20	18	18	19	18	20	20	20	19	22
Hungary	99	80	82	80	80	80	78	80	78	81	80	80	79	76
Latvia	27	13	13	12	12	11	10	11	11	11	11	11	12	12
Lithuania	49	22	23	23	23	21	19	20	21	21	22	23	23	25
Malta	2	3	3	3	3	3	3	3	3	3	3	3	3	3
Poland	459	446	454	449	414	400	389	385	371	384	384	387	399	399
Romania	243	181	187	167	149	132	136	140	147	154	155	149	154	152
Slovakia	73	53	51	50	50	49	48	50	49	50	50	49	49	47
Slovenia	19	19	19	20	19	19	19	20	20	20	20	20	21	21
EU-27	**5.564**	**5.213**	**5.318**	**5.214**	**5.159**	**5.049**	**5.053**	**5.109**	**5.066**	**5.150**	**5.153**	**5.111**	**5.104**	**5.045**

Note: For some countries the data provided in this table is based on gap filling (see Chapter 1.8.2 for details.).

The overall EC GHG emission trend is dominated by the two largest emitters Germany and the United Kingdom, accounting for about one third of total EU-27 GHG emissions. These two Member States have achieved total GHG emission reductions of 393 million tonnes CO_2 equivalents compared to 1990[21].

The main reasons for the favourable trend in Germany were increasing efficiency in power and heating plants and the economic restructuring of the five new Länder after the German reunification. The reduction of GHG emissions in the United Kingdom was primarily the result of liberalising energy markets and the subsequent fuel switches from oil and coal to gas in electricity production and N_2O emission reduction measures in the adipic acid production.

Italy and France are the third and fourth largest emitters both with a share of 11 %. Italy's GHG emissions are about 7 % above 1990 levels in 2007. Italian GHG emissions increased since 1990 primarily from road transport, electricity and heat production and petrol-refining. France's emissions were 6 % below 1990 levels in 2007. In France, large reductions were achieved in N_2O emissions from the adipic acid production, but CO_2 emissions from road transport increased considerably between 1990 and 2007.

Spain and Poland are the fifth and sixth largest emitters in the EU-27, both accounting for 9 % and 8 % repectively of total EU-27 GHG emissions. Spain increased emissions by 54 % between 1990 and 2007. This was largely due to emission increases from road transport, electricity and heat production, and manufacturing industries. Poland decreased GHG emissions by 13 % between 1990 and 2007 (-29 % since the base year, which is 1988 in the case of Poland). Main factors for decreasing emissions in Poland — as for other new Member States — was the decline of energy inefficient heavy industry and the overall restructuring of the economy in the late 1980s and early 1990s. The notable exception was transport (especially road transport) where emissions increased.

(*21*) The EU-15 as a whole needs emission reductions of total GHG of 8 %, i.e. 341 million tonnes on the basis of the 2008 inventory in order to meet the Kyoto target. This can be achieved by a combination of existing and planned domestic policies and measures, the use of carbon sinks and the use of Kyoto mechanisms.

2.5 Emission trends for indirect greenhouse gases and sulphur dioxide

Emissions of CO, NO_x, NMVOC and SO_2 have to be reported to the UNFCCC Secretariat because they influence climate change indirectly: CO, NO_x and NMVOC are precursor substances for ozone which itself is a greenhouse gas. Sulphur emissions produce microscopic particles (aerosols) that can reflect sunlight back out into space and also affect cloud formation. Table 2.7 shows the total indirect GHG and SO_2 emissions in the EU-15 between 1990–2007. All emissions were reduced significantly from 1990 levels: the largest reduction was achieved in SO_2 (– 75 %), followed by CO (– 58 %), NMVOC (– 48 %) and NO_x (– 35 %).

Table 2.9 Overview of EU-15 indirect GHG and SO_2 emissions for 1990–2007 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	(Gg)													
NOx	13.448	11.870	11.610	11.209	11.039	10.761	10.494	10.279	10.007	9.916	9.704	9.442	9.141	8.812
CO	52.273	41.593	40.008	38.062	36.410	34.028	31.691	29.885	28.046	27.186	26.076	24.120	23.083	22.083
NMVOC	15.877	12.941	12.441	12.230	11.806	11.333	10.631	10.153	9.676	9.735	9.113	8.875	8.704	8.205
SO2	16.464	9.941	8.914	8.163	7.623	6.756	6.072	5.807	5.567	5.096	4.879	4.562	4.354	4.163

In the EU-27, SO_2 emissions decreased by 70 %, followed by CO (-55 %), NMVOC (-46 %) and NO_x (-35 %) (Table 2.10).

Table 2.10 Overview of EU-27 indirect GHG and SO2 emissions for 1990–2007 (Gg)

GREENHOUSE GAS EMISSIONS	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	(Gg)													
NOx	16.740	14.488	14.287	13.807	13.423	12.997	12.314	11.965	11.674	11.640	11.845	11.538	11.352	10.977
CO	64.251	50.994	50.048	47.649	45.400	42.717	37.559	35.139	33.148	32.295	34.142	31.738	30.139	28.914
NMVOC	17.949	14.754	14.352	14.096	13.630	13.078	12.280	11.755	11.301	11.392	10.742	10.468	10.403	9.799
SO2	24.952	16.622	15.463	14.414	12.741	11.287	9.978	9.650	9.167	8.671	8.458	7.956	7.799	7.587

Table 2.11 shows the NO_x emissions of the EU-27 Member States between 1990–2007. The largest emitters, the UK, Spain, Germany and France, made up 51 % of total NO_x emissions in 2007. Most EU-27 Member States reduced their emissions, only Austria, Greece, Spain and Hungary had emission increases between 1990 and 2007.

Table 2.11 Overview of Member States' contributions to EU-15 and EU-27 NO_x emissions for 1990–2007 (Gg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	192	179	201	189	204	196	204	214	225	236	235	239	227	219
Belgium	382	371	352	344	346	320	329	314	297	295	297	284	267	259
Denmark	273	265	302	255	233	215	201	198	195	204	188	180	181	167
Finland	295	245	248	240	225	220	211	211	208	217	203	175	193	183
France	1.923	1.766	1.741	1.699	1.711	1.663	1.615	1.575	1.539	1.509	1.488	1.472	1.408	1.358
Germany	2.863	2.122	2.036	1.954	1.903	1.872	1.803	1.720	1.624	1.551	1.487	1.403	1.364	1.294
Greece	296	315	320	329	353	344	337	351	350	361	359	386	361	375
Ireland	124	125	129	129	134	134	136	138	128	123	123	124	119	118
Italy	2.009	1.869	1.806	1.730	1.630	1.529	1.435	1.422	1.367	1.361	1.320	1.229	1.188	1.150
Luxembourg	0,2	0,5	1	1	1	1	1	1	1	1	0,4	0,4	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	545	449	427	395	390	397	386	376	369	366	346	330	317	290
Portugal	258	290	283	282	293	302	301	302	312	294	292	295	270	255
Spain	1.248	1.349	1.312	1.358	1.369	1.442	1.464	1.447	1.498	1.503	1.533	1.533	1.487	1.499
Sweden	303	266	258	245	234	224	214	204	199	193	183	177	172	167
United Kingdom	2.738	2.260	2.195	2.060	2.011	1.902	1.858	1.806	1.694	1.703	1.650	1.615	1.589	1.479
EU-15	**13.448**	**11.870**	**11.610**	**11.209**	**11.039**	**10.761**	**10.494**	**10.279**	**10.007**	**9.916**	**9.704**	**9.442**	**9.141**	**8.812**
Bulgaria	242	151	145	141	136	123	128	138	134	147	137	149	154	153
Cyprus	19	20	21	21	22	21	20	20	21	21	19	20	20	19
Czech Republic	742	430	447	471	414	391	397	333	319	326	334	279	284	286
Estonia	103	45	48	47	45	39	38	39	40	42	41	39	38	39
Hungary	8	185	192	196	198	197	185	183	183	211	185	203	202	185
Latvia	67	40	40	40	40	39	37	38	38	39	45	43	44	43
Lithuania	136	51	55	56	61	53	46	44	48	51	53	53	61	67
Malta	10	10	10	10	10	10	9	9	9	10	9	9	9	9
Poland	1.280	1.120	1.154	1.114	991	951	498	395	382	378	804	825	921	885
Romania	462	387	430	376	336	290	305	328	342	354	367	333	344	351
Slovakia	222	178	135	128	133	121	109	109	101	98	98	98	87	83
Slovenia	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	49	50	49	48	48	47	47	45
EU-27	**16.740**	**14.488**	**14.287**	**13.807**	**13.423**	**12.997**	**12.314**	**11.965**	**11.674**	**11.640**	**11.845**	**11.538**	**11.352**	**10.977**

Table 2.12 shows the CO emissions of the EU-27 Member States between 1990–2007. The largest emitters, France, Germany and Italy that made up 44 % of the total CO emissions in 2007, reduced their emissions from 1990 levels substantially. Also all other Member States, except for Malta, Hungary and Romania, reduced emissions.

Table 2.12 Overview of Member States' contributions to EU-15 and EU-27 CO emissions for 1990–2007 (Gg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	1.432	1.256	1.236	1.144	1.099	1.026	954	946	930	953	911	869	838	768
Belgium	1.377	1.113	1.079	1.010	975	992	1.068	1.010	980	948	895	836	815	747
Denmark	717	645	624	563	530	488	472	467	446	452	439	448	439	448
Finland	710	634	623	621	616	607	587	579	570	557	539	509	497	487
France	11.733	10.131	9.535	8.971	8.770	8.258	7.622	7.040	6.838	6.554	6.652	6.137	5.601	5.136
Germany	12.155	6.686	6.279	6.140	5.732	5.361	5.080	4.823	4.533	4.319	4.100	3.812	3.793	3.763
Greece	1.295	1.328	1.355	1.355	1.385	1.311	1.356	1.266	1.230	1.193	1.155	930	841	785
Ireland	418	317	324	308	318	282	254	244	225	213	203	192	182	171
Italy	6.986	6.887	6.586	6.306	5.922	5.510	4.894	4.669	4.231	4.091	3.896	3.520	3.355	3.416
Luxembourg	17	10	7	5	3	7	7	7	7	7	4	4	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	1.067	804	772	725	701	611	647	625	603	582	583	551	544	534
Portugal	959	937	879	833	859	812	830	755	761	918	721	749	655	615
Spain	3.956	3.537	3.614	3.544	3.469	3.150	3.054	2.992	2.783	2.890	2.741	2.655	2.751	2.570
Sweden	938	866	839	788	722	697	664	626	610	613	583	581	549	566
United Kingdom	8.513	6.440	6.256	5.749	5.310	4.915	4.202	3.836	3.298	2.894	2.653	2.327	2.223	2.077
EU-15	**52.273**	**41.593**	**40.008**	**38.062**	**36.410**	**34.028**	**31.691**	**29.885**	**28.046**	**27.186**	**26.076**	**24.120**	**23.083**	**22.083**
Bulgaria	790	644	610	531	641	618	635	583	678	654	674	646	667	629
Cyprus	47	42	41	38	40	35	31	33	33	35	33	28	28	26
Czech Republic	1.071	932	965	981	812	726	680	687	587	630	622	556	540	581
Estonia	256	177	200	204	171	164	161	169	156	155	150	136	131	148
Hungary	168	645	648	637	633	592	592	579	574	600	585	585	596	574
Latvia	383	314	323	313	303	303	304	308	308	316	323	320	317	300
Lithuania	499	279	306	354	368	313	1.528	217	216	221	183	189	198	196
Malta	24	30	31	31	31	31	30	29	29	28	28	31	31	32
Poland	7.406	4.547	4.837	4.700	4.301	4.363	237	942	856	757	3.426	3.321	2.804	2.603
Romania	824	1.370	1.715	1.435	1.344	1.209	1.196	1.238	1.233	1.269	1.610	1.390	1.345	1.365
Slovakia	512	420	364	364	346	335	313	315	292	308	310	299	290	277
Slovenia	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	162	154	141	135	121	117	108	99
EU-27	**64.251**	**50.994**	**50.048**	**47.649**	**45.400**	**42.717**	**37.559**	**35.139**	**33.148**	**32.295**	**34.142**	**31.738**	**30.139**	**28.914**

Table 2.13 shows the NMVOC emissions of the EU-27 Member States between 1990–2007. The largest emitters France, Germany and Italy that made up 49 % of the total NMVOC emissions in 2007, reduced their emissions from 1990 levels. All Member States except for Hungary reduced emissions.

Table 2.13 Overview ofMember States' contributions to EU-15 and EU-27 NMVOC emissions for 1990–2007 (Gg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	274	222	214	199	184	171	176	180	185	188	170	178	186	179
Belgium	357	312	288	285	275	269	249	244	230	226	207	202	204	192
Denmark	181	161	163	151	141	137	133	125	123	117	115	113	107	104
Finland	229	192	185	180	176	171	165	162	156	151	147	136	133	128
France	3.921	3.583	3.385	3.399	3.257	3.291	3.118	2.967	2.788	3.087	2.673	2.681	2.704	2.325
Germany	3.759	2.091	1.999	1.958	1.915	1.760	1.593	1.499	1.423	1.351	1.355	1.334	1.298	1.280
Greece	300	336	342	343	351	350	351	346	343	334	328	274	211	204
Ireland	78	72	76	75	77	70	65	66	61	58	56	55	55	48
Italy	1.948	2.003	1.963	1.910	1.834	1.730	1.571	1.503	1.433	1.377	1.321	1.250	1.223	1.207
Luxembourg	6	6	6	6	5	5	5	5	5	5	6	6	5	5
Netherlands	456	316	271	247	249	234	218	198	188	175	168	168	163	156
Portugal	326	332	328	329	330	322	318	316	319	329	315	315	308	303
Spain	1.095	1.031	1.061	1.075	1.108	1.103	1.085	1.063	1.021	1.040	1.020	990	974	958
Sweden	352	247	240	229	216	208	199	187	185	187	185	182	177	178
United Kingdom	2.595	2.038	1.920	1.844	1.689	1.513	1.386	1.292	1.217	1.108	1.046	989	956	938
EU-15	**15.877**	**12.941**	**12.441**	**12.230**	**11.806**	**11.333**	**10.631**	**10.153**	**9.676**	**9.735**	**9.113**	**8.875**	**8.704**	**8.205**
Bulgaria	117	94	87	72	87	78	79	82	87	86	96	103	109	78
Cyprus	12	13	13	13	13	14	14	14	14	14	14	13	12	10
Czech Republic	311	215	265	272	267	247	244	220	203	203	198	182	179	174
Estonia	54	36	38	39	32	29	29	30	28	29	29	26	25	30
Hungary	63	170	170	165	169	165	166	162	160	169	157	176	187	168
Latvia	90	54	55	55	55	55	53	54	55	57	60	60	60	58
Lithuania	110	72	77	83	83	76	70	66	66	80	75	90	84	83
Malta	6	7	8	8	8	8	3	3	3	3	3	3	3	3
Poland	831	769	766	774	730	731	599	576	600	585	510	492	628	596
Romania	335	281	335	293	280	259	265	266	282	301	359	321	296	281
Slovakia	141	101	97	92	88	82	76	80	77	82	83	79	75	74
Slovenia	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	10	NA,NE,NO	51	50	48	47	46	48	41	39
EU-27	**17.949**	**14.754**	**14.352**	**14.096**	**13.630**	**13.078**	**12.280**	**11.755**	**11.301**	**11.392**	**10.742**	**10.468**	**10.403**	**9.799**

Table 2.14 shows the SO_2 emissions of the EU-27 Member States between 1990–2007. The largest emitters, Poland, Spain and Bulgaria, that made up 46 % of the total SO_2 emissions in 2007, reduced their emissions from 1990 levels. All other Member States except for Greece and Hungary reduced emissions.

Table 2.14 Overview ofMember States' contributions to EU-15 and EU-27 SO_2 emissions for 1990–2007 (Gg)

Member State	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Austria	74	47	45	40	36	34	32	33	32	33	27	27	29	26
Belgium	362	262	247	227	214	175	171	167	157	154	157	144	134	126
Denmark	178	137	172	99	76	55	29	27	25	32	25	22	25	23
Finland	249	105	110	101	93	91	81	90	88	101	83	68	84	82
France	1.363	1.009	984	842	858	742	650	595	547	539	535	512	481	462
Germany	5.291	1.695	1.430	1.186	946	772	616	613	569	547	521	501	504	484
Greece	472	539	529	522	530	548	499	504	516	554	548	549	534	543
Ireland	182	161	149	167	178	159	140	135	102	79	71	70	60	54
Italy	1.796	1.320	1.210	1.133	995	896	750	697	616	518	480	401	379	340
Luxembourg	0,2	0,2	0,2	0,2	0,3	0,2	0,2	0,2	0,2	0,2	0,2	0,2	IE,NA,NE,NO	IE,NA,NE,NO
Netherlands	190	128	116	102	94	88	72	73	67	63	63	65	64	60
Portugal	320	334	273	294	344	344	307	296	296	202	206	213	191	185
Spain	2.167	1.782	1.554	1.734	1.581	1.594	1.457	1.429	1.532	1.267	1.310	1.266	1.162	1.156
Sweden	105	68	67	60	57	47	44	42	42	43	39	37	37	34
United Kingdom	3.716	2.352	2.029	1.655	1.622	1.210	1.226	1.105	978	965	812	686	669	590
EU-15	**16.464**	**9.941**	**8.914**	**8.163**	**7.623**	**6.756**	**6.072**	**5.807**	**5.567**	**5.096**	**4.879**	**4.562**	**4.354**	**4.163**
Bulgaria	1.517	1.300	1.311	1.311	1.192	1.056	1.045	1.096	983	1.043	998	957	1.049	1.168
Cyprus	45	39	42	45	45	45	48	46	46	49	41	39	32	30
Czech Republic	1.876	1.095	934	981	442	269	264	251	237	232	227	219	211	217
Estonia	216	117	123	120	102	95	98	98	97	111	101	89	101	102
Hungary	10	707	671	656	593	598	489	404	365	348	249	147	123	99
Latvia	101	49	55	39	36	29	10	8	6	5	4	5	4	3
Lithuania	214	85	86	76	99	69	42	38	38	38	41	42	42	34
Malta	16	29	30	32	33	30	24	26	25	27	12	12	12	13
Poland	3.210	2.376	2.368	2.181	1.897	1.719	1.202	1.172	1.088	1.019	1.241	1.232	1.222	1.131
Romania	757	639	698	606	495	448	460	506	540	532	514	523	543	543
Slovakia	526	246	231	205	184	173	127	131	103	106	97	89	88	71
Slovenia	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	98	68	71	66	54	41	18	14
EU-27	**24.952**	**16.622**	**15.463**	**14.414**	**12.741**	**11.287**	**9.978**	**9.650**	**9.167**	**8.671**	**8.458**	**7.956**	**7.799**	**7.587**

3 Energy (CRF Sector 1)

This chapter starts with an overview on emission trends in CRF Sector 1 Energy. For each EU-15 key category overview tables are presented including the Member States' contributions to the key category in terms of level and trend, information on methodologies and emission factors. The chapter includes also sections on uncertainty estimates, sector-specific QA/QC, recalculations, the reference approach, and international bunkers.

3.1 Overview of sector (EU-15)

CRF Sector 1 Energy contributes 80 % to total GHG emissions and is the largest emitting sector in the EU-15. Total GHG emissions from this sector decreased by 0.7 % from 3 257 Tg in 1990 to 3 233 Tg in 2007 (Figure 3.1). In 2007, emissions decreased by 2.1 % compared to 2006.

The most important energy-related gas is CO_2 that makes up 78 % of the total EU-15 GHG emissions. CH_4 and N_2O are each responsible for 1 % of the total GHG emissions. The key sources in this sector are as follows.

1 A 1 a Public Electricity and Heat Production: Gaseous Fuels (CO_2)
1 A 1 a Public Electricity and Heat Production: Liquid Fuels (CO_2)
1 A 1 a Public Electricity and Heat Production: Other Fuels (CO_2)
1 A 1 a Public Electricity and Heat Production: Solid Fuels (CO_2)
1 A 1 a Public Electricity and Heat Production: Solid Fuels (N_2O)
1 A 1 b Petroleum refining: Gaseous Fuels (CO_2)
1 A 1 b Petroleum refining: Liquid Fuels (CO_2)
1 A 1 b Petroleum refining: Solid Fuels (CO_2)
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Gaseous Fuels (CO_2)
1 A 1 c Manufacture of Solid fuels and Other Energy Industries: Solid Fuels (CO_2)
1 A 2 a Iron and Steel: Gaseous Fuels (CO_2)
1 A 2 a Iron and Steel: Liquid Fuels (CO_2)
1 A 2 a Iron and Steel: Solid Fuels (CO_2)
1 A 2 b Non-Ferous Metals: Solid Fuels (CO_2)
1 A 2 c Chemicals: Gaseous Fuels (CO_2)
1 A 2 c Chemicals: Liquid Fuels (CO_2)
1 A 2 c Chemicals: Other Fuels (CO_2)
1 A 2 c Chemicals: Solid Fuels (CO_2)
1 A 2 d Pulp, Paper and Print: Gaseous Fuels (CO_2)
1 A 2 d Pulp, Paper and Print: Liquid Fuels (CO_2)
1 A 2 e Food Processing, Beverages and Tobacco: Gaseous Fuels (CO_2)
1 A 2 e Food Processing, Beverages and Tobacco: Liquid Fuels (CO_2)
1 A 2 e Food Processing, Beverages and Tobacco: Solid Fuels (CO_2)
1 A 2 f Other: Gaseous Fuels (CO_2)
1 A 2 f Other: Liquid Fuels (CO_2)
1 A 2 f Other: Other Fuels (CO_2)
1 A 2 f Other: Solid Fuels (CO_2)
1 A 3 a Civil Aviation: Jet Kerosene (CO_2)
1 A 3 b Road Transportation: Diesel oil (CO_2)
1 A 3 b Road Transportation: Diesel oil (N_2O)
1 A 3 b Road Transportation: Gasoline (CO_2)
1 A 3 b Road Transportation: Gasoline (N_2O)
1 A 3 b Road Transportation: LPG (CO_2)
1 A 3 c Railways: Liquid Fuels (CO_2)
1 A 3 d Navigation: Gas/Diesel Oil (CO_2)
1 A 3 d Navigation: Residual Oil (CO_2)
1 A 3 e Other Transportation: Gaseous Fuels (CO_2)
1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)
1 A 4 b Residential: Biomass (CH_4)
1 A 4 b Residential: Gaseous Fuels (CO_2)
1 A 4 b Residential: Liquid Fuels (CO_2)
1 A 4 b Residential: Solid Fuels (CO_2)
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)
1 A 5 a Stationary: Solid Fuels (CO_2)
1 A 5 b Mobile: Liquid Fuels (CO_2)
1 B 1 a Coal Mining:(CH_4)
1 B 2 a Oil:(CO_2)
1 B 2 b Natural gas:(CH_4)

1 B 2 c Venting and flaring:(CO_2)

Figure 3.1 CRF Sector 1 Energy: EU-15 GHG emissions in CO_2 equivalents (Tg)for 1990–2007

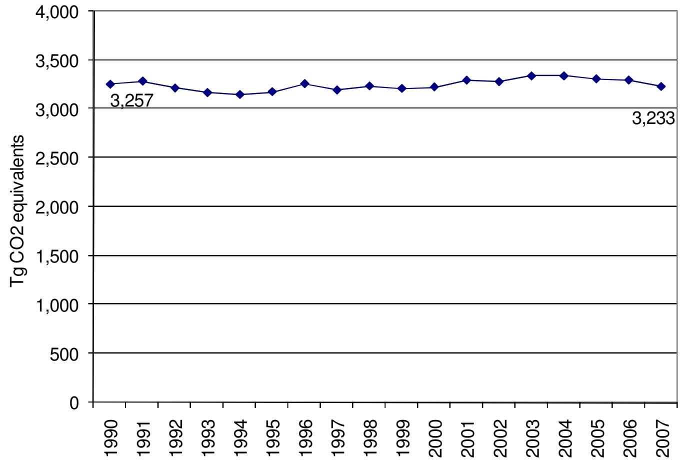
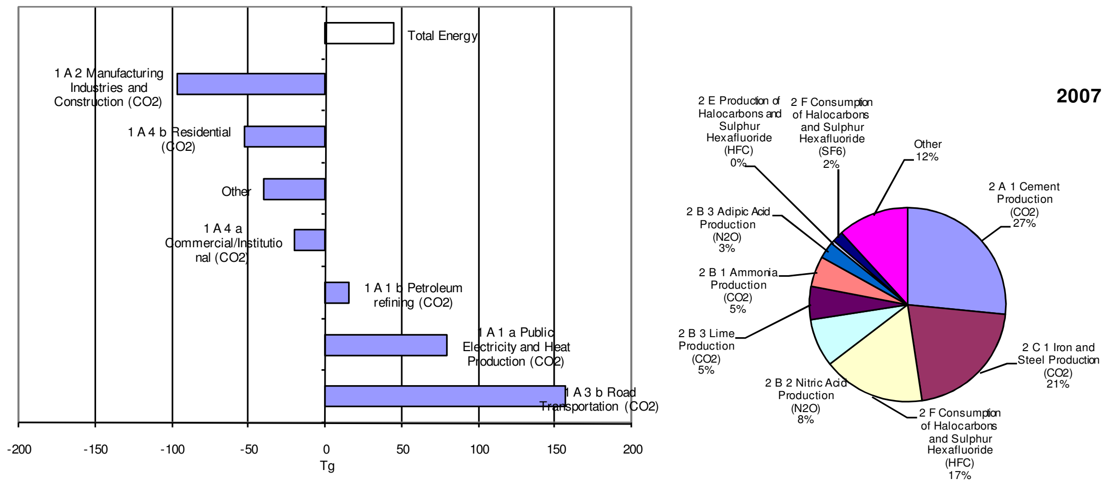


Figure 3.2 shows that CO_2 emissions from road transport had the highest increase in absolute terms of all energy-related emissions, while CO_2 emissions from 1A2 Manufacturing Industries decreased substantially between 1990 and 2007. The increases in road transport occurred in almost all Member States, whereas the emission reductions from manufacturing industries mainly occurred in Germany after the reunification. The decline of coal-mining (CH_4) and decreasing CO_2 emissions from 1A1c Manufacture of Solid Fuels and Other Energy Industries are the main reasons for the large absolute emission reductions from Other in Figure 3.2. Figure 3.2 shows that the six largest key sources account for 90 % of emissions in Sector 1.

Figure 3.2 CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2007 and share of largest key source categories in 2007



3.2 Source categories (EU-15)

3.2.1 Energy industries (CRF Source Category 1A1)

Energy industries (CRF 1A1) comprises emissions from fuels combusted by the fuel extraction or energy-producing industries. For the EU-15, this source category includes three key sources: CO_2 from 'Electricity and heat production' (CRF 1A1a), CO_2 from 'Petroleum-refining' (CRF 1A1b), and CO_2 from 'Manufacture of solid fuels and other energy industries' (CRF 1A1c).

Figure 3.3 shows the trends in emissions in energy industries for the EU-15 between 1990 and 2007, which was mainly dominated by CO_2 emissions from public electricity and heat production. CO_2 from 1A1a currently represents about 84 % of greenhouse gas emissions in 1A1 (i.e. including methane and nitrous oxide).

Total greenhouse gas emissions from 1A1 increased by 5 %, between 1990 and 2007. About 84 % of the gross increase was accounted for by emissions from public electricity and heat production (79 Tg) and 15 % by petroleum refining (16 Tg). Greenhouse gas emissions from the manufacturing of solid fuels fell by 39 Tg over the 1990-2007 period.

Figure 3.3: 1A1 Energy Industries: Total GHG, CO_2 and N_2O emission trends and Activity Data

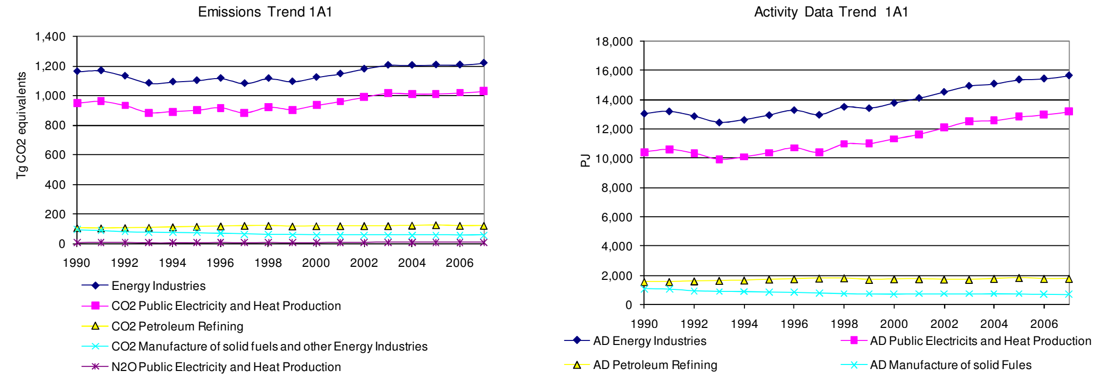


Table 3.1 summarises the information by Member State. Greenhouse gas emissions from energy industries increased in eleven Member States and fell in four. Of the twelve countries where emissions were higher in 2007 than in 1990, the highest absolute increase was accounted for by Spain and Italy. Of the four countries were emissions fell over the 1990-2007 period, about 93 % of the reductions came from Germany and the UK. The change in the EU-15 was a net increase of 57 Tg, as explained above. The table also shows the contributions of CO_2 and N_2O separately.

Table 3.1 1A1 Energy industries: Member States' contributions to CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 2007 (Gg CO_2 equivalents)
Austria	13,844	14,014	13,792	13,929	48	80
Belgium	30,192	26,968	29,948	26,803	234	144
Denmark	26,315	25,475	26,173	25,132	119	150
Finland	19,187	30,789	19,057	30,439	122	327
France	66,824	67,268	66,157	66,393	593	842
Germany	419,448	389,716	414,853	385,528	4,416	4,053
Greece	43,316	59,051	43,149	58,840	154	193
Ireland	11,576	14,854	11,159	14,407	417	446
Italy	134,791	158,548	134,092	157,850	504	565
Luxembourg	1,302	1,363	1,299	1,359	2	3
Netherlands	52,707	65,904	52,492	65,519	140	246
Portugal	16,010	19,914	15,944	19,777	61	129
Spain	77,694	123,035	77,357	122,137	283	739
Sweden	10,181	10,764	9,831	10,283	329	406
United Kingdom	238,304	211,259	236,075	209,467	2,025	1,551
EU-15	**1,161,691**	**1,218,923**	**1,151,380**	**1,207,864**	**9,446**	**9,874**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.4 shows the relative contributions of greenhouse gas emissions from energy industries in each Member State, ranging from relatively low shares in Luxembourg and France to relatively high in Denmark, Germany, Finland and Greece. Figure 3.5 shows the absolute contributions to EU-15 greenhouse gas emissions from energy industries, which are clearly dominated by Germany and the

UK. These two countries represent about half of the EU's greenhouse gas emissions from energy industries.

Figure 3.4: Share of greenhouse gas emissions from energy industries in totalgreenhouse gas emissions by Member State in 2007

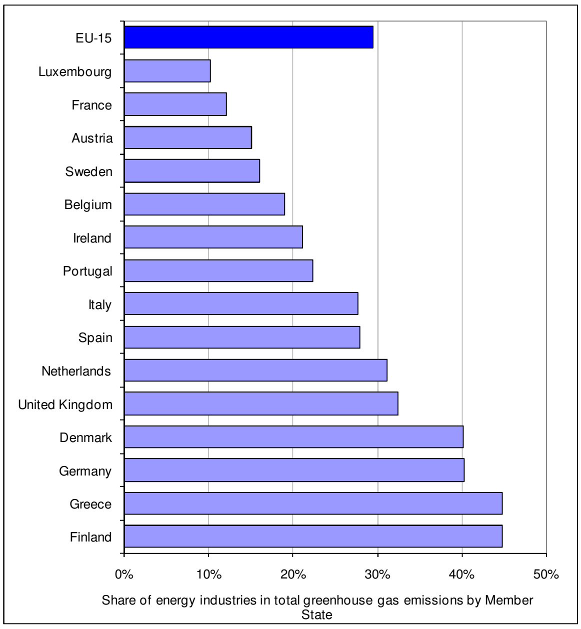
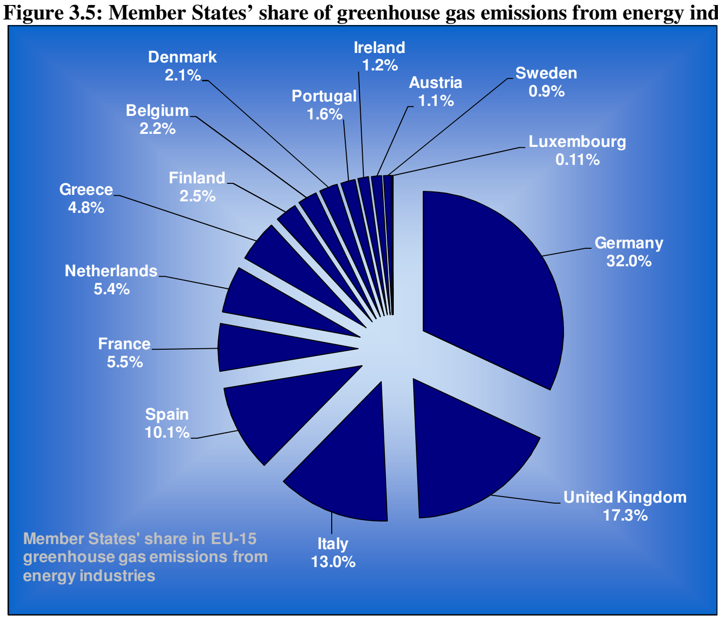


Figure 3.5: Member States' share of greenhouse gas emissions from energy industries in EU-15



Public heat and electricity production is the largest source category in the EU-15, as well as the main source of emissions from energy industries. The fuel mix can explain to a large extent differences in the greenhouse gas intensity of heat and electricity production of Member States. The relative low share of greenhouse gas emissions from energy industries in France can be partly explained by the use of nuclear energy for power generation. Luxembourg is a net importer of electricity from neighbouring countries. Some countries rely more on coal than on gas. At the EU-15 level, about 45 % of the fuel used in energy industries comes from solid fuels, although its contribution has been declining in favour of relatively cleaner natural gas, whose share stood at about 33 % in 2007.

Table 3.2 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A1 Energy Industries for 1990 and 2006 as well as the main explanations for the largest recalculations in absolute terms.

Table 3.2 1A1 Energy Industries: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0.0	119	0.8	
Belgium	0	0.0	103	0.4	
Denmark	0	0.0	398	1.4	
Finland	2	0.0	-52	-0.2	
France	0	0.0	-213	-0.3	
Germany	-83	0.0	3,243	0.9	Activity data: new data available; Method: improvement of the calculation method as a result of quality control
Greece	704	1.7	744	1.4	
Ireland	0	0.0	0	0.0	
Italy	0	0.0	71	0.0	
Luxembourg	-3	-0.2	61	4.2	
Netherlands	0	0.0	496	0.8	
Portugal	0	0.0	55	0.2	
Spain	0	0.0	-123	-0.1	
Sweden	-219	-2.2	-211	-1.9	
UK	-348	-0.1	-2,785	-1.3	Emission factor: Introduction of EUETS based emission factors for coal fired power stations; Method: Change to geographical coverage used
EU-15	**54**	**0.0**	**1,907**	**0.2**	

Table 3.3 provides information on the contribution of Member States to EU-15 recalculations in N_2O from 1A1 Energy Industries for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 3.3. 1A1 Energy industries: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006	
	Gg	Percent	Gg	Percent
Austria	0	0.0	0	-0.5
Belgium	16	7.2	26	21.0
Denmark	0	0.0	0	-0.1
Finland	0	0.1	1	0.3
France	0	0.0	-5	-0.6
Germany	-156	-3.4	-56	-1.4
Greece	47	44.4	2	0.8
Ireland	0	0.0	0	0.0
Italy	0	0.0	-3	-0.6
Luxembourg	-1	-	-6	-
Netherlands	0	0.0	0	-0.1
Portugal	0	0.0	0	0.3
Spain	0	0.0	15	2.1
Sweden	-14	-4.0	-13	-3.0
UK	139	7.3	37	2.3
EU-15	**32**	**0.3**	**-2**	**0.0**

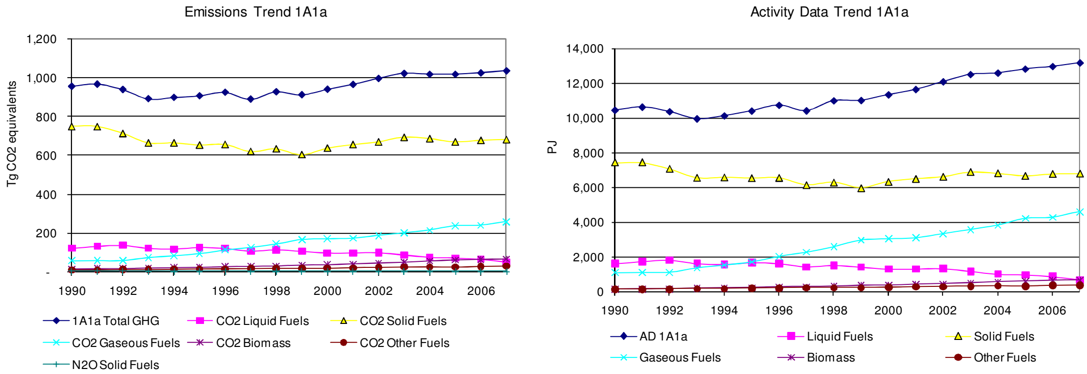
3.2.1.1 Public Electricity and Heat Production (1A1a) (EU-15)

According to the IPCC, emissions from public electricity and heat production (CRF 1A1a) should include emissions from main activity producers of electricity generation, combined heat and power generation, and heat plants. Main activity producers (i.e. public utilities) are defined as those undertakings whose primary activity is to supply the public. They may be in public or private ownership. Emissions from own on-site use of fuel should be included. Emissions from autoproducers (undertakings which generate electricity/heat wholly or partly for their own use, as an activity that supports their primary activity) should be assigned to the sector where they were generated and not under 1A1a. Autoproducers may be in public or private ownership.

CO_2 emissions from electricity and heat production is the largest key source in the EU-15 accounting for about one quarter of total greenhouse gas emissions in 2007 and for 99 % of greenhouse gas emissions from public heat and electricity production. Between 1990 and 2007, CO_2 emissions from electricity and heat production increased by 8 % in the EU-15.

Figure 3.6 shows the trends in emissions originating from the production of public heat and electricity by fuel in the EU-15 between 1990 and 2007. It also shows the activity data behind the emissions[22].

Figure 3.6: 1A1a-Public Electricity and Heat Production: Total, CO_2 and N_2O emission and activity trends

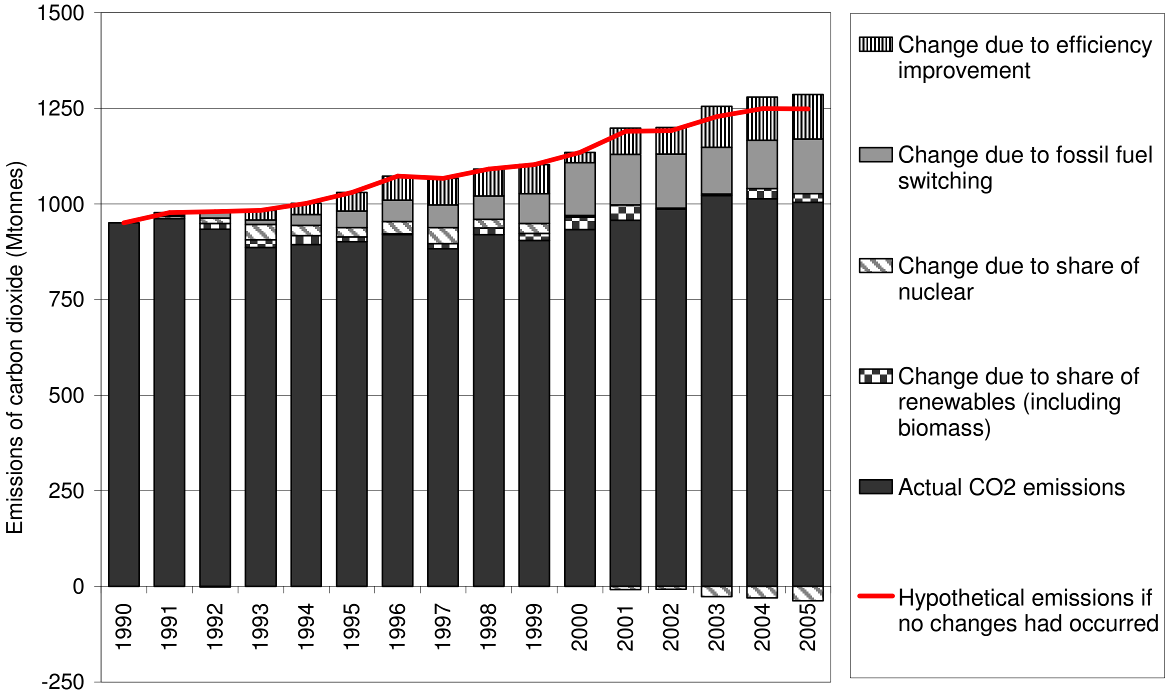


Fuel used for public heat and electricity production increased by 26 % in the EU-15 between 1990 and 2007. Solid fuels still represent more than half of the fuel used in public conventional thermal power plants, although its share in the fuel mix has been declining. Gas has increased very rapidly, by a factor of 3 between 1990 and 2007, and its share stands at about one third of all the fuel used for the production of heat and electricity in the EU. Liquid fuels still account for some 5 % but its use has declined gradually during the past 17 years. The use of biomass has increased as rapidly as the use of gas, but its share in the fuel mix is relatively small, at around 5 %.

CO_2 emissions from public electricity and heat production did not increase in line with fuel consumption. There are several reasons for this. Figure 3.7 below shows the estimated impact of different factors on the reduction of CO_2 emissions from public heat and electricity generation in the EU-15 between 1990–2005. The main explanatory factors at the EU-15 level during the past 16 years have been improvements in energy efficiency and (fossil) fuel switching from coal to gas.

[22] CO_2 emissions from the combustion of biomass fuels are reported as a memo item and are therefore not included in the emissions from public electricity and heat production. The biomass used as a fuel is however included in the national energy consumption (i.e. activity data). The fact that CO_2 emissions from biomass are treated differently from other fuel emissions does not imply emissions from the production of heat and electricity are due to fossil fuel combustion only. Biomass CO_2 emissions are just reported elsewhere. Non-CO_2 emissions from the combustion of biomass (CH_4 and N_2O) are reported under the energy sector.

Figure 3.7: Estimated impact of different factors on the reduction in emissions of CO_2 from public electricity and heat production in the EU-15 between 1990 and 2005.



Note: The chart show the estimated contributions of the various factors that have affected emissions from public electricity and heat production (including public thermal power stations, nuclear power stations, hydro power plants and wind plants). The top line represents the hypothetical development of emissions that would have occurred due to increasing public heat and electricity production between 1990 and 2005, if the structure of electricity and heat production had remained unchanged since 1990, i.e. if the shares of input fuels used to produce electricity and heat had remained constant, and if the efficiency of electricity and heat production also stayed the same. However, there were a number of changes that tended to reduce emissions. The contribution of each of these changes to reducing emissions are shown by each of the bars. The cumulative effect of all these changes was that emissions from electricity and heat production actually followed the trend shown by the black bars. This is a frequently used approach for portraying the primary driving forces of emissions. It is based on the IPAT and Kaya identities. The explanatory factors should not be seen as fundamental factors in themselves nor should they be seen as independent from each other. The underpinning energy data is based on Eurostat's energy balances.

Based on the chart above, CO_2 emissions from public heat and electricity production increased by about 6 % during 1990-2005, but emissions would have risen by over 30 %, had the shares of input fuels used to produce electricity and heat and the efficiency remained constant, an increase which would be in line with the additional amount of electricity and heat produced. The relationship between the increase in electricity generation and the actual reduction in emissions during 1990-2005 can be explained by the following factors:

- An improvement in the thermal efficiency of electricity and heat production. During 1990-2005, there was a 9 % reduction in the fossil-fuel input per unit of electricity produced from fossil fuels.
- Changes in the fossil fuel mix used to produce electricity, i.e. fuel switching from coal and lignite to natural gas. There was a 12 % reduction in the CO_2 emissions per unit of fossil-fuel input during 1990-2005.

- The lower combined share of nuclear and renewable energy for electricity and heat production in 2005 compared to 1990[23]. During 1990-2005, the share of electricity from fossil fuels in total electricity production increased by 1 %.

These three factors interact with each other in a multiplicative way: Actual CO_2 emissions change = 1.31 (increase in electricity production) X 0.91 (efficiency improvement) X 0.88 (fossil fuel switching) X 1.01 (lower nuclear-renewable share)= 1.06. The combined effect was an increase of about 6 % in CO_2 emissions in 2005 compared to the 1990 level.

Returning to the 2009 inventory, table 3.4 summarises emissions arising from the production of public heat and electricity by Member State. CO_2 emissions increased in ten Member States and fell in five. Of the ten countries where emissions were higher in 2007 than in 1990, close to 39 % of the increase was accounted for by Spain alone. Of the remaining four countries, where emissions fell, more than 85 % of the reduction came from the UK. The change in the EU-15 was a net increase of about 79 Tg.

Table 3.4: 1A1a Public Electricity and Heat Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	10,888	12,048	10,434	1.0%	-1,613	-13%	-454	-4%
Belgium	23,504	22,740	21,862	2.1%	-878	-4%	-1,642	-7%
Denmark	24,736	27,271	22,545	2.2%	-4,727	-17%	-2,191	-9%
Finland	16,450	29,413	27,330	2.7%	-2,083	-7%	10,880	66%
France	47,925	46,671	47,493	4.6%	823	2%	-431	-1%
Germany	335,782	330,322	345,673	33.6%	15,351	5%	9,891	3%
Greece	40,582	51,392	54,764	5.3%	3,372	7%	14,182	35%
Ireland	10,876	14,411	13,933	1.4%	-478	-3%	3,056	28%
Italy	107,136	122,056	120,808	11.7%	-1,248	-1%	13,672	13%
Luxembourg	1,299	1,523	1,359	0.1%	-164	-11%	59	5%
Netherlands	39,923	49,809	52,669	5.1%	2,859	6%	12,746	32%
Portugal	13,960	19,554	17,153	1.7%	-2,401	-12%	3,193	23%
Spain	64,341	101,420	107,365	10.4%	5,945	6%	43,024	67%
Sweden	7,691	8,123	8,034	0.8%	-89	-1%	343	4%
United Kingdom	204,091	181,124	177,132	17.2%	-3,991	-2%	-26,959	-13%
EU-15	**949,185**	**1,017,876**	**1,028,553**	**100.0%**	**10,677**	**1%**	**79,368**	**8%**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Note that German CO_2 emissions from SO2 scrubbing are included in this source category. Other Member States include these emissions in 1B1 or 2A3.

Figure 3.8 shows the relative contributions of greenhouse gas emissions from energy industries in each Member State, ranging from relatively low shares in Luxembourg and France to relatively high in Denmark, Greece, Germany and Finland. Figure 3.9 shows the absolute contributions to EU-15 CO_2 emissions from this source category, dominated by Germany and the UK. These two countries represent about half of the EU's greenhouse gas emissions from public electricity and heat production.

23 The specific nuclear effect can be separated from the renewable effect in an additive way. These two factors will then be additive to each other and the combined renewable and nuclear effect will remain multiplicative to the already-mentioned fuel-switching and efficiency factors.

Figure 3.8: Share of CO_2 emissions from public electricity and heat production in total greenhouse gas emissions by Member State in 2007

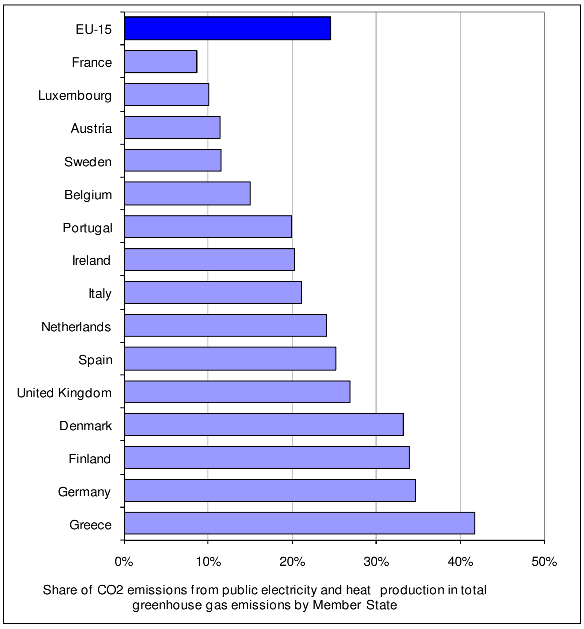
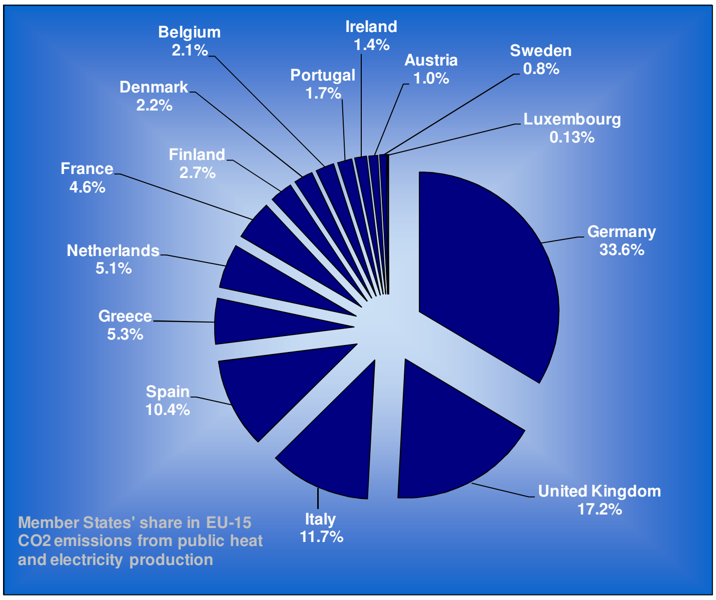


Figure 3.9: Member States' share of CO_2 emissions from public heat and electricity production in EU-15



Finally, N_2O emissions currently represent about 1 % of greenhouse gas emissions from public electricity and heat production. They increased by 10 % between 1990 and 2007 (Table 3.5). Emissions from this source category only declined in the United Kingdom and Belgium.

Table 3.5: 1A1a Public Electricity and Heat Production: Member States' contributions to N_2O emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	43	70	74	0.9%	4	6%	31	71%
Belgium	101	102	100	1.2%	-3	-3%	-2	-2%
Denmark	103	138	120	1.4%	-18	-13%	17	17%
Finland	104	308	303	3.6%	-6	-2%	198	190%
France	452	689	699	8.3%	11	2%	247	55%
Germany	3,610	3,555	3,743	44.4%	187	5%	133	4%
Greece	147	173	182	2.2%	8	5%	34	23%
Ireland	412	510	436	5.2%	-74	-14%	25	6%
Italy	326	343	331	3.9%	-12	-4%	5	2%
Luxembourg	2	3	3	0.0%	0	-	1	-
Netherlands	132	227	219	2.6%	-8	-3%	88	67%
Portugal	52	129	118	1.4%	-11	-9%	67	130%
Spain	197	608	623	7.4%	15	2%	425	216%
Sweden	305	393	382	4.5%	-11	-3%	77	25%
United Kingdom	1,668	1,193	1,105	13.1%	-88	-7%	-563	-34%
EU-15	**7,654**	**8,442**	**8,438**	**100.0%**	**-5**	**0%**	**783**	**10%**

1A1a Electricity And Heat Production - Liquid Fuels (CO_2)

CO_2 emissions arising from the combustion of liquid fuels for public electricity and heat generation account for about 5 % of all greenhouse gas emissions from 1A1a. Within the EU-15, emissions fell by about 58 % between 1990 and 2007 (Table 3.6).

Table 3.6: 1A1a Public Electricity and Heat Production, liquid fuels: Member States' contributions to CO_2 emissions

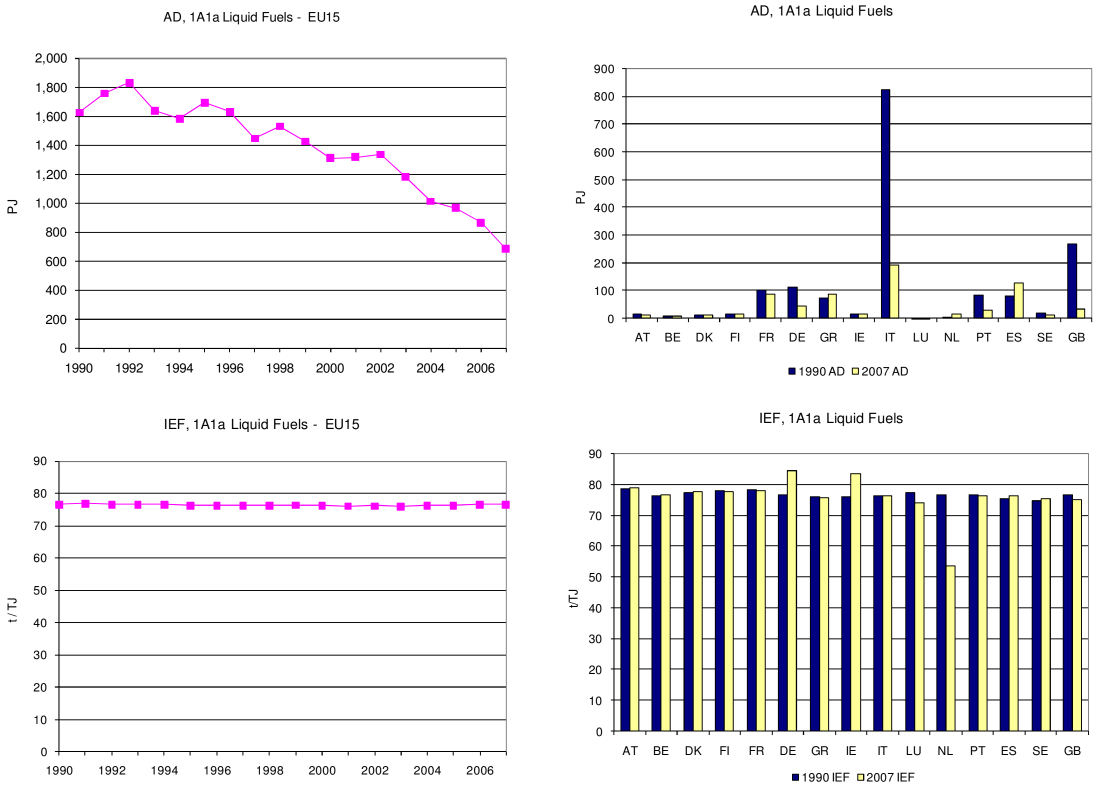
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,229	1,169	766	1.5%	-403	-35%	-463	-38%	T2	NS, PS	CS, PS
Belgium	659	854	536	1.0%	-318	-37%	-123	-19%	CS/T3	PS/Q/AS	CS/D
Denmark	947	1,168	961	1.8%	-207	-18%	15	2%	C	NS/PS	CS/C/D
Finland	1,244	1,147	1,109	2.1%	-38	-3%	-134	-11%	T3	PS	CS, D
France	7,894	7,575	6,788	13.0%	-788	-10%	-1,106	-14%	C	PS	CS
Germany	8,507	3,916	3,556	6.8%	-359	-9%	-4,950	-58%	CS	NS	CS
Greece	5,375	6,415	6,572	12.6%	157	2%	1,197	22%	T2	NS	PS
Ireland	1,087	2,222	1,284	2.5%	-938	-42%	198	18%	T3	NS	PS
Italy	63,047	22,341	14,654	28.0%	-7,686	-34%	-48,393	-77%	T3	NS, PS	CS
Luxembourg	9	1	1	0.0%	0	11%	-8	-86%	T1	NS PS	D
Netherlands	207	734	741	1.4%	7	1%	535	258%	T2	NS/Q	CS
Portugal	6,301	2,830	2,333	4.5%	-497	-18%	-3,967	-63%	T2	PS,NS	D,C,PS
Spain	6,007	11,293	9,706	18.5%	-1,587	-14%	3,699	62%	T2	PS, Q	PS, C
Sweden	1,278	1,368	854	1.6%	-514	-38%	-424	-33%	T2	PS	CS
United Kingdom	20,791	3,322	2,498	4.8%	-824	-25%	-18,293	-88%	T2	NS,AS	CS
EU-15	**124,579**	**66,355**	**52,360**	**100.0%**	**-13,995**	**-21%**	**-72,219**	**-58%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.10 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels used in public electricity and heat production. The charts clearly show the importance of liquid fuels has been declining rather gradually since 1992. The implied emission factor has remained broadly stable at the EU-15 level (77 t/Tj in 2007). The largest emitters in 2007 were Italy and Spain, together responsible fornearly half the EU-15 emissions, although emissions have fallen markedly in Italy compared to 1990.

In 2007 Germany had the highest IEF of all EU-15 countries (84 t/Tj). Its IEF declined up to 1998 but has gone up since then. This can be explained by the increase in the use of pet coke to generate electricity. The high IEF of over 80 arises from the category 'other mineral oil products', a mixture of diverse mineral products, and it is based on expert judgement. In the Netherlands, the IEF declined from 71 t/Tj in 1994 to about 60 t/Tj in 1995 and onwards, and stood at 54 t/TJ in 2007. This is explained by the sharp increase in liquid fuel use since 1994/1995 and the use of residual chemical gas[24].

Figure 3.10: 1A1a-Public Electricity and Heat Production, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A1a Electricity and Heat Production - Solid Fuels (CO_2, N_2O)

CO_2 emissions from the combustion of solid fuels represented about two thirds of all greenhouse gas emissions from public electricity and heat production. Within the EU-15, emissions fell by 9 % between 1990 and 2007 (Table 3.7).

[24] In the Netherlands in this sector, among others, residual gases from the chemical industry are combusted. The implied emission factor is low because these residual gases contain hydrogen gas. The IEF decreased by 15% between 2006-2007 because for a few companies company specific emission factors for residual gases were calculated (based on the Annual Environmental Reports) for the first time, in stead of using default emission factors for residual gases. The default EF do not take the hydrogen in the residual gases into account.

Table 3.7: 1A1a Public Electricity and Heat Production, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	6,247	5,643	5,067	0.7%	-576	-10%	-1,180	-19%	T2	NS, PS	CS, PS
Belgium	19,345	10,476	9,122	1.3%	-1,354	-13%	-10,223	-53%	CS/T3	PS/Q/AS	CS/D
Denmark	22,462	20,928	17,341	2.5%	-3,587	-17%	-5,121	-23%	C	NS/PS	CS/C
Finland	9,281	14,921	12,914	1.9%	-2,007	-13%	3,633	39%	T3	PS	CS
France	36,565	28,899	30,088	4.4%	1,188	4%	-6,477	-18%	C	PS	CS
Germany	304,692	277,484	291,129	42.6%	13,645	5%	-13,563	-4%	CS	NS	CS
Greece	35,207	40,727	42,571	6.2%	1,844	5%	7,364	21%	T2	NS	CS
Ireland	7,909	6,966	6,704	1.0%	-262	-4%	-1,206	-15%	T3	NS	PS
Italy	28,148	40,643	41,043	6.0%	400	1%	12,895	46%	T3	NS, PS	CS
Luxembourg	1,230	NO	NO	-	-	-	-1,230	-100%	T1	PS	D
Netherlands	25,776	24,098	26,068	3.8%	1,969	8%	292	1%	T2	NS/Q	CS
Portugal	7,659	12,150	10,014	1.5%	-2,136	-18%	2,354	31%	T2	PS	D,C,PS
Spain	57,787	65,583	71,082	10.4%	5,499	8%	13,294	23%	T2	PS, Q	PS
Sweden	5,376	5,052	5,188	0.8%	137	3%	-188	-3%	T2	PS	CS
United Kingdom	183,150	125,957	115,120	16.8%	-10,837	-9%	-68,030	-37%	T2	NS,AS	CS
EU-15	**750,835**	**679,527**	**683,450**	**100.0%**	**3,923**	**1%**	**-67,385**	**-9%**			

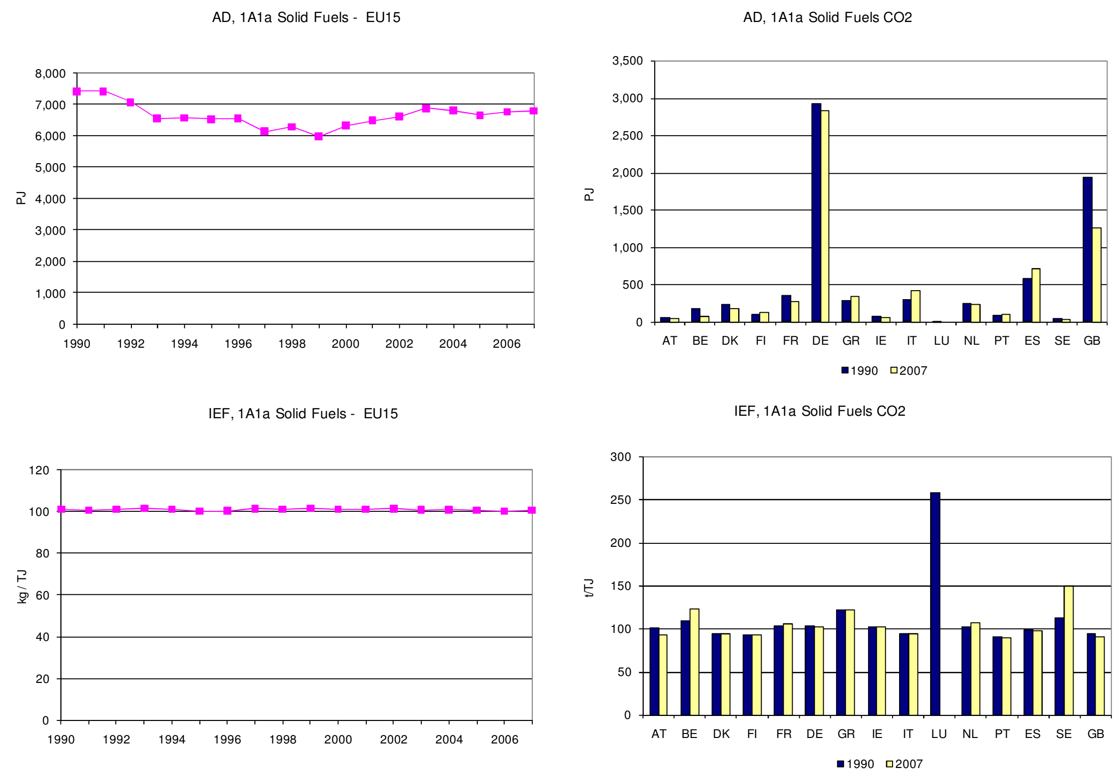
Note that German CO_2 emissions from SO2 scrubbing are included in this source category. Other Member States include these emissions in 1B1 or 2A3.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.11 shows the relevant activity data and implied emission factors. The weight of solid fuels fell gradually up to 1999 and has somewhat increased thereafter. The EU-15 implied emission factor has remained fairly stable (100.5 t/Tj in 2007). The largest emitters in 2007 were Germany and the UK, jointly responsible for 61 % of EU-15 emissions. In both countries, however, emissions have fallen compared to 1990, particularly in the UK.

Solid fuels used in public heat and electricity production in Luxembourg are insignificant after 1997. Before then, the emission factor was the highest of EU-15 countries because of the use of blast furnace technology. There has also been a sharp increase in the emission factor in Sweden. This is explained by the increase in the use of blast furnace gas since 1996 (SCB, Tomas Gustafsson, 2007-03-12). In Belgium, the IEF increased sharply in the last few years (from 106 t/Tj in 1998 to 123 t/Tj in 2007) and it has become the second largest in the EU. The main reason behind such increase is the use of blast furnace gas.

Figure 3.11: **1A1a- Public Electricity and Heat Production, solid fuels: Activity Data and Implied Emission Factors for CO_2**



The related N_2O emissions from the use of solid fuels are responsible for almost 1 % of all greenhouse gas emissions in the heat and power sector. For the EU-15, emissions in 2007 fell by 9 %, although this is the net effect of averaging Member States' trends (Table 3.8) . In Spain and Finland, emissions doubled whereas in Austria, Belgium and Sweden emissions more than halved. The UK showed the largest reduction in absolute terms.

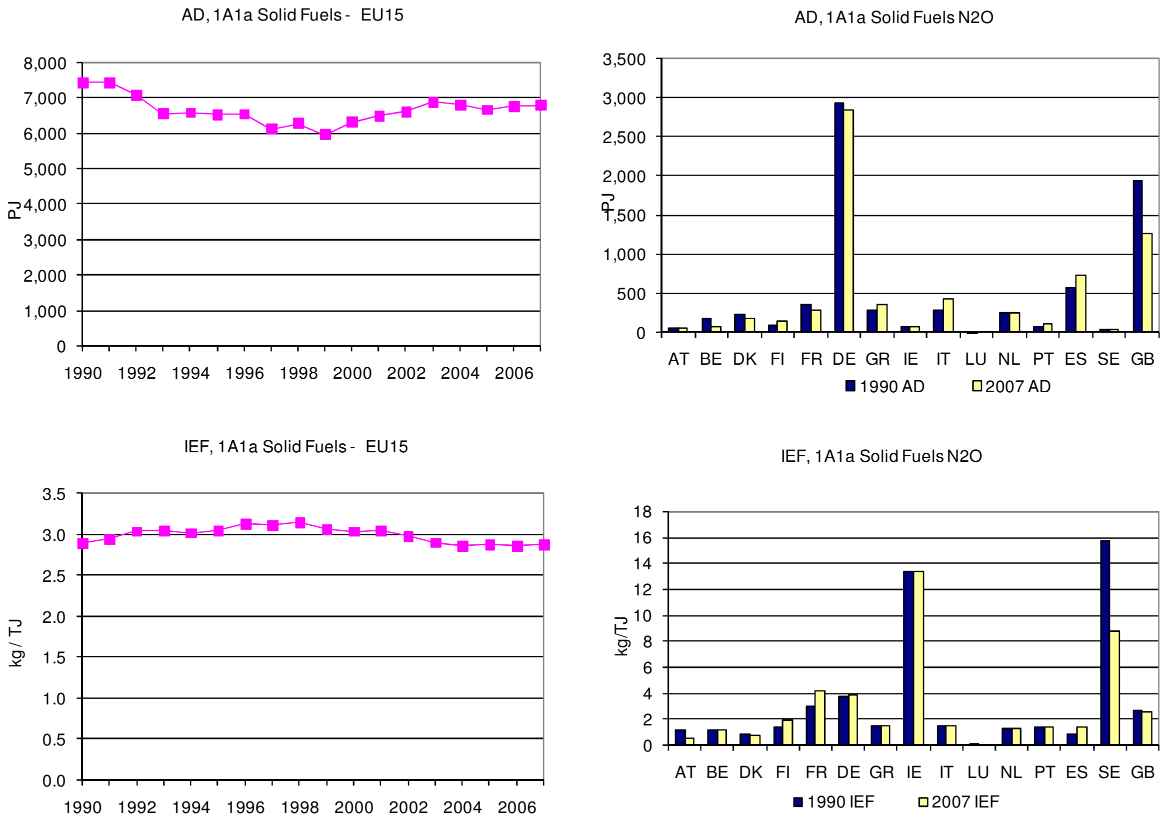
Table 3.8: **1A1a Electricity and heat production, solid fuels: Member States' contributions to N_2O emissions**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	23	9	9	0.1%	-1	-8%	-14	-63%	T2	NS, PS	CS
Belgium	66	28	27	0.4%	-1	-5%	-40	-60%	T2	PS/Q/AS	D/CS
Denmark	63	55	46	0.8%	-9	-17%	-17	-27%	C	NS/PS	CS/C
Finland	43	88	82	1.4%	-6	-7%	39	92%	T3	PS	CS
France	321	354	364	6.0%	10	3%	43	13%	C	PS	CS
Germany	3,431	3,179	3,352	55.4%	173	5%	-79	-2%	T2	NS	CS
Greece	134	155	162	2.7%	7	5%	28	21%	T2	NS	D
Ireland	318	298	271	4.5%	-27	-9%	-46	-15%	T3	NS	CR
Italy	138	197	201	3.3%	4	2%	63	45%	T3	NS, PS	C, D
Luxembourg	0	NO	NO	-	-	-	-0.1	-100%	T1	NS PS	D
Netherlands	101	89	94	1.6%	4	5%	-7	-7%	T1	NS	D
Portugal	36	58	47	0.8%	-10	-18%	11	31%	T2	PS	C,D
Spain	146	301	307	5.1%	6	2%	162	111%	T2	PS	D, C, OTH
Sweden	233	104	94	1.6%	-10	-10%	-139	-60%	T2	PS	CS
United Kingdom	1,610	1,088	995	16.4%	-93	-9%	-615	-38%	T2	NS, AS	CS
EU-15	**6,663**	**6,004**	**6,051**	**100.0%**	**47**	**1%**	**-612**	**-9%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.12 shows the related activity data and implied emission factors for N_2O. The EU-15 implied emission factor has somewhat remained stable compared to 1990, and stood at 2.9 kg/Tj in 2007. The largest emitter in 2007 was Germany, accounting for over half of EU-15 emissions. The IEF in Ireland was in 2007 the highest among all EU-15 countries (13.5 Kg/Tj in 2007) because of the use of a CORINAIR90 emission factor based on large point sources. Ireland is currently reviewing this emission factor. In Sweden, there was a gradual but strong decline in the IEF during 1990-2006. This was due to the increased use of blast furnace gas and a lower use of coal. Since the IEF for coal is ten times higher than the IEF for blast furnace gas, the IEF for solid fuels declined overall during the period. The Swedish IEF stood at about 8.8 kg/Tj in 2007. This comparatively high implied emission factor is regularly reviewed and found to be correct for Swedish conditions.

Figure 3.12 1A1a Public Electricity and Heat Production, solid fuels:Activity Data and Implied Emission Factors for N_2O



1A1a Electricity and Heat Production - Gaseous Fuels (CO_2)

CO_2 emissions from the combustion of gaseous fuels accounted for about 25 % of all greenhouse gas emissions from public electricity and heat generation in 2007. Emissions increased by a factor of four in the EU-15 between 1990 and 2007 (Table 3.9). In all EU-15 Member States the consumption of gas was higher in 2007 than in 1990.

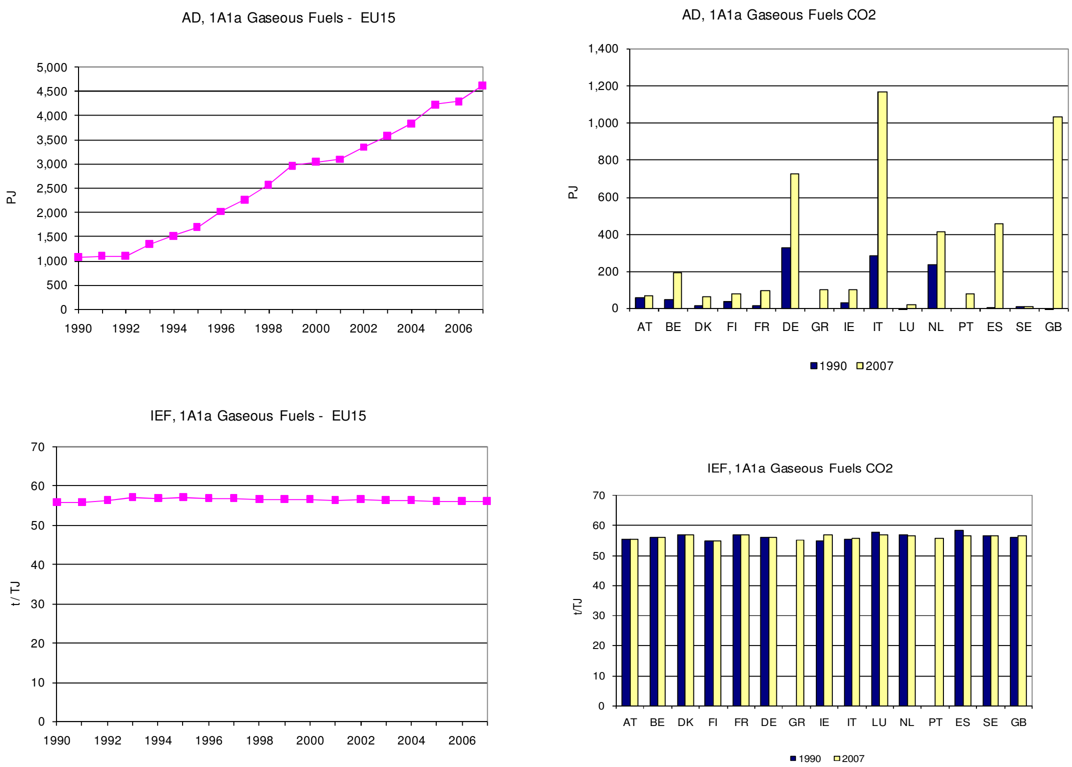
Table 3.9 1A1a Electricity and heat production, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,294	4,540	3,946	1.5%	-594	-13%	652	20%	T2	NS, PS	CS
Belgium	2,751	9,894	10,742	4.1%	847	9%	7,991	290%	CS/T3	PS/Q/AS	CS/D
Denmark	1,000	4,521	3,577	1.4%	-944	-21%	2,577	258%	C	NS/PS	CS/C
Finland	1,976	5,152	4,277	1.6%	-875	-17%	2,301	116%	T3	PS	CS, D
France	984	5,438	5,660	2.2%	222	4%	4,676	475%	C	PS	CS
Germany	18,462	39,591	40,733	15.7%	1,142	3%	22,271	121%	CS	NS	CS
Greece	NO	4,250	5,621	2.2%	1,371	32%	5621	-	T2	NS	PS
Ireland	1,881	5,223	5,945	2.3%	722	14%	4,064	216%	T3	NS	PS
Italy	15,787	58,883	64,879	25.0%	5,995	10%	49,092	311%	T3	NS, PS	CS
Luxembourg	27	1,457	1,292	0.5%	-166	-11%	1,265	4753%	T1	NS PS	D
Netherlands	13,348	22,857	23,675	9.1%	818	4%	10,327	77%	T2	NS/Q	CS
Portugal	NO	4,226	4,462	1.7%	236	6%	4,462	-	T2	PS	D,C,PS
Spain	427	23,857	25,880	10.0%	2,023	8%	25,453	5959%	T2	PS, Q	PS, CS
Sweden	485	587	732	0.3%	145	25%	247	51%	T2	PS	CS
United Kingdom	16	50,908	58,563	22.5%	7,655	15%	58,547	367225%	T2	NS, AS	CS
EU-15	**60,437**	**241,387**	**259,984**	**100.0%**	**18,597**	**8%**	**199,547**	**330%**			

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Figure 3.13 shows the activity data and implied CO_2emission factors from gaseous fuels. Gas use in the power generating sector increased strongly after 1992. The EU-15 implied emission factor has remained fairly stable (56 t/Tj in 2007). The increase in the EU-15 factor observed in the early 1990s can be explained by the higher UK’s gas share in the EU-15 and by a significant increase in the UK’s implied emission factor. The latter is the result of the commissioning of the Peterhead power station in Scotland, which uses sour gas, a fuel with a much higher factor than natural gas. The largest emitters in 2007 were the UK and Italy, jointly responsible for close to half the EU-15 emissions.

Figure 3.13: 1A1a-Public Electricity and Heat Production, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A1a Electricity and Heat Production - Other Fuels (CO_2)

In 2007, the share of CO_2 emissions from other fuels stood at about 3 % of total greenhouse gas emissions from public electricity and heat generation. Emissions more than doubled at the EU-15 level and increased in all countries where ‘other fuels’ are used in heat and power generation. Other fuels should cover the fossil part of municipal solid waste incineration where there is energy recovery, including plastics (Table 3.10).

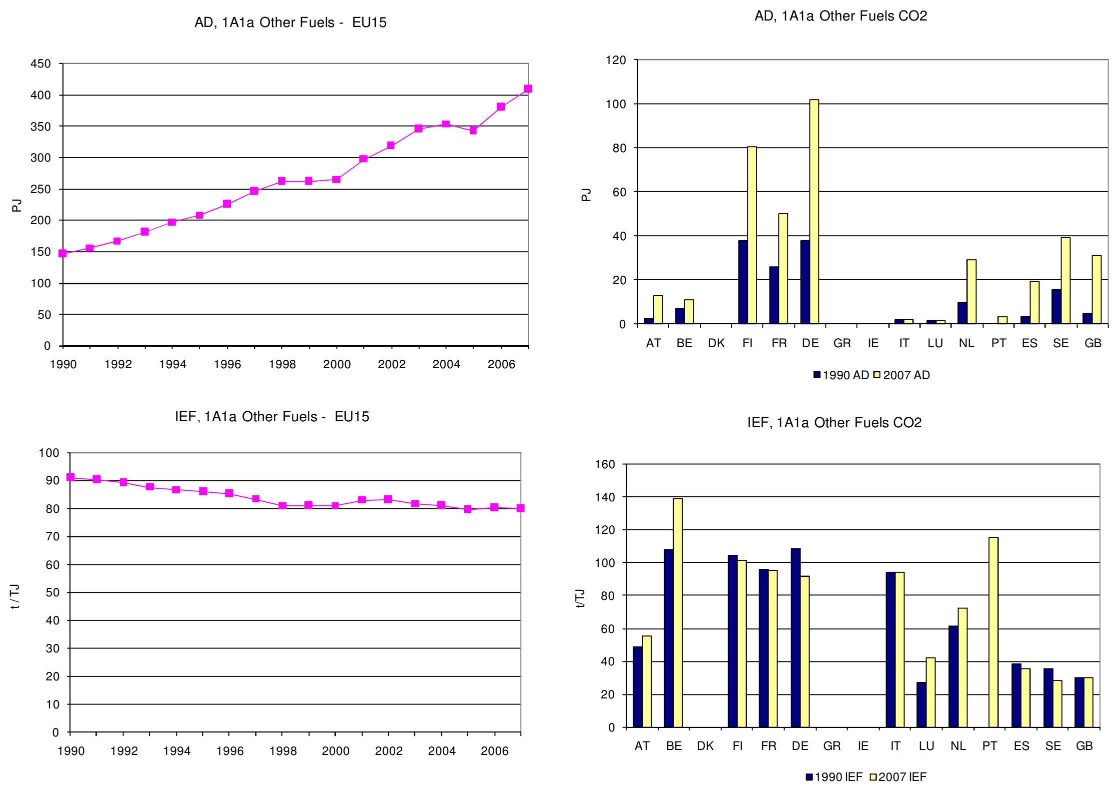
Table 3.10: 1A1a Public Electricity and Heat Production, other fuels:Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	118	695	655	2.0%	-40	-6%	537	455%	T2	NS, PS	D(Ind. Waste)
Belgium	749	1,516	1,463	4.5%	-53	-4%	713	95%	CS/T3	PS/Q/AS	CS/D
Denmark	328	654	665	2.0%	11	2%	338	103%	C	NS/PS	CS/C
Finland	3,950	8,192	9,030	27.6%	838	10%	5,080	129%	T3	PS	CS
France	2,483	4,757	4,958	15.1%	201	4%	2,476	100%	C	PS	CS
Germany	4,121	9,331	10,254	31.3%	923	10%	6,133	149%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	153	189	232	0.7%	43	23%	79	51%	T3	NS, PS	CS
Luxembourg	33	64	66	0.2%	2	2%	32	97%	T2	NS Q	D
Netherlands	592	2,120	2,184	6.7%	65	3%	1,592	269%	T2	NS/Q	CS
Portugal	NO	348	344	1.0%	-4	-1%	344	-	T2	PS	D,C,PS
Spain	120	687	697	2.1%	10	1%	577	480%	T2	PS, Q	PS, CS, C
Sweden	553	1,116	1,260	3.8%	144	13%	707	128%	T2	PS	CS
United Kingdom	134	936	952	2.9%	15	2%	817	609%	T2	NS	CS
EU-15	**13,334**	**30,608**	**32,759**	**100.0%**	**2,152**	**7%**	**19,425**	**146%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.14 shows the activity data and implied emission factors. The EU-15 implied emission factor has fallen gradually since 1990, standing at about 80 t/Tj in 2007. The chart does not show the emission factor for Denmark. CO_2 emissions from the combustion of the plastic content of municipal waste are correctly reported under other fuels but the split is not applied to the activity data, and so the full fuel consumption of municipal waste is included under biomass. The largest emitters in 2007 were Germany, Finland and France, which together accounted for more than 70 % of EU-15 emissions.

Figure 3.14: 1A1a Public Electricity and Heat Production, other fuels: Activity Data and Implied Emission Factors for CO_2



In Germany, the IEF declined continuously between 1990 and 2007 (from 109 to 92). This is because the combustion of industrial waste has been greatly reduced in the early 1990s whereas the combustion of residential waste for electricity and heat has increased in the complete reporting period; furthermore, the calorific value of the applied waste has increased due to a better national waste separation management.

Figure 3.14 shows the share of Finnish activity in the EU-15 is disproportionally high. This is due to the reporting of 'peat' under 'other fuels' instead of under 'solid fuels' as recommended by the revised 1996 IPCC Guidelines. This apparent mis-allocation is clearly explained and argued[25] and is consistent with national energy statistics as well as with the IPCC 2006 Guidelines. In the Netherlands, the IEF increases considerably after 2003 to reach 70 t/Tj in 2007. This was due to the increase in the share of plastics (with a high carbon fraction) in combustible waste – as explained in table 8.7 of the Dutch NIR about the composition of incinerated waste.

3.2.1.2 Petroleum Refining (1A1b) (EU-15)

According to the IPCC, petroleum refining (CRF 1A1b) should include all combustion activities supporting the refining of petroleum products including on-site combustion for the generation of electricity and heat for own use. It does not include evaporative emissions occurring at the refinery. These emissions should be reported separately under 1B2a.

CO_2 emissions from petroleum refining is the sixth largest key source in the EU-15 accounting for 3.0 % of total greenhouse gas emissions in 2007. Between 1990 and 2007, EU-15 CO_2 emissions increased by 15 % (Table 3.11). Emissions in 2007 were above 1990 levels in all Member States, with the exception of the UK and the Netherlands.

Table 3.111A1b Petroleum Refining: Member States' contributions to CO_2 emissions

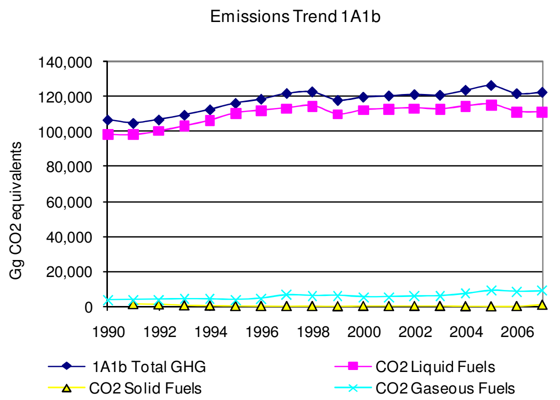
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,394	2,830	2,868	2.4%	38	1%	473	20%
Belgium	4,299	4,522	4,607	3.8%	85	2%	308	7%
Denmark	897	966	970	0.8%	4	0%	73	8%
Finland	2,260	2,680	2,757	2.3%	77	3%	497	22%
France	13,239	13,832	15,165	12.5%	1,333	10%	1,927	15%
Germany	20,006	22,531	22,004	18.1%	-527	-2%	1,998	10%
Greece	2,465	4,005	3,989	3.3%	-16	0%	1,524	62%
Ireland	182	377	360	0.3%	-16	-4%	178	98%
Italy	16,337	24,868	25,862	21.3%	995	4%	9,526	58%
Luxembourg	NO	NO	NO	0.0%	-	-	-	-
Netherlands	11,041	10,673	10,641	8.7%	-32	0%	-400	-4%
Portugal	1,910	2,621	2,624	2.2%	3	0%	715	37%
Spain	10,906	12,916	12,850	10.6%	-66	-1%	1,944	18%
Sweden	1,778	2,165	1,921	1.6%	-244	-11%	143	8%
United Kingdom	18,275	15,852	15,004	12.3%	-849	-5%	-3,272	-18%
EU-15	**105,989**	**120,838**	**121,623**	**100.0%**	**785**	**1%**	**15,634**	**15%**

Figure 3.15 shows the trends in emissions originating from the refining of petroleum by fuel in the EU-15 between 1990 and 2007. More than 90 % of greenhouse gas emissions from this source category are accounted for by CO_2 emissions from liquid fuels. The figure also shows the activity data behind the emissions.

Fuel used for petroleum refining increased by about 14 % in the EU-15 between 1990 and 2007. Liquid fuels represent over 90 % of all fuel used in the refining of petroleum. Gaseous fuels almost fully account for the remaining part and their use has more than doubled since 1990. There remains a small amount of solid fuels used in petroleum refining, mainly in France and Germany.

[25] There are several reasons for reporting peat separately from solid fuels in Finland. Solid fuels include hard coal, coke and other fuels derived from coal (BFG, coke oven gas). The origin of these fuels is totally from imported sources, whereas peat is totally a domestic energy source. This categorisation follows the practise used in national energy statistics as well as in the IPCC 2006 Guidelines. Moreover, the CO_2 IEF of peat is higher than the IEF of hard coal. Combining both fuels would cause significant variation in the IEF of solid fuels. Finally, other properties of peat and hard coal are very different, and would justify the reporting under two different fuel categories. See also the 2008 Finnish NIR to the UNFCCC.

Figure 3.15 **1A1b Petroleum Refining: Total and CO_2 emission trends**



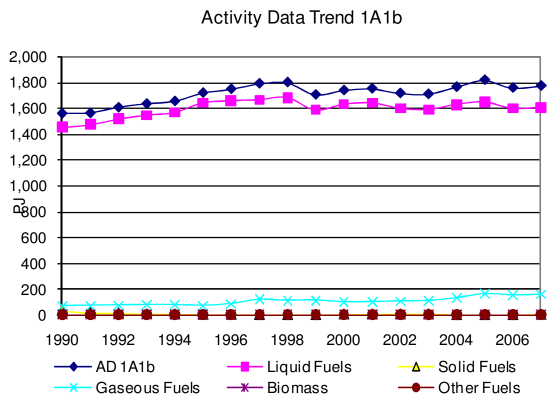


Figure 3.16 shows the relative importance of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State, ranging from the relatively low share in Ireland to relatively high share in the Netherlands. Figure 3.17 shows the absolute contributions to EU-15 CO_2 emissions from petroleum refining. Italy was the largest EU-15 emitter in 2007, accounting for more than 20 % of all EU-15 emissions.

Figure 3.16: Share of CO_2 emissions from petroleum refining in total greenhouse gas emissions by Member State in 2007

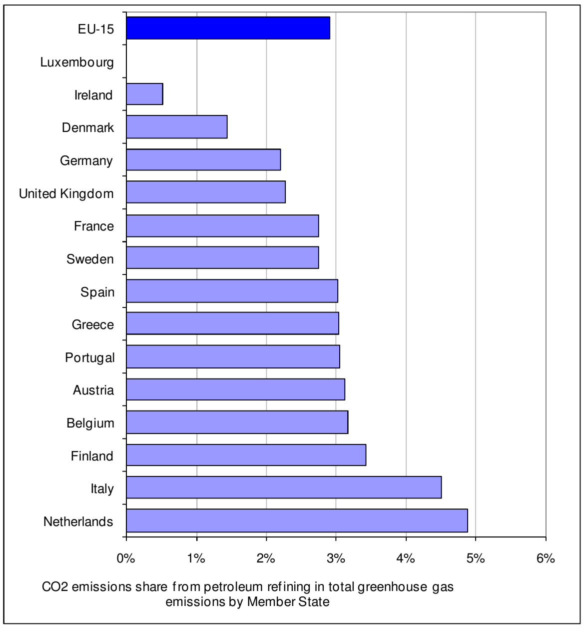
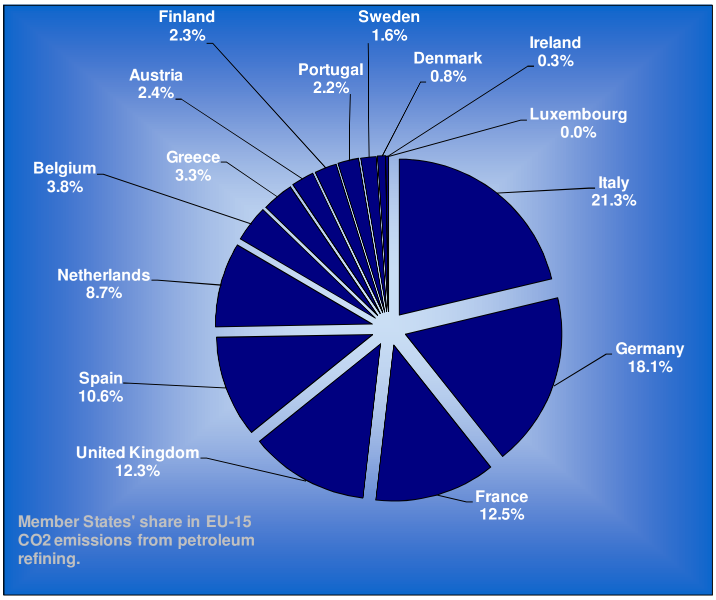


Figure 3.17: Member States' share of CO_2 emissions from petroleum refining in EU-15



1A1b Petroleum Refining - Liquid Fuels (CO_2)

CO_2 emissions from the combustion of liquid fuels used for petroleum refining accounted for over 90 % of all greenhouse gas emissions from petroleum refining in 2007. Emissions increased by 13 % between 1990 and 2007 (Table 3.12). With the exception of France, the Netherlands and the UK, Member State emissions from liquid fuels were higher in 2007 than in 1990. More than half of the gross increase in EU-15 emissions (and more than 80 % in net terms) between 1990 and 2007 was due to Italy alone.

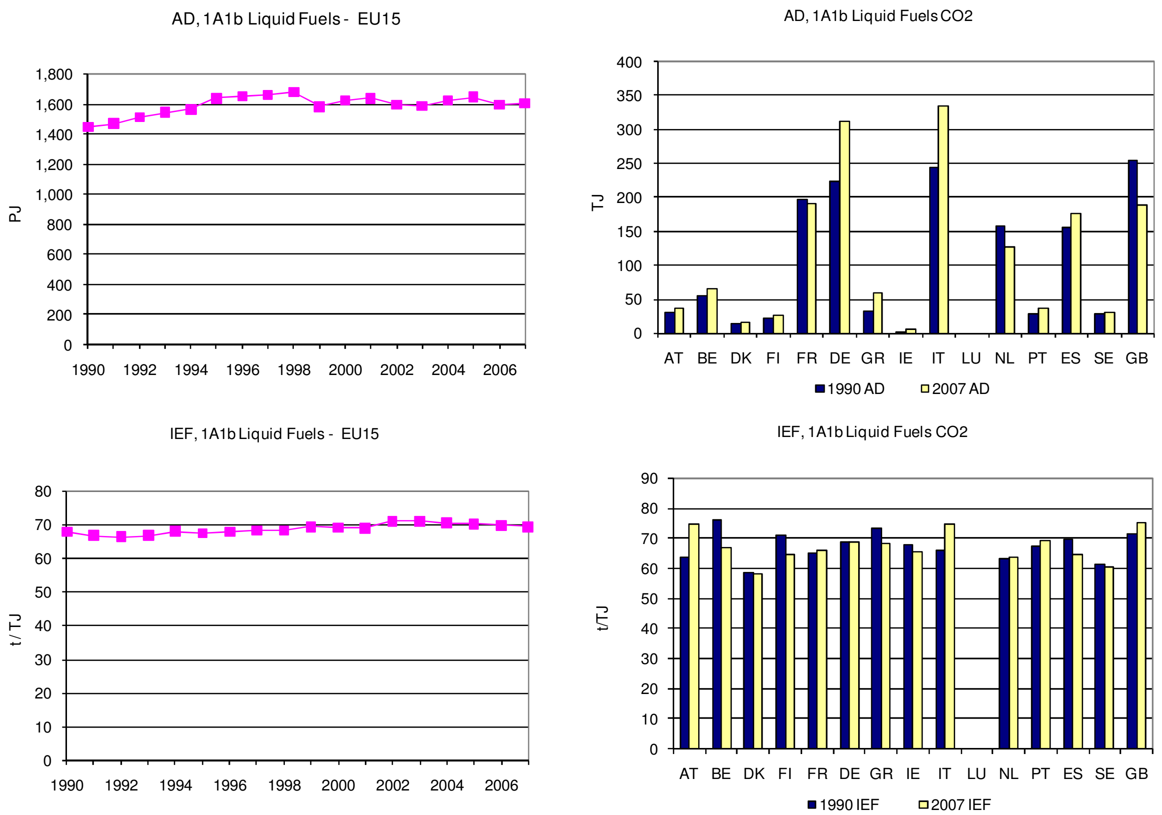
Table 3.121A1b Petroleum Refining, liquid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,958	2,688	2,725	2.4%	38	1%	768	39%	T2	NS	PS
Belgium	4,285	4,317	4,347	3.9%	30	1%	62	1%	CS/T3	PS	PS
Denmark	897	966	970	0.9%	4	0%	73	8%	C	NS/PS	CS/C
Finland	1,603	1,713	1,744	1.6%	31	2%	140	9%	T3	PS	CS, PS
France	12,732	11,971	12,585	11.3%	614	5%	-147	-1%	C	PS	CS
Germany	15,315	21,872	21,351	19.2%	-521	-2%	6,037	39%	CS	NS	CS
Greece	2,465	4,005	3,989	3.6%	-16	0%	1,524	62%	T2	NS	PS
Ireland	182	377	360	0.3%	-16	-4%	178	98%	T3	NS	PS
Italy	16,178	24,141	25,123	22.6%	982	4%	8,946	55%	T3	NS, PS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	9,999	8,028	8,046	7.2%	18	0%	-1,953	-20%	T2	NS/Q	CS
Portugal	1,910	2,607	2,607	2.3%	0	0%	697	37%	T2	PS	D,C,PS
Spain	10,861	11,683	11,372	10.2%	-311	-3%	511	5%	T2	PS	PS, C
Sweden	1,778	2,104	1,863	1.7%	-242	-11%	85	5%	T2	PS	CS
United Kingdom	18,226	15,130	14,253	12.8%	-877	-6%	-3,973	-22%	T2	NS	CS
EU-15	**98,388**	**111,602**	**111,336**	**100.0%**	**-267**	**0%**	**12,947**	**13%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.18 shows the activity data and implied emission factors for CO_2 emissions from liquid fuels. The use of liquid fuels increased rapidly from 1990 to 1998 and fell somewhat thereafter. The EU-15 implied emission factor has varied between 66 t/Tj and 71 t/Tj. The increase in the EU-15 factor can be partly explained by the growing Italian share in EU-15 activity and emissions and by the increase in Italy's implied emission factor during the period. The largest emitters in 2007 were Italy, Germany and the UK, which together contributed to more than half of EU-15 emissions.

Figure 3.18 1A1b Petroleum Refining, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A1b Petroleum Refining - Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels in petroleum refining represented less than 1 % of all greenhouse gas emissions from 1A1b in 2007. There are only three countries reporting emissions in the EU-15 in 1990 and/or 2007, almost all of which find their origin in France and Germany. EU-emissions fell by about 63 % on average between 1990 and 2007 (Table 3.13).

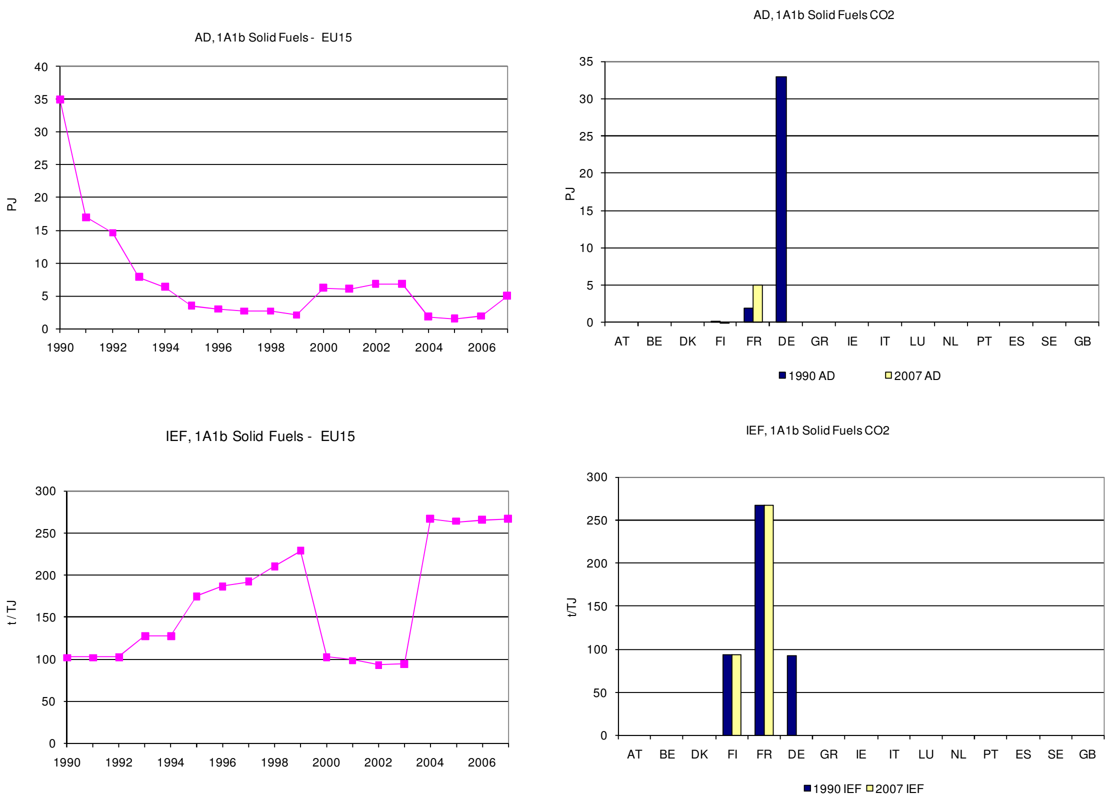
Table 3.131A1b Petroleum Refining, solid fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Belgium	0	0	0	-	-	-	-	-	CS/T3	PS	PS
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	12	2	3	0.2%	1	23%	-9	-75%	T3	PS	CS
France	492	508	1,337	99.8%	829	163%	844	171%	C	PS	CS
Germany	3,076	NO	NO	-	-	-	-3,076	-100%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	T2	NS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Portugal	NO	NO	NO	-	-	-	-	-	T2	PS	D,C,PS
Spain	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	NO	NA	NA	-	-	-	-	-	NO	NO	NO
EU-15	**3,581**	**510**	**1,340**	**100.0%**	**829**	**162%**	**-2,241**	**-63%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.19 shows the relevant activity data and implied emission factors. The use of solid fuels in petroleum refining has declined markedly since 1990. The EU-15 implied emission factor has changed very significantly, and stood at 267 t/Tj in 2007. The variation in the EU-15 factor can be partly explained by the declining use of solid fuels in petroleum refining in Germany between 1990 and 1999. This explains the bigger contribution of the much higher implied emission factor of France. The relatively higher emission factor in France is due to the use of blast furnace gas in the Dunkerque refinery. In Germany, there was a decline in the IEF in the early 1990s compared to a rather stable IEF since the mid-1990s. The reason is that the use of - mainly - lignite has constantly been reduced in favour of cokery gas. The increased EU-15 solid fuel combustion in 2000-2003 is due to an increase in fuel combustion in Germany in these years. The higher weight of the German IEF also explains the lower IEF at EU-15 level during these years. From 2004 onwards no solid fuel combustion occurs in Germany anymore and the EU-15 activity data and IEF mainly reflect the French activity data and IEF.

Figure 3.19 1A1b-Petroleum Refining, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A1b Petroleum Refining - Gaseous Fuels (CO_2)

In 2007, CO_2 emissions from the combustion of gaseous fuels used for petroleum refining accounted for about 7 % of total greenhouse gas emissions from 1A1b. Emissions in the EU-15 increased by a factor of almost 2.5 between 1990 and 2007 (Table 3.14). Emissions only fell in Germany and Austria. More than two thirds of the gross increase in EU-15 emissions between 1990 and 2007 was due to France, Spain and the Netherlands.

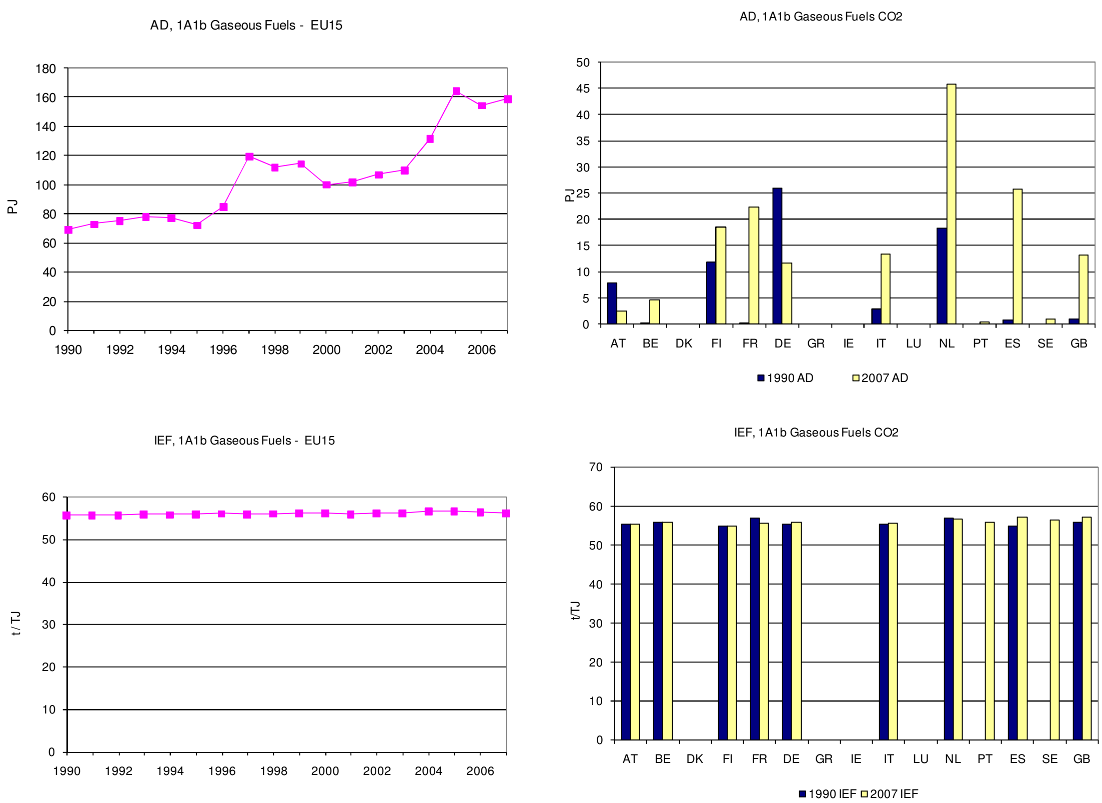
Table 3.141A1b Petroleum Refining, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	437	142	142	1.6%	0	0%	-294	-67%	T2	NS	CS, PS
Belgium	14	204	260	2.9%	55	27%	246	1781%	CS/T3	PS	PS
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	644	964	1,010	11.3%	46	5%	365	57%	T3	PS	CS
France	14	1,353	1,243	13.9%	-110	-8%	1,229	8661%	C	PS	CS
Germany	1,441	659	652	7.3%	-7	-1%	-789	-55%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	T2	NS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	159	726	739	8.3%	13	2%	580	364%	T3	NS, PS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	1,042	2,646	2,596	29.0%	-50	-2%	1,553	149%	T2	NS/Q	CS
Portugal	NO	14	17	0.2%	3	-	17	-	T2	PS	D,C,PS
Spain	45	1,232	1,478	16.5%	246	20%	1,433	3179%	T2	PS	PS, CS
Sweden	NO	61	58	0.7%	-2	-4%	58	-	T2	PS	CS
United Kingdom	49	723	751	8.4%	29	4%	702	1420%	T2	NS	CS
EU-15	**3,846**	**8,725**	**8,947**	**100.0%**	**222**	**3%**	**5,101**	**133%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.20 shows the activity data and implied emission factors for CO_2 emissions from gaseous fuels. The use of gaseous fuels increased by over a factor of 2 between 1990 and 2007. The EU-15 implied emission factor has remained broadly stable, standing at 56 t/Tj in 2007. The largest emitter in 2007 was the Netherlands with 29 % of all EU-15 emissions, followed by Spain and France.

Figure 3.20 1A1b Petroleum Refining, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.1.3 Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-15)

According to the IPCC, the manufacture of solid fuels and other energy industries includes combustion emissions from fuel use during the manufacture of secondary and tertiary products from solid fuels including production of charcoal. It comprises combustion emissions from the production of coke, brown coal briquettes and patent fuel. It can also cover the emissions from own-energy use in coal mining and gas extraction. Emissions from own on-site fuel use should be included.

CO_2 emissions from the manufacture of solid fuels accounted for 1.4 % of total greenhouse gas emissions in 2007. Between 1990 and 2007, CO_2 emissions fell by 40 % in the EU-15 (Table 3.15). Emissions from solid fuels fell gradually during the 1990s, but picked up again in the last few years. On the other hand, emissions from gaseous fuels have steadily increased during the 1990s and fell since 2002 – mirroring to some extent emissions from solid fuels.

Table 3.151A1c Manufacture of Solid Fuels and Other Energy Industries: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	510	668	627	1.1%	-41	-6%	117	23%
Belgium	2,144	395	334	0.6%	-61	-15%	-1,810	-84%
Denmark	540	1,631	1,617	2.8%	-14	-1%	1,078	200%
Finland	347	397	352	0.6%	-45	-11%	5	1%
France	4,993	3,764	3,735	6.5%	-30	-1%	-1,258	-25%
Germany	59,066	16,529	17,852	30.9%	1,323	8%	-41,214	-70%
Greece	102	90	87	0.2%	-3	-4%	-15	-15%
Ireland	100	120	114	0.2%	-6	-5%	13	13%
Italy	10,620	12,255	11,180	19.4%	-1,076	-9%	560	5%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1,528	1,926	2,209	3.8%	283	15%	681	45%
Portugal	75	NO	NO	0.0%	-	-	-75	-100%
Spain	2,110	1,864	1,923	3.3%	59	3%	-187	-9%
Sweden	361	368	328	0.6%	-40	-11%	-33	-9%
United Kingdom	13,709	16,709	17,331	30.0%	622	4%	3,622	26%
EU-15	**96,205**	**56,717**	**57,688**	**100.0%**	**971**	**2%**	**-38,517**	**-40%**

Figure 3.21 shows the trends in emissions from this source category by fuel in the EU-15 between 1990 and 2007. About 90 % of greenhouse gas emissions from the manufacture of solid fuels can be accounted for by CO_2 emissions from solid (51 %) and gaseous (36 %) fuels. The figure also shows the activity data behind the emissions.

Fuel used for manufacturing solid fuels fell by 36 % in the EU-15 between 1990 and 2007. In 2007, solid fuels represented 43 % of all fuel use, whereas gaseous fuels took a share of 49%.

Figure 3.21 **1A1c-Manufacture of Solid Fuels and Other Energy Industries: Total and CO_2 emission and activity trends**

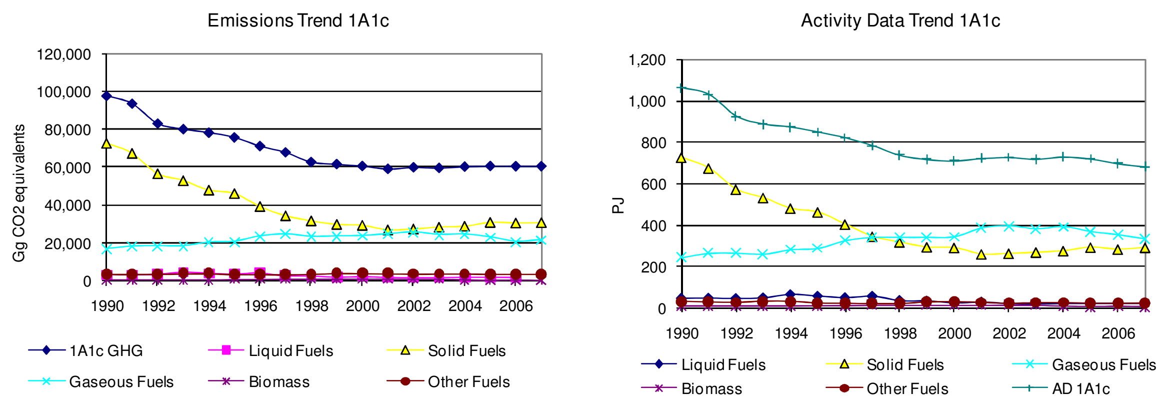


Figure 3.22 shows the relative importance of CO_2 emissions from the manufacture of solid fuels in

total greenhouse gas emissions by Member State. The country shares range from the highest in the UK to the lowest in Greece (Luxembourg and Portugal do not have emissions from this key source category). Figure 3.23 shows the absolute contributions to EU-15 CO_2 emissions from the manufacture of solid fuels. Between Italy, Germany and the UK, they take about 80 % of all EU-15 emissions.

Figure 3.22: Share of CO_2 emissions from the manufacture of solid fuels in total greenhouse gas emissions by Member State in 2007

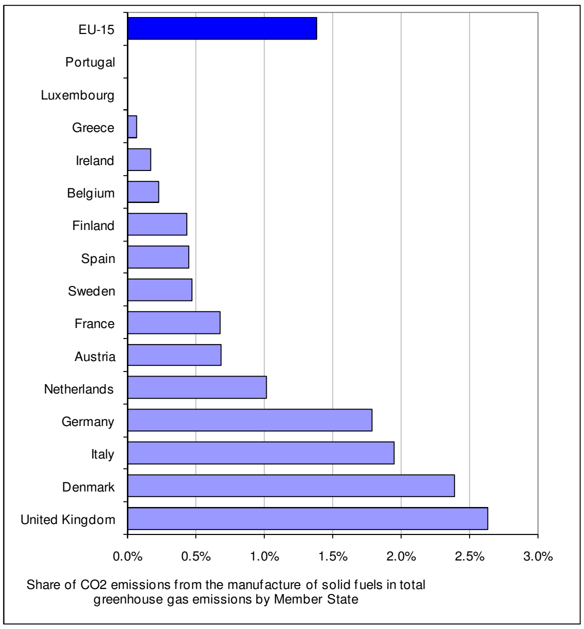
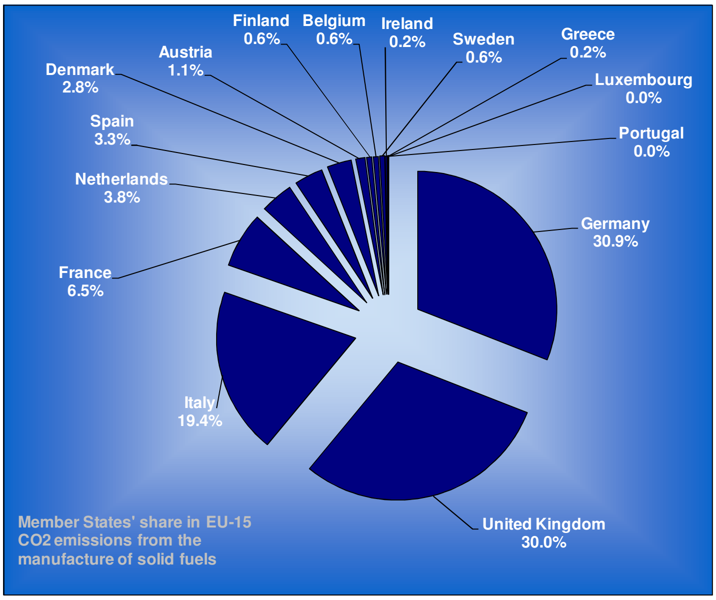


Figure 3.23: Member States' share of CO_2 emissions from the manufacture of solid fuels in EU-15



1A1c Manufacture of Solid Fuels and Other Energy Industries – Gaseous Fuels (CO_2)

CO_2 emissions from the combustion of gaseous fuels used for manufacturing solid fuels accounted for 36 % of total greenhouse gas emissions from 1A1c in 2007. Emissions in the EU-15 increased steadily by over 25 % (Table 3.16) since 1990, although there has been a significant reduction in the last few years. About 70 % of the gross increase in EU-15 emissions between 1990 and 2007 was due to the UK alone.

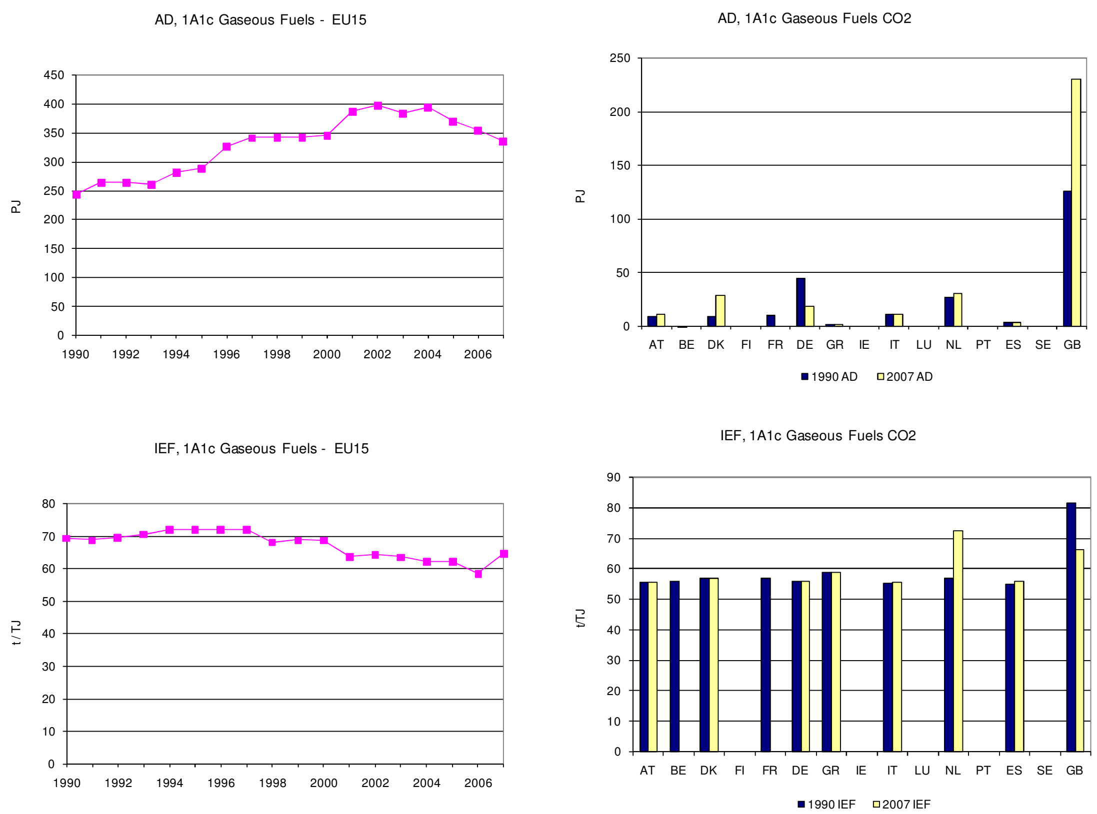
Table 3.16 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	506	668	627	2.9%	-41	-6%	121	24%	T2	NS	CS
Belgium	3	1	0	-	-1	-	-3	-100%	CS/T3	PS	PS
Denmark	540	1,631	1,617	7.5%	-14	-1%	1,078	200%	C	NS	CS/C
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	586	NO	NO	-	-	-	-586	-	C	AS/ PS	CS
Germany	2,501	1,123	1,016	4.7%	-107	-10%	-1,485	-59%	CS	NS	CS
Greece	102	90	87	0.4%	-3	-4%	-15	-15%	T2	NS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	615	259	603	2.8%	345	133%	-12	-2%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	1,526	1,926	2,208	10.2%	282	15%	682	45%	T2	NS/Q	CS
Portugal	NO	NO	NO	-	-	-	-	-	T2	NS	D,C,PS
Spain	205	209	197	0.9%	-11	-5%	-8	-4%	T2	PS, NS	CS
Sweden	NO	NO	NO	-	-	-	-	-	T2	PS	CS
United Kingdom	10,288	14,787	15,234	70.6%	448	3%	4,946	48%	T2	NS	CS
EU-15	**16,872**	**20,693**	**21,590**	**100.0%**	**897**	**4%**	**4,718**	**28%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.24 shows the activity data and implied emission factors for CO_2. The use of gaseous fuels increased by 36% between 1990 and 2007. The EU-15 implied emission factor has declined gradually since 1990. This was mainly due to a comprehensive review of emissions from the offshore oil & gas industry in the UK, which dominates the trend in emissions from this source category. By far, the largest emitter in 2007 was the UK, which represented more than 70 % of all EU-15 emissions. Also the increase of the EU-15 IEF in 2007 compared to 2006 mainly reflects a corresponding increase of the EF reported by the UK offshore operators. The high Dutch IEF for 2007 results from the use of preliminary data and will be revised in future submissions.

Figure 3.24 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A1c Manufacture of Solid Fuels and Other Energy Industries – Solid Fuels (CO_2)

CO_2 emissions from the combustion of solid fuels used for the manufacture of solid fuels accounted for 51 % of total greenhouse gas emissions from 1A1c in 2007. Emissions in the EU-15 more than halved, mainly during the 1990s (Table 3.17). This was almost-entirely due to a strong decline in emissions in Germany.

Table 3.17 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Member States' contributions to CO_2 emissions

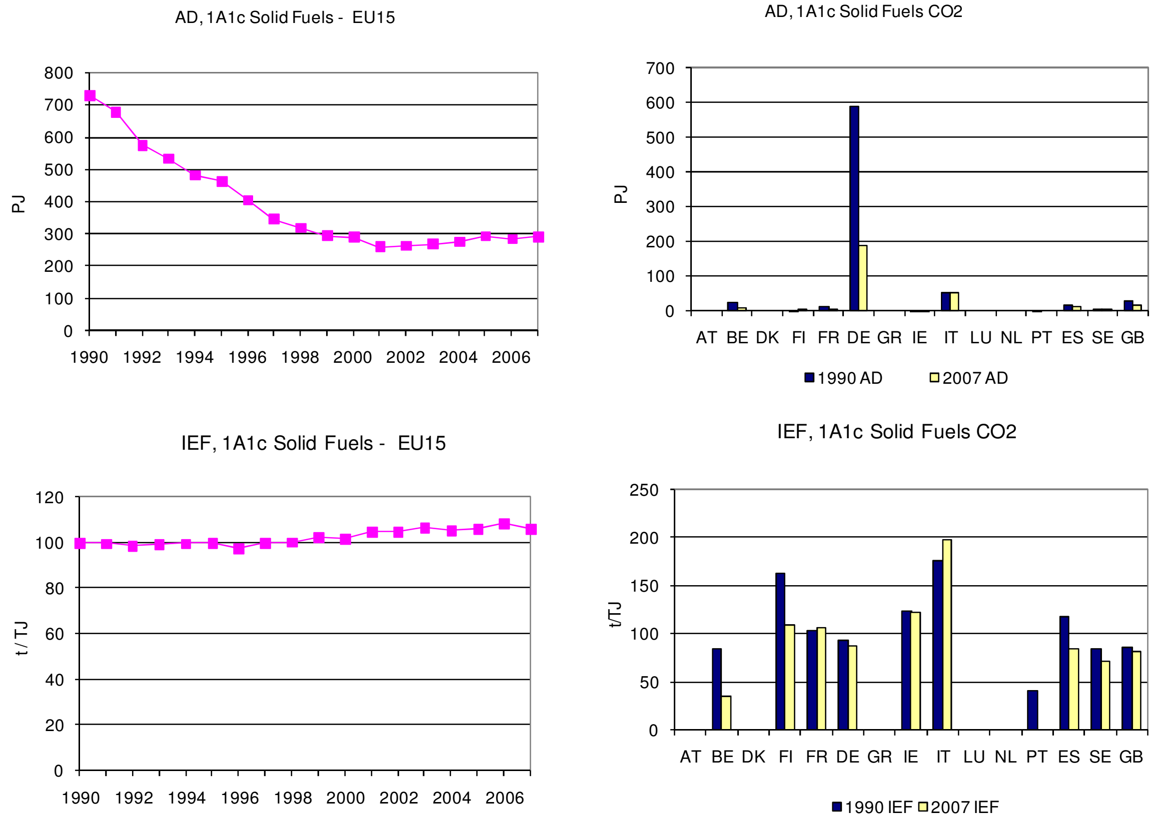
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	IE	IE	IE
Belgium	2,137	394	334	1.1%	-60	-15%	-1,803	-84%	CS/T3	PS	PS
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	347	397	352	1.1%	-45	-11%	5	1%	T3	PS	CS
France	1,315	315	315	1.0%	0	0%	-1,000	-76%	C	AS/ PS	CS
Germany	54,999	15,176	16,607	53.7%	1,431	9%	-38,392	-70%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	100	120	114	0.4%	-6	-5%	13	13%	T1	NS	CS
Italy	9,062	11,915	10,575	34.2%	-1,341	-11%	1,513	17%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	IE	NO	NO	-	-	-	-	-	NA	NO	NA
Portugal	25	NO	NO	-	0	-	-25	-100%	T2	PS	D,C,PS
Spain	1,847	888	945	3.1%	57	6%	-902	-49%	T2	PS, NS	PS, CS
Sweden	360	365	326	1.1%	-39	-11%	-35	-10%	T2	PS	CS
United Kingdom	2,326	1,158	1,332	4.3%	174	15%	-994	-43%	T2	NS	CS
EU-15	**72,520**	**30,729**	**30,900**	**100.0%**	**171**	**1%**	**-41,620**	**-57%**			

Emissions of the Netherlands are included in 1A2.A

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.25 shows the relevant activity data and implied emission factors. Solid fuels have fallen steadily to less than half the 1990 level. The EU-15 implied emission factor has increased to reach 106 t/Tj in 2007. This increase is mainly due to a decline in the German share in EU-15 emissions and a parallel increase in the share of Italy, which has a significantly higher implied emission factor. The largest emitters in 2007 were Italy and Germany, jointly responsible for almost 90 % of all EU-15 emissions.

Figure 3.25 **1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: Activity Data and Implied Emission Factors for CO_2**



3.2.2 Manufacturing industries and construction (CRF Source Category 1A2)

Category 1A2 includes emissions from combustion of fuels in manufacturing industries and construction including fuel use of non public electricity and heat generation (autoproducers). According to the guidelines emissions from fuel combustion in coke ovens are reported under 1A1c except for Austria and the Netherlands, which report on site coke ovens of integrated iron and steel plants under category 1A2a. Some MS report emissions of blast furnace and coke oven gas combustion under categories 1A1a public electricity and heat production or 1A4 other sectors. Emissions from category 1A2 are specified by the sum of subsectors that correspond to the International Standard Industrial Classification of All Economic Activities (ISIC, see listing below). Emissions from transport used by industry are reported under category 1A3 Transport. Most MS report emissions arising from off-road and other mobile machinery used in industry (e.g. construction machinery) under category 1A2f. Emissions from non energy fuel use (e.g. reducing agents used in blast furnaces or natural gas used for ammonia production) are reported under category 2 Industrial Processes.

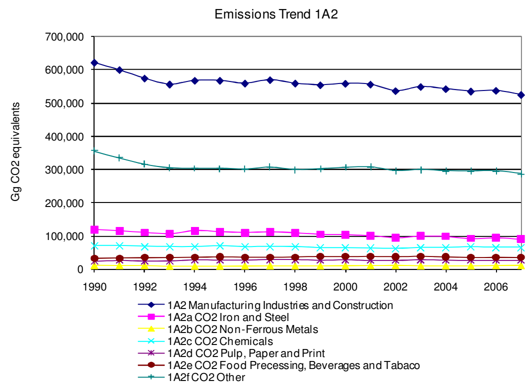
The following enumeration shows the correspondence of 1A2 sub categories and ISIC codes:

- 1 A 2 a Iron and Steel: ISIC Group 271 and Class 2731.
- 1 A 2 b Non-Ferrous Metals: ISIC Group 272 and Class 2732.
- 1 A 2 c Chemicals: ISIC Division 24.
- 1 A 2 d Pulp, Paper and Print: ISIC Divisions 21 and 22
- 1 A 2 e Food Processing, Beverages and Tobacco: ISIC Divisions 15 and 16.
- 1 A 2 f Other: Remaining emissions from fuel combustion in manufaturing industry.

In 2007 category 1A2 contributed to 524 952 Gg CO_2 equivalents of which 98.5% CO_2, 1.2% N_2O and 0.2% CH_4.

Figure 3.26 shows the emission trends within source category 1A2, which is mainly dominated by CO_2 from 1A2f Other contributing by 55% and 1A2a Iron and steel by 17%. Some Member States still have difficulties to allocate emissions to all sub-categories under 1A2, which is a main reason for 1A2f being the largest sub-category within 1A2 source category.

Figure 3.26 1A2 Manufacturing Industries and Construction: Total and CO_2 emission trends



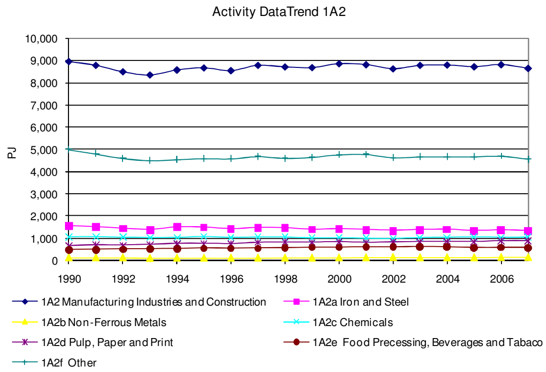


Table 3.18 summarises information by Member State on GHG emission trends and CO_2 emissions from 1A2 Manufacturing Industries and Construction.

Table 3.18 1A2 Manufacturing Industries and Construction: Member States' contributions to total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)
Austria	12,773	15,825	12,687	15,668
Belgium	33,254	26,437	33,118	26,294
Denmark	5,493	5,765	5,424	5,686
Finland	13,418	11,401	13,233	11,232
France	88,372	78,135	87,342	77,106
Germany	156,171	90,061	154,482	89,096
Greece	10,434	10,544	10,378	10,485
Ireland	4,108	6,301	3,970	6,089
Italy	90,609	80,547	88,937	78,867
Luxembourg	5,124	1,819	5,108	1,798
Netherlands	32,788	27,829	32,696	27,749
Portugal	9,267	10,860	9,162	10,695
Spain	46,661	68,330	46,196	67,543
Sweden	11,725	10,660	11,150	10,099
United Kingdom	100,824	80,438	98,877	78,837
EU-15	**621,022**	**524,952**	**612,761**	**517,244**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from 1A2 Manufacturing Industries and Construction is the third largest key source in the EU-15 accounting for 13 % of total GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from manufacturing industries declined by 16 % in the EU-15. The emissions from this key source are due to fossil fuel consumption in manufacturing industries and construction, which was almost the same in 2006 as in 1990. A shift from solid and liquid fuels to mainly natural gas took place and a minor increase of biomass and other fuels has been recorded.

Between 1990 and 2007, Germany shows by far the largest emission reductions in absolute terms. Also United Kingdom, France, Italy, Belgium, the Netherlands and Luxembourg show emission reductions of more than three million tonnes CO_2, whereas large emission increases occurred mainly in Spain. The main reason for the large decline in Germany was the restructuring of the industry and efficiency improvements after German reunification.

Table 3.19 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A2 Manufacturing Industries for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 3.19 1A2 Manufacturing Industries and Construction: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

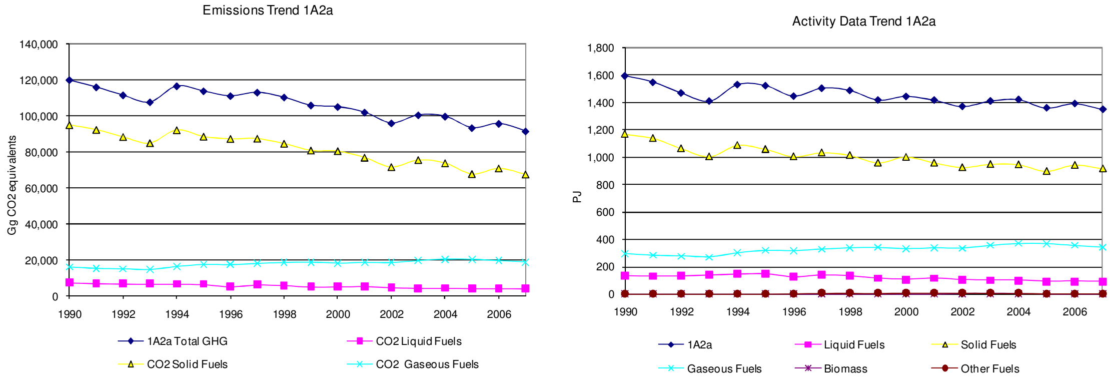
	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	-759	-5.6	153	1.0	
Belgium	-8	0.0	-85	-0.3	
Denmark	0	0.0	126	2.2	
Finland	1	0.0	-133	-1.2	
France	2,541	3.0	2,827	3.7	la prise en compte de l'utilisation de castine (calcaire) dans le procédé d'agglomération de minerai, qui pour des raisons techniques est imputée en combustion pour cette édition de l'inventaire, une révision des consommations des ateliers annexes tels que les fours de réchauffage à partir de données fournies par la fédération française de l'acier ;
Germany	0	0.0	-8,906	-8.8	Emission factor: revision of activity data from 2003 onwards; Activity data: new data available
Greece	8	0.1	-336	-3.5	
Ireland	0	0.0	46	0.8	
Italy	0	0.0	23	0.0	
Luxembourg	-195	-3.7	27	1.6	
Netherlands	-349	-1.1	170	0.6	
Portugal	7	0.1	576	5.9	
Spain	-69	-0.1	-896	-1.3	Actvity data: Revision of energy balance
Sweden	207	1.9	-145	-1.3	
UK	-545	-0.5	-1,135	-1.4	Method: Revision to the reported geopraphical coverage, Revision to the methodology to reflect the significant reduction in the use of lubricants due to the Waste Incineration Directive; Reallocation of Source: Reallocation of gas use to coke in the lime industry following updated information from industry
EU-15	**840**	**0.1**	**-7,686**	**-1.4**	

3.2.2.1 Iron and Steel (1A2a) (EU-15)

This chapter provides information about emission trends, Member States contribution, activity data and emission factors for category 1A2a on a fuel base. CO_2 emissions from 1A2a Iron and Steel accounted for 17.2% of 1A2 source category and 2.2 % of total GHG emissions in 2007.

Figure 3.27 shows the emission trend within the category 1A2a, which is mainly dominated by CO_2 emissions from solid fuels. Total emissions decreased by 24 %, mainly due to improved efficiency of restructured iron and steel plants and the increased share of gaseous fuels. Emissions from solid fuels decreased by 29 %and from liquid fuels by 48%. As follow up increasing emissions were reported for gaseous fuels (+17 %). Some Member States report emissions from blast furnace gas under categories 1A1a or1A2 where it is used for energy recovery in the respective industrial branches. Emissions from coke ovens of integrated iron and steel plants are sometimes not reported in the respective category 1A1c but included in this category. Emissions from blast furnace and coke oven gas flaring without energy recovery are partly reported under category 1B. The methodology of splitting emissions from blast furnaces into energy related and process related emissions reported under category 2C1 does not follow a specific standard. E.g. Germany reports 11% of total CO_2 emissions from categories 1A2a and 2C1 under this category and France reports 83%. However, the main driver of category 1A2a CO_2 emissions is blast furnace iron (BFI) production which slightly decreased from about 99 mio tonnes to 95 mio tonnes since 1990 (www.worldsteel.org statistics) wheras total steel production increased since 1990 from about 149 mio tonnes to 176 mio tonnes (www.worldsteel.org statistics).

Figure 3.27 1A2a Iron and Steel: Total, CO_2 and N_2O emission and activity trends



Between 1990 and 2007, CO_2 emissions from 1A2a Iron and Steel decreased by 24 % in the EU-15 (Table 3.20), mainly due to decreases in Belgium, Germany, France, Italy and the United Kingdom. Between 2006 and 2007 emissions decreased by -4 %.

Table 3.20 1A2a Iron and Steel: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	4,944	6,349	6,225	6.8%	-125	-2%	1,280	26%
Belgium	14,213	9,306	8,569	9.4%	-737	-8%	-5,644	-40%
Denmark	429	440	437	0.5%	-3	-1%	8	2%
Finland	2,555	3,795	3,413	3.8%	-382	-10%	858	34%
France	21,252	17,612	16,737	18.4%	-875	-5%	-4,515	-21%
Germany	12,578	8,323	5,863	6.4%	-2,460	-30%	-6,715	-53%
Greece	475	175	201	0.2%	26	15%	-274	-58%
Ireland	175	2	2	0.0%	0	0%	-173	-99%
Italy	20,729	16,734	17,221	18.9%	486	3%	-3,509	-17%
Luxembourg	4,217	523	568	0.6%	46	9%	-3,648	-87%
Netherlands	4,011	4,601	4,524	5.0%	-77	-2%	513	13%
Portugal	623	213	232	0.3%	19	9%	-391	-63%
Spain	8,473	7,015	7,056	7.8%	41	1%	-1,417	-17%
Sweden	1,057	1,227	1,215	1.3%	-12	-1%	158	15%
United Kingdom	24,101	18,864	18,736	20.6%	-128	-1%	-5,365	-22%
EU-15	**119,831**	**95,179**	**90,999**	**100.0%**	**-4,180**	**-4%**	**-28,832**	**-24%**

1A2a Iron and Steel - Liquid Fuels (CO_2)

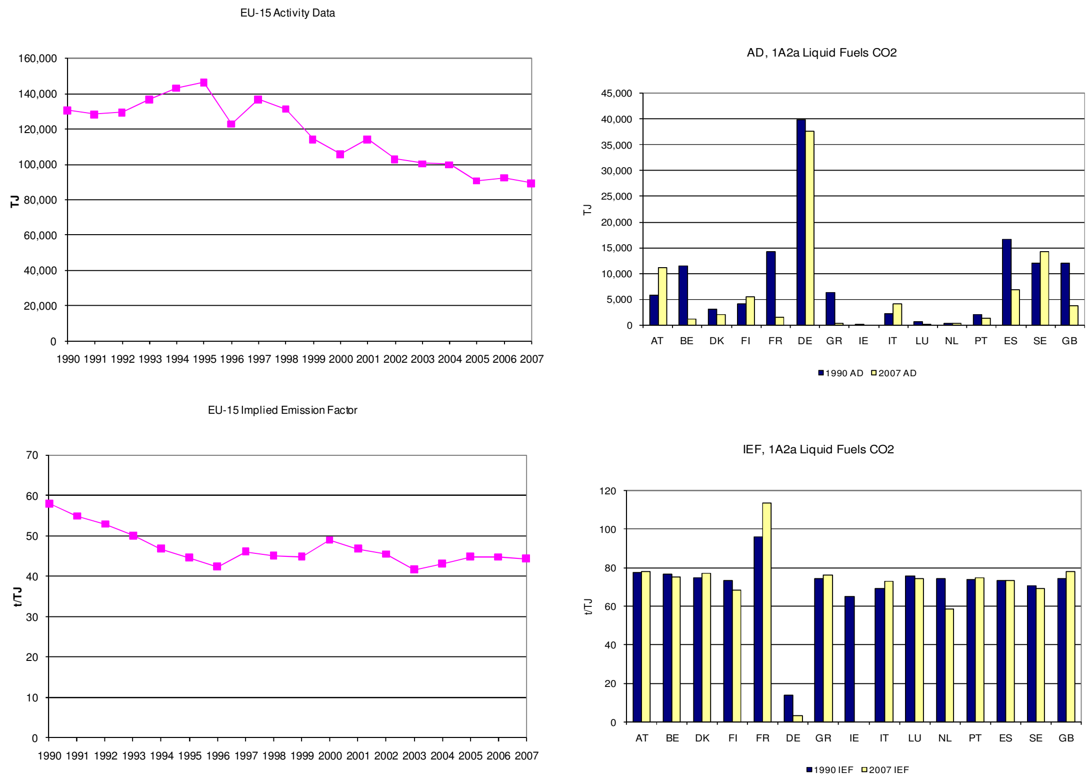
In 2007 CO_2 from liquid fuels had a share of 4 % within this category compared to 6 % in 1990. Between 1990 and 2007 emissions decreased by 48 % (Table 3.21). Significant absolute decreases could be achieved in Belgium, France, Greece, Spain and the United Kingdom wheras Austria, Finland, Italy and Sweden reported increases in this period. This activity mainly consists of residual fuel oil used for iron ore reduction in blast furnaces.

Table 3.21 1A2a Iron and Steel, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	448	768	861	21.7%	93	12%	413	92%	T2	NS, PS	CS, PS
Belgium	879	77	90	2.3%	13	17%	-789	-90%	T3	PS/RS	PS
Denmark	232	153	148	3.7%	-5	-3%	-84	-36%	C	NS	CS/C
Finland	303	456	370	9.3%	-86	-19%	68	22%	T3, M	PS	CS
France	1,375	214	171	4.3%	-43	-20%	-1,204	-88%	C	NS/ AS/ PS	CS
Germany	560	131	125	3.2%	-6	-4%	-434	-78%	T2	NS	CS
Greece	475	19	19	0.5%	0	0%	-457	-96%	T2	NS	PS
Ireland	16	NO	NO	-	-	-	-16	-100%	T1	NS	CS
Italy	153	355	298	7.5%	-57	-16%	145	94%	T2	NS	CS
Luxembourg	51	6	6	-	-	-	-	-	NA	NO	NA
Netherlands	21	11	16	0.4%	5	46%	-5	-25%	T2	NS/Q	CS
Portugal	154	123	96	2.4%	-27	-22%	-58	-38%	T2	NS,PS	D,C,PS
Spain	1,224	567	495	12.5%	-72	-13%	-729	-60%	T2	PS, AS, NS	PS, C
Sweden	849	979	984	24.8%	5	1%	134	16%	T2	PS	CS
United Kingdom	894	283	289	7.3%	6	2%	-605	-68%	T2	NS,AS	CS
EU-15	**7,635**	**4,142**	**3,969**	**100.0%**	**-173**	**-4%**	**-3,667**	**-48%**			

Figure 3.28 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Liquid fuel consumption in the EU-15 decreased by 48 % between 1990 and 2007. The CO_2 implied emission factor of EU-15 was 44.4 t/TJ in 2007. Germany reports total fuel consumption of blast furnaces under category 1A2a but reports only 11% of total 1A2a + 2C CO_2 emissions here which results in the low emission factor. The comparably high implied emission factor of France in 2007 has to be investigated further more.

Figure 3.28 1A2a Iron and Steel, Liquid fuels:Activity Data and Implied Emission Factors for CO_2



1A2a Iron and Steel - Solid Fuels (CO_2)

In 2007, CO_2 from solid fuels had a share of 74 % within this category and 79 % in 1990. Between 1990 and 2007 the emissions decreased by 29 % (Table 3.22). Between 1990 and 2007 Belgium, France, Germany, Italy and the United Kingdom showed major decreases. Between 2006 and 2007, Germany reported a substantial decrease of -55 %.

Table 3.22 1A2a Iron and Steel, solid fuels: Member States' contributions to CO_2 emissions and information on method applied,

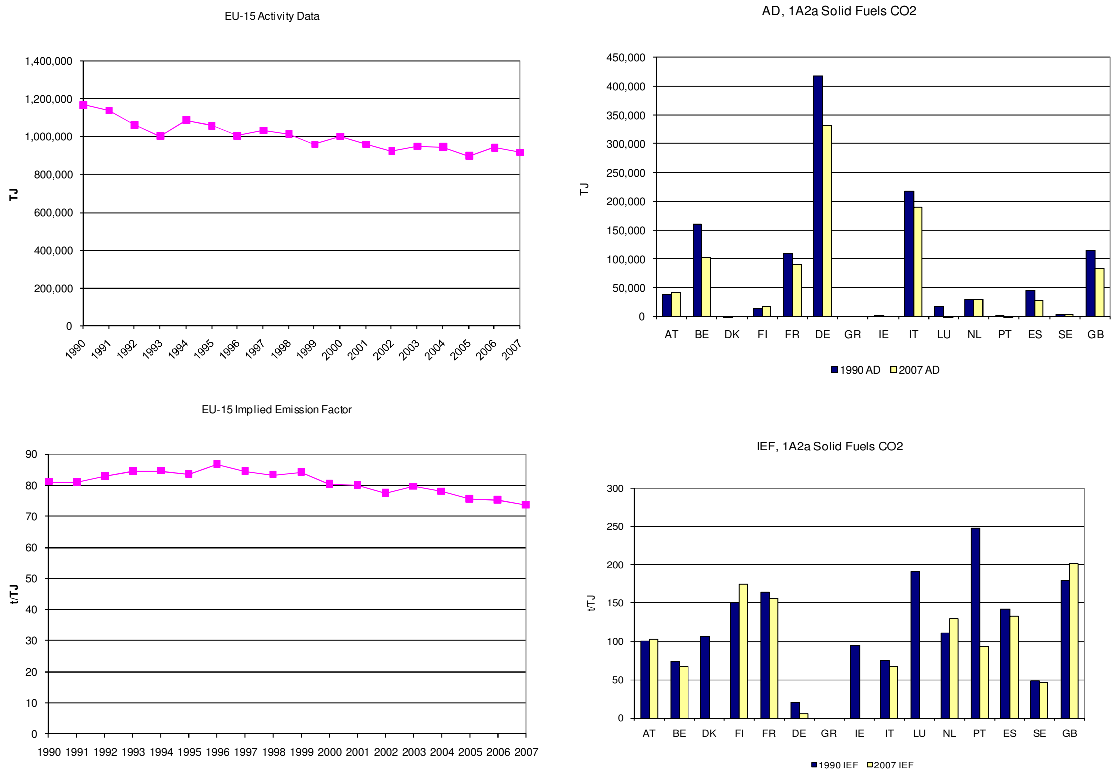
activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,846	4,418	4,280	6.3%	-138	-3%	434	11%	T2	NS, PS	CS, PS
Belgium	11,849	7,512	6,857	10.1%	-654	-9%	-4,992	-42%	T3	PS/RS	PS
Denmark	17	NO	NO	-	-	-	-17	-100%	C	NS	CS/C
Finland	2,146	3,207	2,919	4.3%	-288	-9%	773	36%	T3	PS	CS, PS
France	17,867	15,103	14,241	21.1%	-862	-6%	-3,627	-20%	C	NS/ AS/ PS	CS
Germany	8,518	4,343	1,972	2.9%	-2,370	-55%	-6,546	-77%	T2	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	115	NO	NO	-	-	-	-115	-100%	T1	NS	CS
Italy	16,300	11,948	12,603	18.6%	655	5%	-3,697	-23%	T2	NS	CS
Luxembourg	3,735	NO	NO	-	-	-	-3,735	-100%	T1	PS	D
Netherlands	3,323	3,930	3,891	5.8%	-39	-1%	568	17%	T2	NS/Q	CS
Portugal	466	NO	25	0.0%	25	-	-441	-95%	T2	NS	D,C,PS
Spain	6,525	3,415	3,764	5.6%	349	10%	-2,761	-42%	T2	PS, AS, NS	PS, CS, C
Sweden	182	193	174	0.3%	-19	-10%	-8	-4%	T2	PS	CS
United Kingdom	20,744	16,841	16,885	25.0%	44	0%	-3,859	-19%	T2	NS,AS	CS
EU-15	**95,632**	**70,909**	**67,611**	**100.0%**	**-3,298**	**-5%**	**-28,020**	**-29%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.29 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emitters are Belgium, France, Italy and the UK; together they cause almost 75 % of the CO_2 emissions from solid fuels in 1A2a. Solid fuel combustion in the EU-15 decreased by 29 % between 1990 and 2007. The implied emission factor in 2007 of EU-15 was 73.6 t/TJ. Germany reports total fuel consumption of blast furnaces under category 1A2a but reports only 11% of total CO_2 emissions from 1A2a+2C under this category which results in the low emission factor. Sweden, Belgium and Italy report fuel consumption under this category which was not used for the calculation of the CO_2 emissions which results untypically low CO_2 emission factors.

Figure 3.29 1A2a Iron and Steel, solid fuels:Activity Data and Implied Emission Factors for CO_2



1A2a Iron and Steel - Gaseous Fuels (CO_2)

In 2007 CO_2 from gaseous fuels had a share of 21 % within source category 1A2a (compared to 14 % in 1990). Between 1990 and 2007 the emissions increased by 17 % (Table 3.23). The highest absolute increase occurred in Spain (+2,073 Gg), followed by Austria (+434 Gg) and France (+316 Gg).

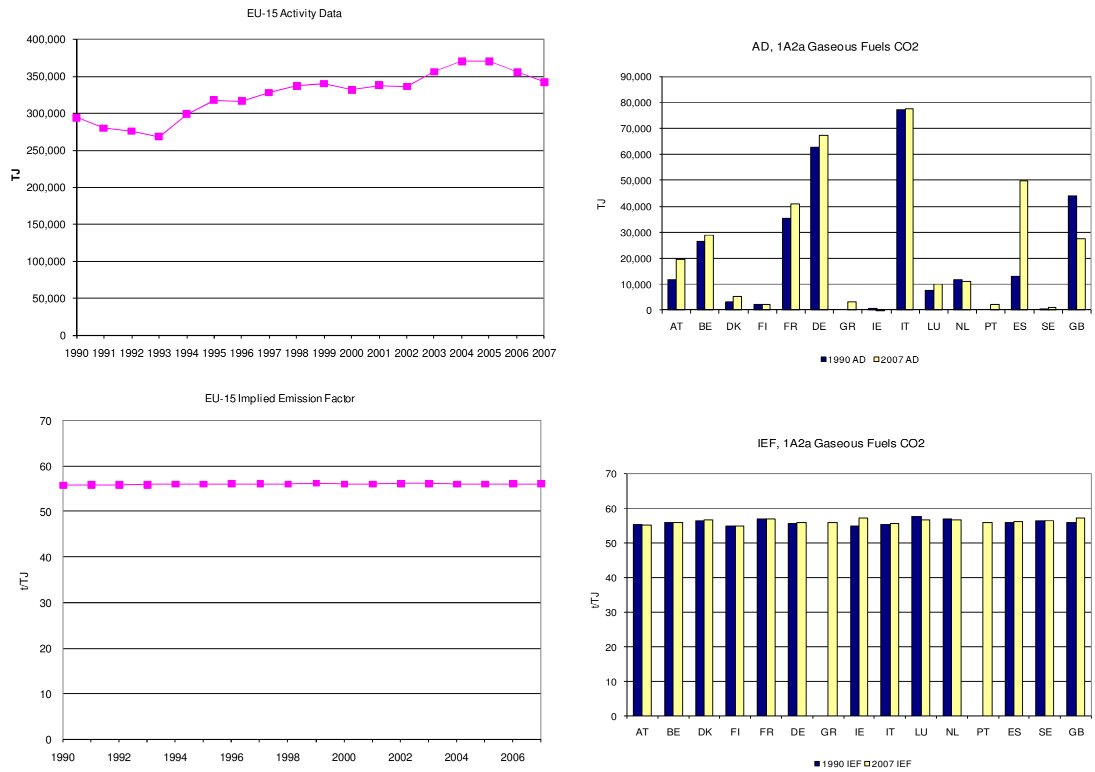
Table 3.23 1A2a Iron and Steel, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	650	1,164	1,083	5.6%	-80	-7%	434	67%	T2	NS, PS	CS, PS
Belgium	1,485	1,717	1,622	8.4%	-96	-6%	136	9%	T3	PS/RS	PS
Denmark	180	288	289	1.5%	2	1%	110	61%	C	NS	CS/C
Finland	107	132	124	0.6%	-9	-7%	17	15%	T3	PS	CS
France	2,009	2,295	2,325	12.0%	31	1%	316	16%	C	NS/ AS/ PS	CS
Germany	3,500	3,849	3,766	19.4%	-84	-2%	265	8%	T2	NS	CS
Greece	NO	157	183	0.9%	26	17%	183	-	T2	NS	PS
Ireland	44	2	2	0.0%	0	-	-41	-95%	T1	NS	CS
Italy	4,276	4,431	4,319	22.2%	-112	-3%	43	1%	T2	NS	CS
Luxembourg	431	516	562	2.9%	46	9%	131	30%	T1	PS	D
Netherlands	667	660	617	3.2%	-42	-6%	-50	-7%	T2	NS/Q	CS
Portugal	NO	88	110	0.6%	21	24%	110	-	T2	NS,PS	D,C,PS
Spain	724	3,033	2,797	14.4%	-236	-8%	2,073	286%	T2	PS, AS, NS	CS
Sweden	25	55	57	0.3%	2	4%	32	127%	T2	PS	CS
United Kingdom	2,463	1,740	1,562	8.0%	-178	-10%	-901	-37%	T2	NS,AS	CS
EU-15	**16,561**	**20,127**	**19,418**	**100.0%**	**-709**	**-4%**	**2,857**	**17%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.30 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France, Germany, Italy, Spain and the United Kingdom which contribute almost 86% to CO_2 emissions from gaseous fuels in 1A2a. Gaseous fuel consumption in the EU-15 increased by 17 % between 1990 and 2007. The implied emission factor of EU-15 was 56.1 t/TJ in 2007.

Figure 3.30 1A2a Iron and Steel, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

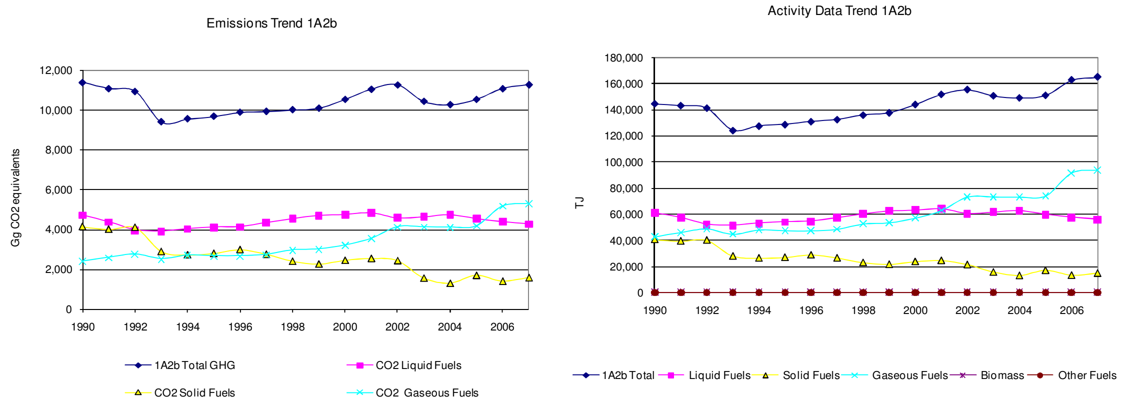


3.2.2.2 Non Ferrous Metals (1A2b) (EU-15)

In this chapter information is provided about emission trends, Member States contribution, activity data and emission factors for category 1A2b by fuels. CO_2 emissions from 1A2b Non-Ferrous Metals accounted for 2.3% of 1A2 source category and 0.3 % of total GHG emissions in 2007.

Figure 3.31 shows the emission trend within the category 1A2b, which is in 2007 mainly dominated by CO_2 emissions from liquid, and gaseous fuels. The share of solid fuels emissions decreased from 36% in 1990 to 14 % in 2007. Total GHG emissions reached the same level as in 1990. Increasing emissions were reported for gaseous fuels (+121 %).

Figure 3.31 1A2b Non ferrous Metals: Total and CO_2 emission trends



Although the EU-15 emissions of 1990 and 2007 were at the same level, the Member States' emissions showed changes. In absolute term France reported the highest decrease, while Spain and Ireland reported substantial absolute and relative increases in this period of 108 % and 124% respectively (Table 3.24).

Table 3.24 1A2b Non ferrous Metals:Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	132	224	254	2.3%	30	13%	122	93%
Belgium	624	527	470	4.2%	-57	-11%	-153	-25%
Denmark	16	8	8	0.1%	0	-1%	-9	-53%
Finland	336	98	102	0.9%	4	4%	-234	-70%
France	3,906	1,934	1,876	16.9%	-58	-3%	-2,029	-52%
Germany	1,600	485	545	4.9%	61	13%	-1,054	-66%
Greece	1,261	1,495	1,538	13.8%	43	3%	277	22%
Ireland	809	1,785	1,812	16.3%	27	2%	1,004	124%
Italy	738	1,176	1,144	10.3%	-32	-3%	406	55%
Luxembourg	28	56	55	-	-1	-2%	27	96%
Netherlands	216	217	250	2.2%	33	15%	34	16%
Portugal	IE,NO	IE	IE	0.0%	-	-	-	-
Spain	1,432	2,831	2,981	26.8%	150	5%	1,549	108%
Sweden	142	93	96	0.9%	2	2%	-47	-33%
United Kingdom	IE,NO	NA	NA	-	-	-	-	-
EU-15	**11,239**	**10,929**	**11,132**	**100.0%**	**203**	**2%**	**-107**	**-1%**

UK includes emissions under 1A2f.

Portugal includes emissions under 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2b Non-Ferrous Metals - Solid Fuels (CO_2)

In 2007 CO_2 from solid fuels had a share of 14 % within source category 1A2b category (compared to 36 % in 1990). Between 1990 and 2007 the emissions decreased by 62 % (Table 3.25). Portugal and the United Kingdom reported emissions as 'Included elsewhere' and the Netherlands, Luxembourg and Denmark as 'Not occuring'. Substantial decreases between 1990 and 2007 were reported by

France and Germany.

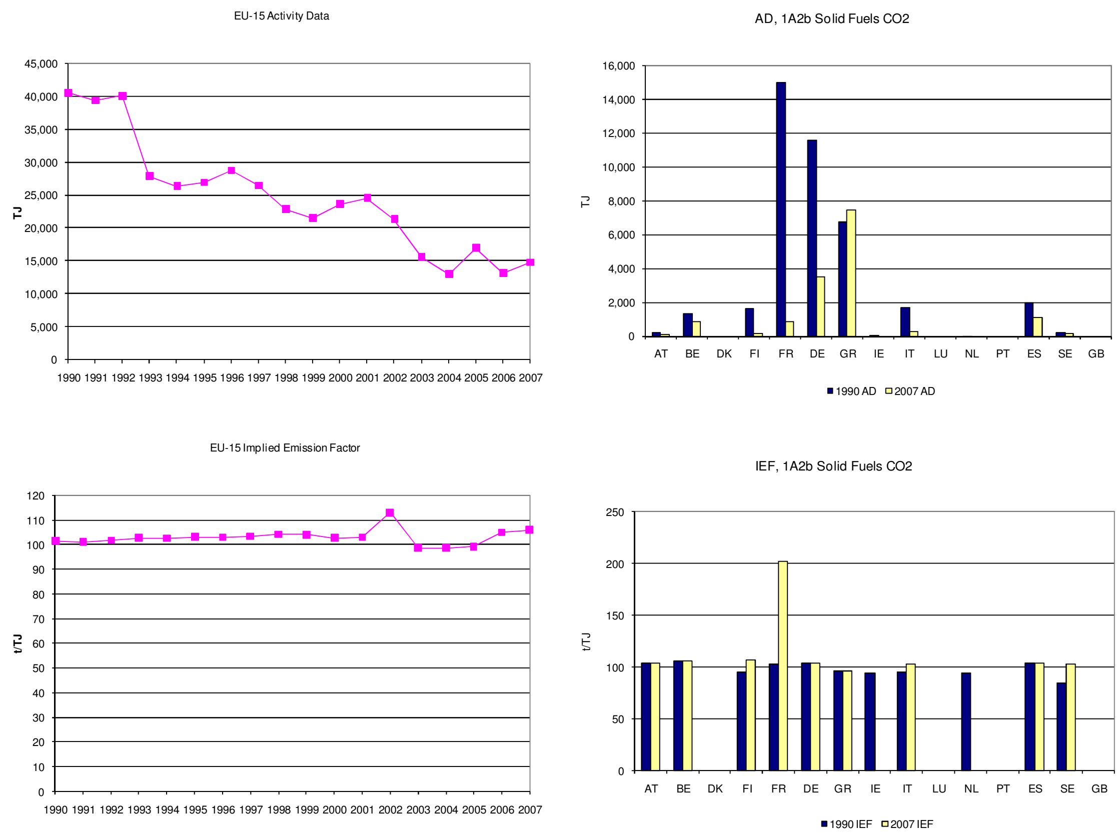
Table 3.25 1A2b Non ferrous Metals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	22	13	14	0.9%	2	13%	-8	-34%	T2	NS	CS
Belgium	146	91	95	6.1%	5	5%	-51	-35%	T1	PS/RS	D
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	155	20	20	1.3%	0	2%	-135	-87%	T3	PS	CS
France	1,548	161	182	11.7%	21	13%	-1,366	-88%	C	NS/ PS	CS
Germany	1,205	298	368	23.6%	70	23%	-837	-69%	CS	NS	CS
Greece	653	669	718	46.0%	49	7%	65	10%	T2	NS	PS
Ireland	4	NO	NO	-	-	-	-4	-100%	T1	NS	CS
Italy	163	28	28	1.8%	0	-1%	-135	-83%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	0	NO	NO	-	-	-	-0.4	-100%	NA	NO	NA
Portugal	IE	IE	IE	-	-	-	-	-	T2	NS	D,C
Spain	211	89	117	7.5%	28	32%	-94	-44%	T2	PS, AS	CS
Sweden	22	16	19	1.2%	3	20%	-3	-13%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**4,129**	**1,384**	**1,562**	**100.0%**	**178**	**13%**	**-2,567**	**-62%**			

UK includes emissions under 1A2f.
Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry not available
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.32 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by France, Germany and Greece; together they cause 81 % of the CO_2 emissions from solid fuels in 2007 and 82 % in 1990. Consumption of solid fuelsin the EU-15 decreased by 64 % between 1990 and 2007. The implied emission factor of EU-15 was 106 t/TJ in 2007. The high implied emission factor of France in 2007 is caused by the high share of of blast furnace and steel plants gases with an emission factor of 268 kg CO_2/ GJ and 183 kg CO_2/ GJ respectively. This also implies the peak in the EU-15 implied emission factor for 2002.

Figure 3.32 1A2b Non ferrous Metals, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2b Non-Ferrous Metals - Gaseous Fuels (CO_2)

In 2007 CO_2 from gaseous fuels had a share of 47 % within source category 1A2b (compared to 21 % in 1990). Between 1990 and 2007 the emissions increased by 120 % (Table 3.26). Between 1990 and 2007 only Denmark reported a decrease of emission. The highest absolute and relative increase ocurred in Spain followed by Ireland. Between 2006 and 2007 emissions increased in three Member States Belgium, Italy and Spain.

Table 3.26 1A2b Non ferrous Metals, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

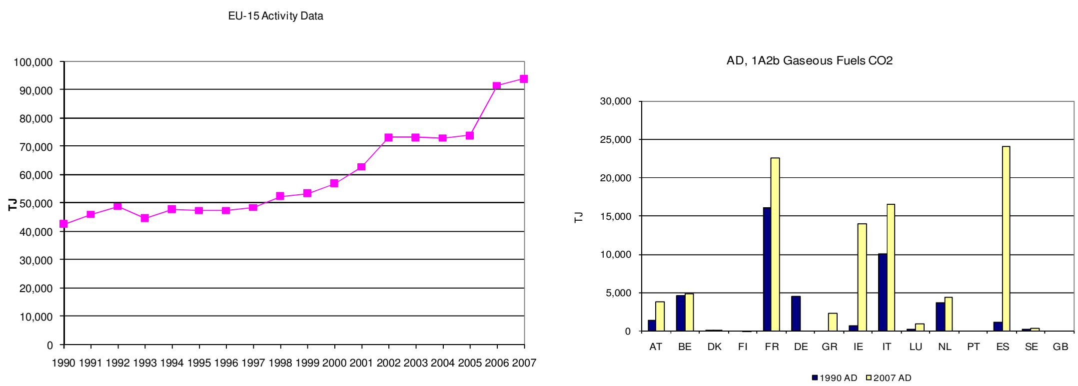
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	75	179	210	4.0%	31	17%	135	180%	T2	NS	CS
Belgium	260	322	270	5.1%	-52	-16%	11	4%	T1	PS/RS	D
Denmark	7	5	5	0.1%	0	1%	-1	-21%	C	NS	CS/C
Finland	NO	1	1	0.0%	0	1%	1	-	T3	PS	CS
France	919	1,273	1,286	24.2%	13	1%	367	40%	C	NS/ PS	CS
Germany	253	IE	IE	0.0%	-	-	-253	-100%	CS	NS	CS
Greece	NO	117	133	2.5%	16	13%	133	-	T2	NS	PS
Ireland	39	637	802	15.1%	165	-	763	1980%	T1	NS	CS
Italy	558	934	924	17.4%	-10	-1%	366	66%	T2	NS	CS
Luxembourg	13	56	55	1.0%	-1	-2%	42	-	T1	PS	D
Netherlands	213	217	250	4.7%	33	15%	37	17%	0.0	0.0	0.0
Portugal	NO	IE	IE	-	-	-	-	-	T2	NS	D,C
Spain	66	1,409	1,350	25.5%	-58	-4%	1,285	1955%	T2	PS, AS	CS
Sweden	10	18	18	0.3%	0	1%	7	70%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**2,413**	**5,167**	**5,304**	**100.0%**	**136**	**3%**	**2,891**	**120%**			

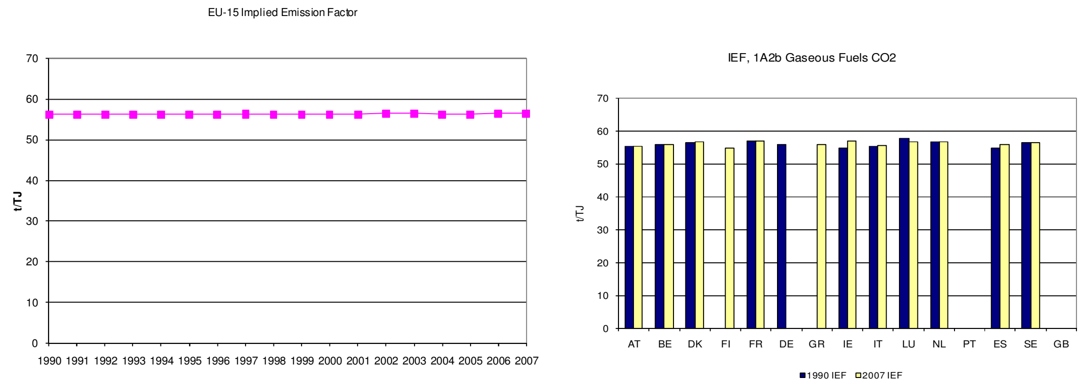
UK includes emissions under 1A2f.

Portugal includes emissions under 1A2f because the separation of AD between ferrous and non-ferrous industry not available
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.33 shows activity data and CO_2 implied emission factors for EU-15 and the Member States. The largest emissions are reported by France, Ireland, Italy and Spain; together they cause around 82 % of the CO_2 emissions in 2007 from gaseous fuels in 1A2b. Consumption of gaseous fuels in the EU-15 rose by 120 % between 1990 and 2007. The implied emission factor of EU-15 was 56.4 t/TJ in 2007.

Figure 3.33 1A2b Non ferrous Metals, gaseous fuels:Activity Data and Implied Emission Factors for CO_2



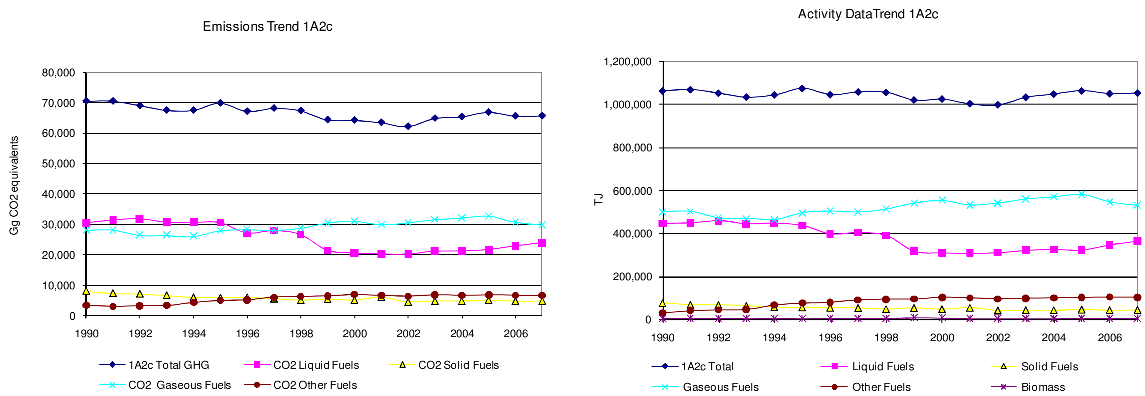


3.2.2.3 Chemicals (1A2c) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2c on a fuel base. CO_2 emissions from 1A2c Chemicals accounted for 12.5% of 1A2 category and 1.6 % of total GHG emissions in 2007.

Figure 3.34 shows the emission trend within the category 1A2c, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 7 %, mainly due to decreases in emissions from solid (-41 %) and liquid (-22 %) fuels. Increasing emissions were reported for gaseous fuels (+6 %) and other fuels (+ 99 %).

Figure 3.34 1A2c Chemicals: Total and CO_2 emission and activity trends



Between 1990 and 2007, CO_2 emissions from 1A2c Chemicals decreased by 7 % in the EU-15 (Table 3.27), mainly due to decreases in Italy and the Netherlands; Spain reported a substantial increase of 59 % in this period. Between 2006 and 2007 emissions decreased in Austria, Greece, Italy and Spain.

Table 3.27 1A2c Chemicals: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	883	1,696	1,528	2.3%	-168	-10%	646	73%
Belgium	6,585	7,710	7,852	12.0%	142	2%	1,267	19%
Denmark	379	442	440	0.7%	-2	0%	62	16%
Finland	1,286	899	941	1.4%	43	5%	-345	-27%
France	13,652	16,072	16,124	24.7%	52	0%	2,471	18%
Germany	IE	IE	IE	-	-	-	-	-
Greece	1,312	973	926	1.4%	-47	-5%	-386	-29%
Ireland	411	434	452	0.7%	18	4%	41	10%
Italy	20,052	11,746	11,340	17.4%	-405	-3%	-8,711	-43%
Luxembourg	173	204	171	0.3%	-33	-16%	-2	-1%
Netherlands	17,176	12,442	12,849	19.7%	406	3%	-4,327	-25%
Portugal	1,479	1,860	2,125	3.3%	265	14%	646	44%
Spain	5,658	9,258	8,987	13.8%	-271	-3%	3,330	59%
Sweden	1,146	1,573	1,590	2.4%	17	1%	444	39%
United Kingdom	IE,NO	IE,NA	IE,NA	-	-	-	-	-
EU-15	**70,191**	**65,308**	**65,327**	**100.0%**	**18**	**0%**	**-4,865**	**-7%**

Emissions of Germany and the UK are included in 1A2f.

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2c Chemicals - Liquid Fuels (CO_2)

In 2007, CO_2 from liquid fuels had a share of 36 % within source category 1A2c (compared to 43 % in 1990). Between 1990 and 2007 the emissions decreased by 22 % (Table 3.28). Six of the EU-15 Member States reported decreasing CO_2 emissions from this source category; Luxembourg and the UK reported emissions as 'Not occuring' or 'Not applicable'. Italy showed the highest reduction in absolute terms. The Netherlands contributing the most to EU-15 emissions in 2007, increased between 1990 and 2007.

Table 3.28 1A2c Chemicals, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

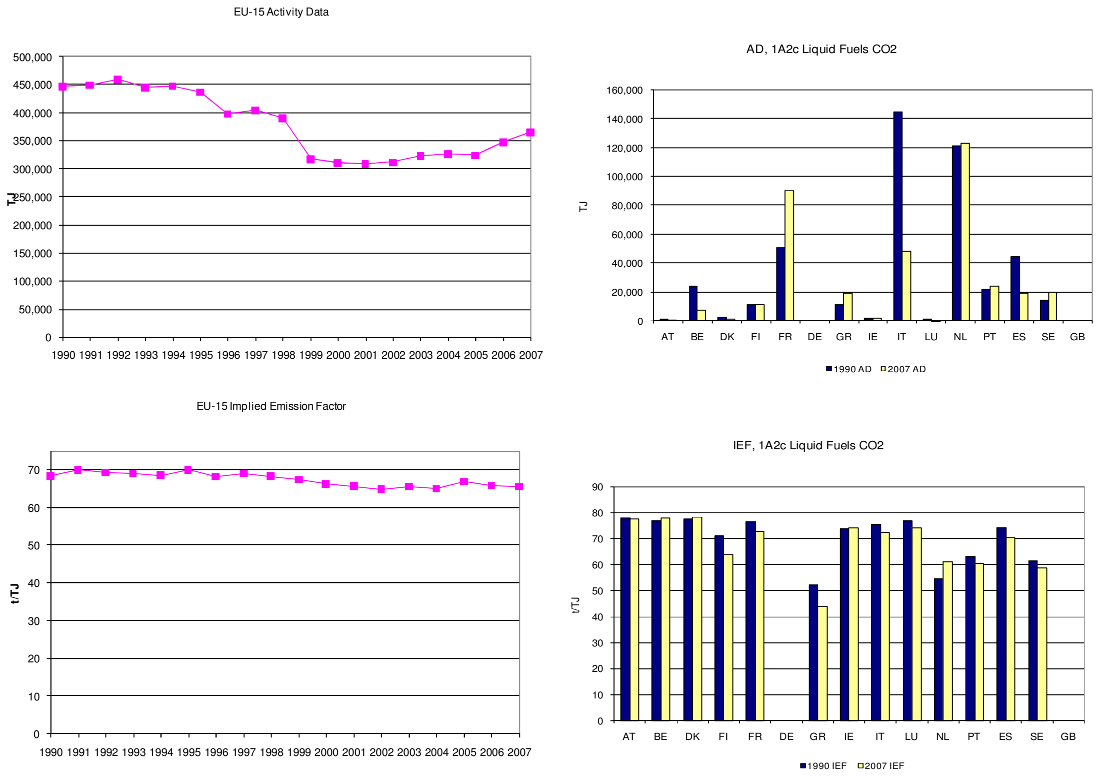
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	82	50	55	0.2%	5	10%	-27	-33%	T2	NS, PS	CS, PS
Belgium	1,835	622	570	2.4%	-52	-8%	-1,265	-69%	T1	PS/RS	D
Denmark	211	94	91	0.4%	-3	-3%	-120	-57%	C	NS	CS/C
Finland	772	662	703	2.9%	41	6%	-69	-9%	T3	PS	CS, PS
France	3,862	6,045	6,561	27.4%	515	9%	2,699	70%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	(IE)	(IE)	(IE)
Greece	584	868	833	3.5%	-34	-4%	250	43%	T2	NS	PS
Ireland	131	135	150	0.6%	15	11%	20	15%	T1	NS	CS
Italy	10,956	3,624	3,474	14.5%	-150	-4%	-7,482	-68%	T2	NS	CS
Luxembourg	117	3	3	0.0%	0	0%	-113	-97%	NA	NO	NA
Netherlands	6,613	6,926	7,551	31.5%	625	9%	938	14%	T2	NS/Q	CS
Portugal	1,372	1,359	1,466	6.1%	107	8%	94	7%	T2	PS,NS	D,C
Spain	3,276	1,332	1,334	5.6%	2	0%	-1,943	-59%	T2	NS	CS, C
Sweden	878	1,200	1,154	4.8%	-46	-4%	275	31%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**30,690**	**22,921**	**23,945**	**100.0%**	**1,025**	**4%**	**-6,745**	**-22%**			

Emissions of the UK are included in 1A2f

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.35 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest contributions are reported by France, Italy and the Netherlands; together they cause around 73 % of the CO_2 emissions from liquid fuels in 1A2c. Fuel combustion in the EU-15 decreased only by 1 % between 1990 and 2007. The implied emission factor of EU-15 was 65.5 t/TJ in 2007. The low implied emission factor of Greece is because non-energy use is included in activity data. The low implied emission factor of the Netherlands is because chemical gases are included in liquid fuels.

Figure 3.35 1A2c Chemicals, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals - Solid Fuels (CO_2)

In 2007, solid fuels had a share of 7 % within source category 1A2c (compared to 11 % in 1990). Between 1990 and 2007 the emissions decreased by 41 % (Table 3.29). In absolute terms France and the Netherlands reported a significant decrease in this period. Germany and the UK include emissions from this source category in source category 1A2f.

Table 3.29 1A2c Chemicals, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

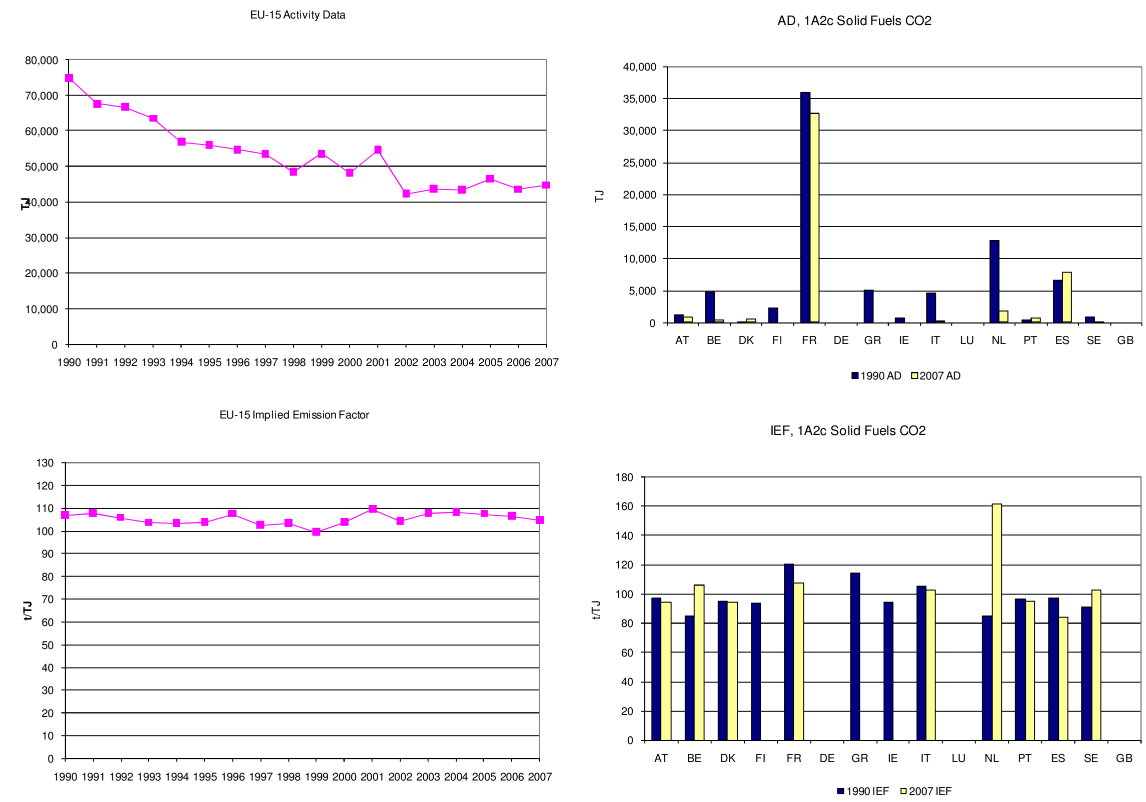
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	107	105	79	1.7%	-26	-25%	-28	-26%	T2	NS, PS	CS, PS
Belgium	397	31	31	0.7%	0	0%	-365	-92%	T1	PS/RS	D
Denmark	7	52	52	1.1%	0	-1%	45	601%	C	NS	CS/C
Finland	214	4	NO	-	-4	-100%	-214	-100%	T3	PS	CS
France	4,319	3,471	3,502	74.6%	31	1%	-817	-19%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	(IE)	(IE)	(IE)
Greece	569	NO	NO	-	-	-	-569	-100%	0.0	0.0	0.0
Ireland	72	NO	NO	-	-	-	-72	-100%	T1	NS	CS
Italy	478	28	28	0.6%	0	0%	-450	-94%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	1,087	263	279	5.9%	16	6%	-809	-74%	T2	NS/Q	CS
Portugal	44	75	62	1.3%	-13	-17%	18	40%	T2	NS	D,C
Spain	642	621	660	14.1%	39	6%	18	3%	T2	NS	CS, C
Sweden	79	NO	4	0.1%	4	-	-75	-95%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**8,017**	**4,651**	**4,697**	**100.0%**	**46**	**1%**	**-3,320**	**-41%**			

Emissions of Germany and the UK are inlcuded in 1A2f.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.36 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, the Netherlands and Spain; together they cause almost 95 % of the CO_2 emissions from solid fuels in 1A2c. Solid fuel combustion in the EU-15 decreased by -40 % between 1990 and 2007. The implied emission factor of EU-15 was 104.7 t/TJ in 2007.

Figure 3.36 1A2c Chemicals, solid fuels:Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals – Gaseous Fuels (CO_2)

In 2007, CO_2 from gaseous fuels had a share of 45 % within source category 1A2c (compared to 40 % in 1990). Between 1990 and 2007 the emissions increased by 7 % (Table 3.30). Between 1990 and 2007 only France, Greece, Italy and the Netherlands reported decreases. The highest increase ocurred in Spain. Germany and the United Kingdom include emissions from this source category in source category 1A2f.

Table 3.30 1A2c Chemicals, gaseous fuels: Member States' contributions to CO_2 and information on method applied, activity data and emission factor

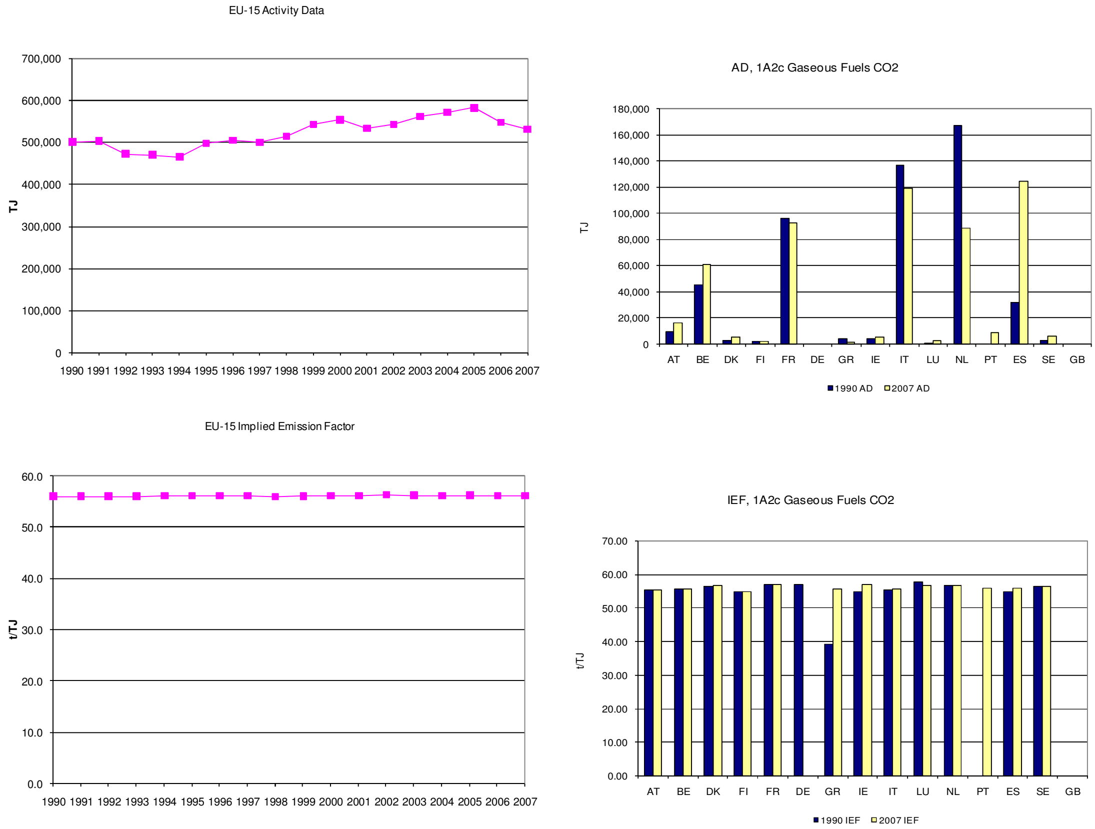
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	519	961	887	3.0%	-74	-8%	368	71%	T2	NS, PS	CS
Belgium	2,519	3,211	3,405	11.4%	194	6%	886	35%	T1	PS/RS	D
Denmark	160	296	297	1.0%	2	1%	137	86%	C	NS	CS/C
Finland	98	88	114	0.4%	26	30%	16	16%	T3	PS	CS
France	5,471	5,921	5,298	17.7%	-623	-11%	-173	-3%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	(IE)	(IE)	(IE)
Greece	159	105	93	0.3%	-12	-12%	-66	-42%	T2	NS	PS
Ireland	208	299	301	1.0%	2	1%	93	45%	T1	NS	CS
Italy	7,561	6,699	6,608	22.0%	-91	-1%	-953	-13%	T2	NS	CS
Luxembourg	57	200	168	0.6%	-33	-16%	111	197%	NA	NO	NA
Netherlands	9,476	5,253	5,019	16.7%	-234	-4%	-4,457	-47%	T2	NS/Q	CS
Portugal	NO	341	490	1.6%	149	44%	490	-	T2	NS	D,C
Spain	1,739	7,272	6,966	23.2%	-306	-4%	5,227	301%	T2	NS	CS
Sweden	154	289	329	1.1%	41	14%	175	113%	T2	PS	CS
United Kingdom	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-15	**28,121**	**30,935**	**29,976**	**100.0%**	**-959**	**-3%**	**1,855**	**7%**			

Emissions of Germany are included in 1A2f.

Emissions of the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.37 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France, Italy, the Netherlands and Spain; together they cause more than 92 % of the CO_2 emissions from gaseous fuels in 1A2c. Gaseous fuel consumption in the EU-15 rose by 6 % between 1990 and 2007. The implied emission factor of EU-15 was 56.2 t/TJ in 2007. The low 1990 implied emission factor of Greece is because non-energy use is included in activity data.

Figure 3.37 1A2c Chemicals, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



1A2c Chemicals - Other Fuels (CO_2)

In 2007 , CO_2 from other fuels had a share of 10 % within source category 1A2c (compared to 5 % in 1990). Between 1990 and 2007 the emissions increased by 99 % (Table 3.31). Denmark, Greece, Ireland, Luxembourg, the Netherlands and the UK reported emissions as 'Not occuring' or 'Not applicable', Germany included emissions in 1A2f. Major absolute increases were reported by Belgium and France between 1990 and 2007. Belgium reports recovered fuels from cracking units or other processes under this category.

Table 3.31 1A2c Chemicals, other fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	174	579	507	7.6%	-72	-12%	333	192%	T2	NS, PS	D, PS
Belgium	1,834	3,846	3,846	57.3%	0	0%	2,012	110%	T3	PS/RS	PS
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	202	145	124	1.9%	-21	-14%	-78	-39%	T3	PS	CS
France	NO	634	762	11.4%	129	20%	762	-	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	(IE)	(IE)	(IE)
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	1,057	1,395	1,231	18.4%	-163	-12%	174	16%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Portugal	63	85	106	1.6%	21	25%	44	70%	T2	PS,NS	D,C
Spain	NA	33	28	0.4%	-5	-16%	28	-	NO	NO	NO
Sweden	34	85	104	1.5%	19	22%	69	203%	T2	PS	CS
United Kingdom	NO	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**3,363**	**6,801**	**6,708**	**100.0%**	**-93**	**-1%**	**3,345**	**99%**			

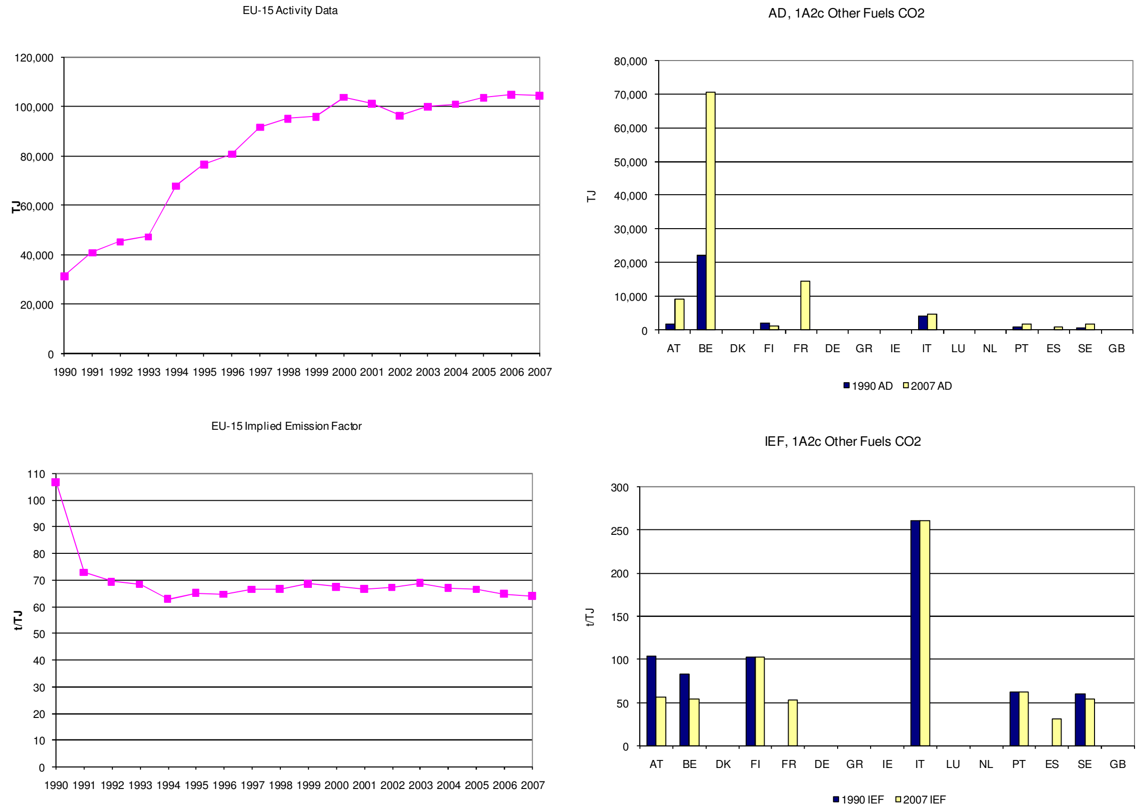
Emissions of Germany are included in 1A2f.

Emissions of the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.38 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France and Italy; together they cause 87 % of the CO_2 emissions from other fuels in 1A2c. Other fuel consumption in the EU-15 increased by 99 % between 1990 and 2007. The implied emission factor of EU-15 was 64.3.1 t/TJ in 2007.

The high implied emission factor 1990 is due to new naphta cracking plants in Belgium which started operation in 1991 and which use recovered fuels with a high share of hydrogen gas. Therefore the IEF of Belgium is much lower for the years after 1990. Because Belgium contributes to 67.3% of EU-15 activity data in 2007 it strongly affects the EU-15 IEF.

Figure 3.38 1A2c Chemicals, other fuels:Activity Data and Implied Emission Factors for CO_2

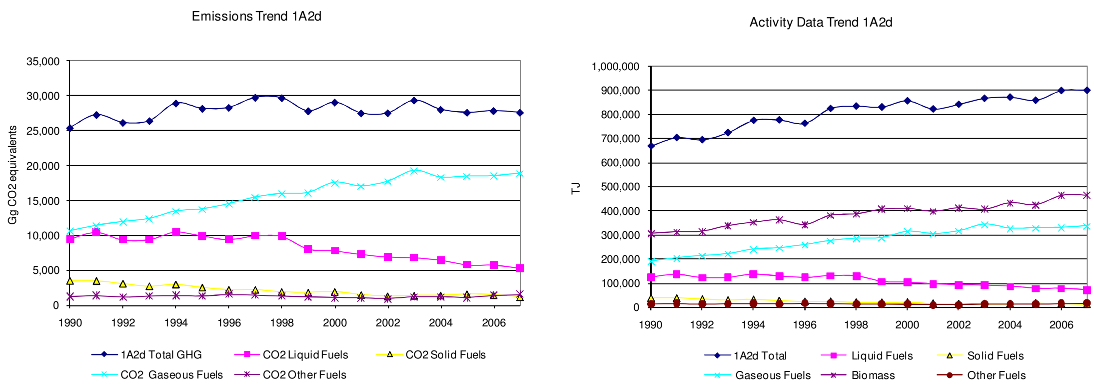


3.2.2.4 Pulp, Paper and Print (1A2d) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2d by fuels. CO_2 emissions from 1A2d Pulp, Paper and Print accounted for 5.4 % of 1A2 source category and 0.7 % of total GHG emissions in 2007.

Figure 3.39 shows the emission trend within the category 1A2d, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels. Total GHG emissions increased by 9 %. The share of gaseous fuels is gradualy increasing from 1990.

Figure 3.39 1A2d Pulp, Paper and Print: Total and CO_2 emission trends



Between 1990 and 2007, CO_2 emissions from 1A2d Pulp, Paper and Print increased by 8 % in the EU-15 (Table 3.32), mainly due to increases in Italy and Spain; Finland reported a relevant decrease in this period. Between 2006 and 2007 emissions decreased by 1 %. Luxembourg and the UK reported emissions as 'Not occuring' or 'Not applicable'.

Table 3.32 1A2d Pulp, Paper and Print: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,213	2,189	2,191	8.1%	2	0%	-22	-1%
Belgium	637	651	585	2.2%	-65	-10%	-52	-8%
Denmark	356	231	232	0.9%	0	0%	-125	-35%
Finland	5,336	4,067	4,291	15.9%	224	6%	-1,045	-20%
France	5,069	4,821	4,554	16.9%	-267	-6%	-515	-10%
Germany	4	17	18	0.1%	0	2%	14	380%
Greece	301	270	257	1.0%	-13	-5%	-45	-15%
Ireland	28	77	79	0.3%	2	2%	50	176%
Italy	3,076	4,573	5,201	19.3%	629	14%	2,125	69%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	1,743	1,616	1,391	5.2%	-225	-14%	-352	-20%
Portugal	743	848	810	3.0%	-38	-4%	67	9%
Spain	3,211	5,781	5,719	21.2%	-62	-1%	2,507	78%
Sweden	2,186	2,069	1,650	6.1%	-419	-20%	-536	-25%
United Kingdom	IE,NO	NA	NA	-	-	-	-	-
EU-15	**24,906**	**27,209**	**26,977**	**100.0%**	**-232**	**-1%**	**2,071**	**8%**

Emissions of the UK are inlcuded in 1A2f.

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2d Pulp, Paper and Print - Liquid (CO_2)

In 2007 CO_2 from liquid fuels had a share of 19 % within source category 1A2d (compared to 37 % in 1990). Between 1990 and 2007 the emissions decreased by 44 % (Table 3.33). Between 1990 and 2007 all Member States reported decreasing CO_2 emissions from this source category.

Table 3.33 1A2d Pulp, Paper and Print, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

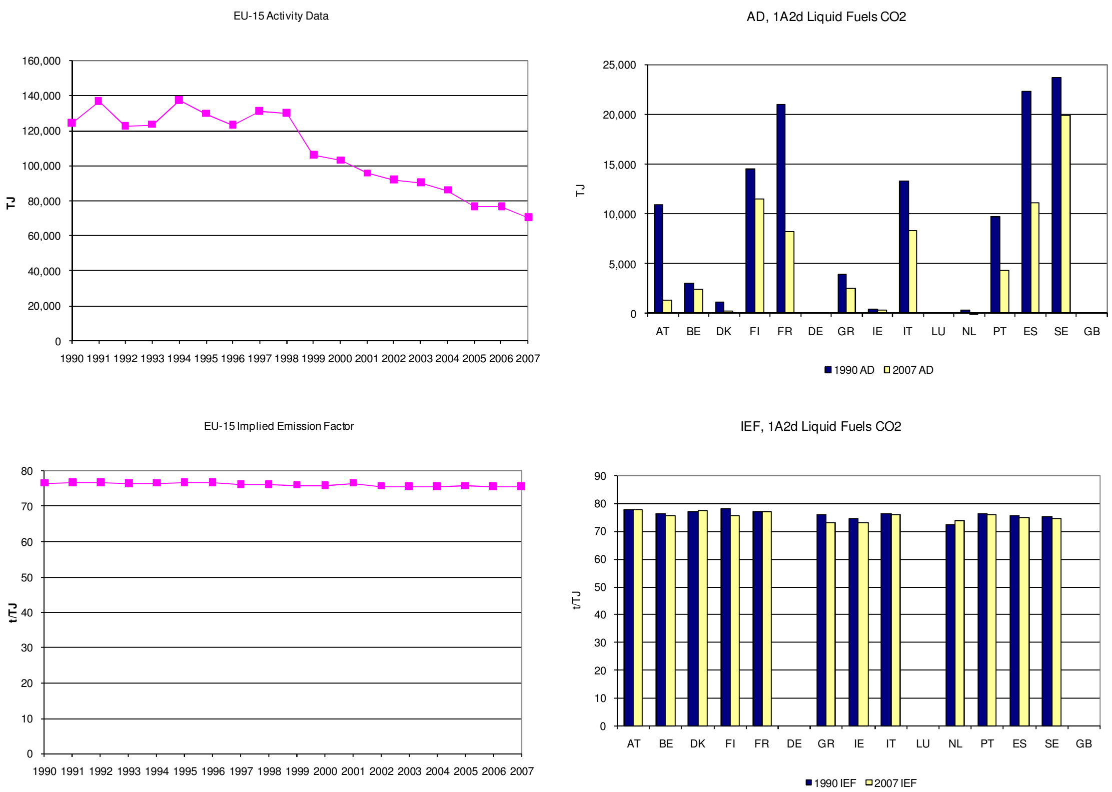
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	853	128	100	1.9%	-28	-22%	-753	-88%	T2	NS, PS	CS, PS
Belgium	232	234	186	3.5%	-48	-20%	-46	-20%	T1	PS/RS	D
Denmark	83	20	20	0.4%	-1	-3%	-64	-77%	C	NS	CS/C
Finland	1,132	893	872	16.4%	-21	-2%	-260	-23%	T3	PS	CS
France	1,617	557	635	12.0%	78	14%	-982	-61%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	(IE)	(IE)	(IE)
Greece	297	193	187	3.5%	-6	-3%	-110	-37%	T2	NS	PS
Ireland	28	22	23	0.4%	1	6%	-5	-18%	T1	NS	CS
Italy	1,015	658	628	11.8%	-30	-5%	-387	-38%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	20	3	2	0.0%	0	-15%	-18	-88%	T2	NS/Q	CS
Portugal	743	381	329	6.2%	-53	-14%	-415	-56%	T2	PS,NS	D,C
Spain	1,692	819	835	15.7%	16	2%	-857	-51%	T2	PS, NS, AS	PS, C
Sweden	1,786	1,881	1,488	28.0%	-394	-21%	-299	-17%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**9,500**	**5,790**	**5,305**	**100.0%**	**-485**	**-8%**	**-4,195**	**-44%**			

Emissions of Germany are included in 1A2f.

Emissions of the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.40 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Finland, France, Italy, Spain and Sweden; together they cause 84% of the CO_2 emissions from liquid fuels in 1A2d. Fuel consumption in the EU-15 decreased by 44 % between 1990 and 2007. The implied emission factor of EU-15 was 75.5 t/TJ in 2007.

Figure 3.40 1A2d Pulp, Paper and Print, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2d Pulp, Paper and Print - Solid Fuels (CO_2)

In 2007 CO_2 from solid fuels had a share of 5 % within source category 1A2d (compared to 14 % in 1990). Between 1990 and 2007 the emissions decreased by 66 % (Table 3.34). Only seven of the EU-15 Member States reported CO_2 emissions from this source category for the years 2006 and 2007; all of them showed decreases.

Table 3.34 1A2d Pulp, Paper and Print, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

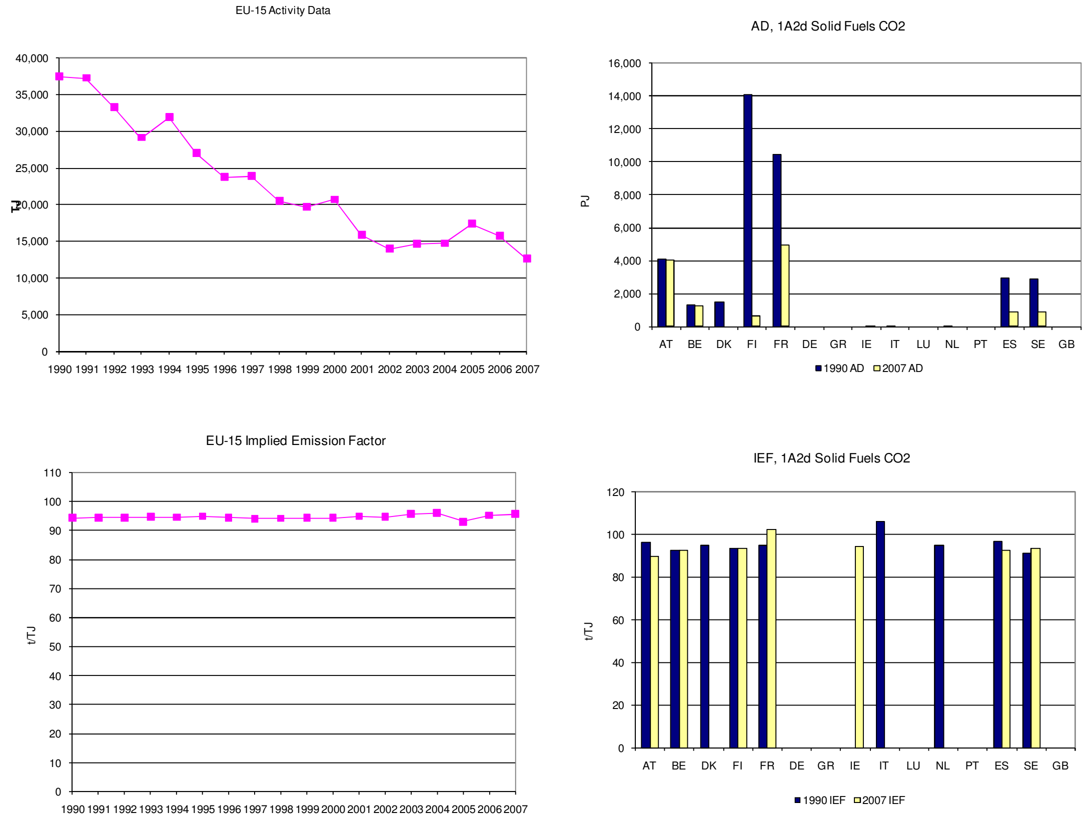
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	397	466	360	30.0%	-105	-23%	-37	-9%
Belgium	125	140	115	9.6%	-26	-18%	-10	-8%
Denmark	143	NO	NO	-	-	-	-143	-100%
Finland	1,318	80	61	5.0%	-19	-24%	-1,257	-95%
France	990	627	504	41.9%	-123	-20%	-486	-49%
Germany	IE	IE	IE	-	-	-	-	-
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	1	1	0.1%	-	-	1	-
Italy	6	NO	NO	-	-	-	-6	-100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	8	NO	NO	-	-	-	-8	-100%
Portugal	NO	NO	NO	-	-	-	-	-
Spain	286	88	81	6.7%	-8	-9%	-205	-72%
Sweden	263	92	80	6.7%	-12	-13%	-183	-70%
United Kingdom	IE	NA	NA	-	-	-	-	-
EU-15	**3,536**	**1,495**	**1,202**	**100.0%**	**-292**	**-20%**	**-2,333**	**-66%**

Emissions of Germany are included in 1A2f.

Emissions of the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.41 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Austria and France; together they cause around 72 % of the CO_2 emissions from solid fuels in 1A2d. Solid fuel consumption in the EU-15 decreased by 66 % between 1990 and 2007. The implied emission factor of EU-15 was 95.8 t/TJ in 2007.

Figure 3.41 1A2d Pulp, Paper and Print, solid fuels:Activity Data and Implied Emission Factors for CO_2



1A2d Pulp, Paper and Print - Gaseous Fuels (CO_2)

In 2007, CO_2 from gaseous fuels had a share of 69 % within source category 1A2d (compared to 42 % in 1990). Between 1990 and 2007 the emissions increased by 78 % (Table 3.35). In all EU-15 Member States emissions increased between 1990 and 2007 except for in Belgium, the Netherlands and Sweden. Germany and the United Kingdom include emissions in 1A2f.

Table 3.35 1A2d Pulp, Paper and Print, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

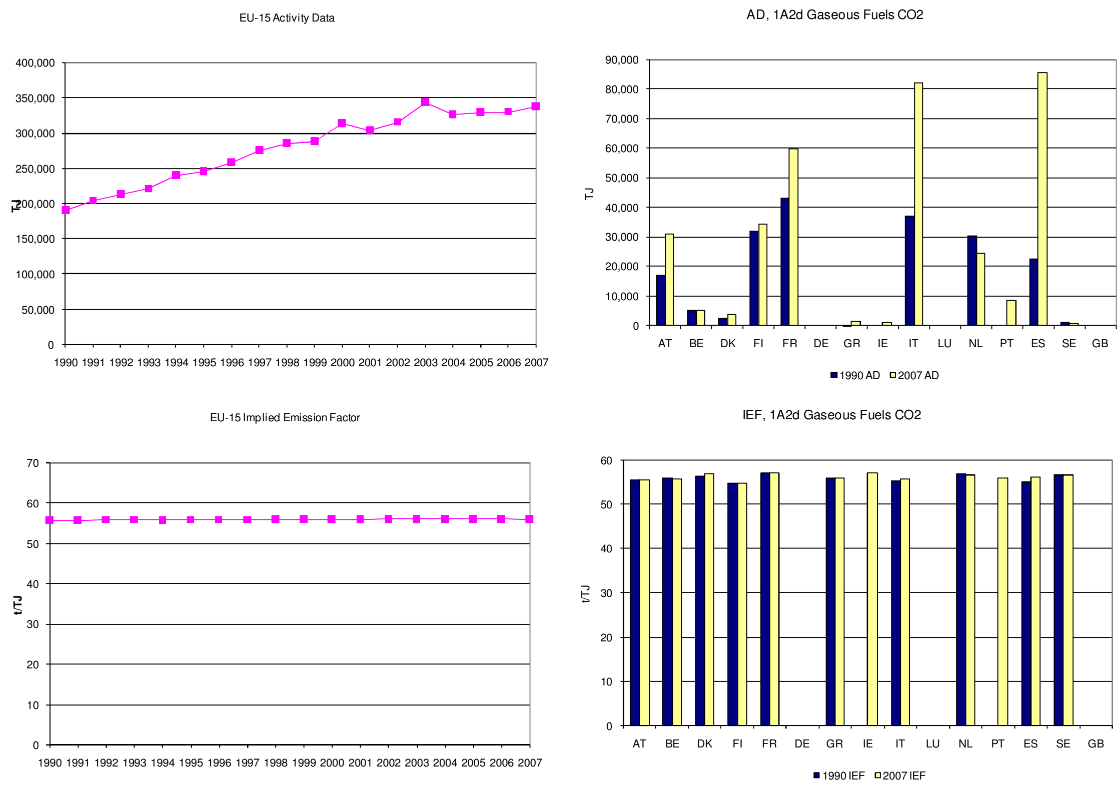
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	943	1,587	1,716	9.1%	129	8%	774	82%	T2	NS, PS	CS
Belgium	280	276	278	1.5%	2	1%	-3	-1%	T1	PS/RS	D
Denmark	130	211	212	1.1%	1	1%	82	63%	C	NS	CS/C
Finland	1,748	1,714	1,880	9.9%	166	10%	133	8%	T3	PS	CS
France	2,461	3,633	3,409	18.0%	-224	-6%	948	39%	C	NS/ PS	CS
Germany	IE	IE	IE	-	-	-	-	-	(IE)	(IE)	(IE)
Greece	5	77	70	0.4%	-7	-9%	65	1366%	T2	NS	PS
Ireland	NO	54	54	0.3%	0	-	54	-	T1	NS	CS
Italy	2,055	3,914	4,573	24.2%	659	17%	2,518	123%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	1,715	1,613	1,389	7.3%	-225	-14%	-327	-19%	T2	NS/Q	CS
Portugal	NO	467	482	2.5%	15	3%	482	-	T2	PS,NS	D,C
Spain	1,233	4,873	4,803	25.4%	-70	-1%	3,570	290%	T2	PS, NS, AS	CS
Sweden	66	96	47	0.3%	-49	-51%	-18	-28%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**10,636**	**18,516**	**18,912**	**100.0%**	**396**	**2%**	**8,276**	**78%**			

Emissions of Germany are included in 1A2f.

Emissions of the UK are included in 1A2f.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.42 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by France, Italy and Spain; together they cause around 68 % of the CO_2 emissions from gaseous fuels in 1A2d. Gaseous fuel consumption in the EU-15 rose by 78 % between 1990 and 2007. The implied emission factor of EU-15 was 56.0 t/TJ in 2007.

Figure 3.42 1A2d Pulp, Paper and Print, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

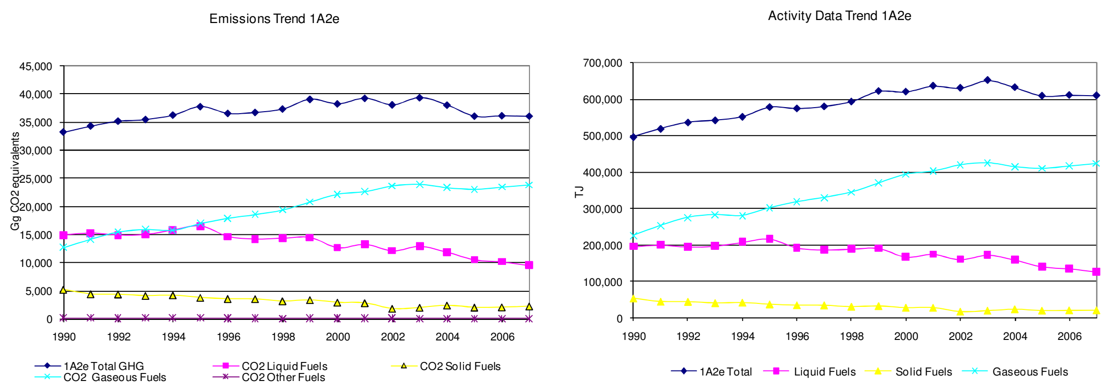


3.2.2.5 Food Processing, Beverages and Tobacco (1A2e) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2e by fuels. CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco accounted for 7.0 % of 1A2 source category and for 0.9 % of total GHG emissions in 2007.

Figure 3.43 shows the emission trend within the category 1A2e, which is mainly dominated by CO_2 emissions from gaseous and liquid fuels. Total GHG emissions increased by 8 %, mainly due to increases in emissions from gaseous fuels (+88 %), emissions from all other fossil fuel types decreased.

Figure 3.43 1A2e Food Processing, Beverages and Tobacco: Total and CO_2 emission trends



Between 1990 and 2007, CO_2 emissions from 1A2e Food Processing, Beverages and Tobacco increased by 7 % in the EU-15 (Table 3.36), mainly due to increases in France, Italy and Spain. Between 2006 and 2007 emissions decreased slightly.

Table 3.36 1A2e Food Processing, Beverages and Tobacco: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	870	941	899	2.5%	-41	-4%	29	3%
Belgium	2,990	2,015	1,786	5.0%	-228	-11%	-1,203	-40%
Denmark	1,585	1,522	1,508	4.2%	-14	-1%	-78	-5%
Finland	815	200	168	0.5%	-32	-16%	-647	-79%
France	9,702	10,997	11,741	32.9%	744	7%	2,039	21%
Germany	1,989	635	654	1.8%	18	3%	-1,336	-67%
Greece	902	828	698	2.0%	-130	-16%	-204	-23%
Ireland	1,018	936	990	2.8%	54	6%	-28	-3%
Italy	3,853	5,721	5,453	15.3%	-268	-5%	1,600	42%
Luxembourg	16	21	24	0.1%	3	15%	8	48%
Netherlands	4,079	3,769	3,839	10.7%	70	2%	-240	-6%
Portugal	822	878	826	2.3%	-51	-6%	5	1%
Spain	3,373	6,699	6,471	18.1%	-228	-3%	3,099	92%
Sweden	949	638	662	1.9%	24	4%	-286	-30%
United Kingdom	IE,NO	NA	NA	-	-	-	-	-
EU-15	**32,963**	**35,800**	**35,721**	**100.0%**	**-79**	**0%**	**2,757**	**8%**

Emissions of the UK are inlcuded in 1A2f.

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2e Food Processing, Beverages and Tobacco - Liquid (CO_2)

In 2007 CO_2 from liquid fuels decreased to a share of 26 % within source category 1A2e (compared to 45 % in 1990). Between 1990 and 2007 the emissions decreased by 36 % (Table 3.37). Between 1990 and 2007 all Member States showed reduction of emissions except for Italy.

Table 3.37 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

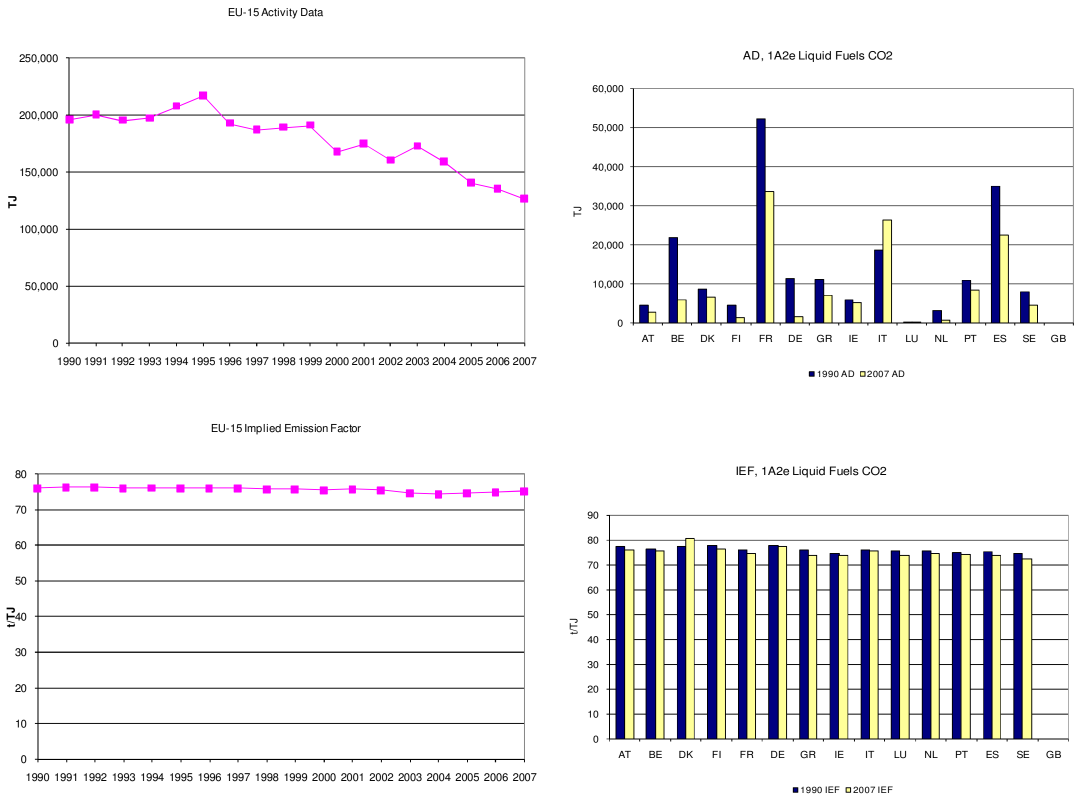
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	345	244	210	2.2%	-34	-14%	-135	-39%	T2	NS, PS	CS, PS
Belgium	1,671	546	440	4.6%	-107	-20%	-1,232	-74%	T1	PS/RS	D
Denmark	656	541	524	5.5%	-17	-3%	-132	-20%	C	NS	CS/C
Finland	353	124	106	1.1%	-18	-15%	-247	-70%	T3	PS	CS
France	3,973	2,612	2,511	26.5%	-101	-4%	-1,463	-37%	C	NS/ PS	CS
Germany	889	116	116	1.2%	0	0%	-773	-87%	CS	NS	CS
Greece	847	535	516	5.4%	-19	-4%	-331	-39%	T2	NS	PS
Ireland	433	352	389	4.1%	37	10%	-44	-10%	T1	NS	CS
Italy	1,421	2,206	1,998	21.0%	-209	-9%	577	41%	T2	NS	CS
Luxembourg	13	13	16	0.2%	3	25%	3	26%	NA	NO	NA
Netherlands	235	67	50	0.5%	-17	-25%	-185	-79%	T2	NS/Q	CS
Portugal	820	705	624	6.6%	-81	-11%	-196	-24%	T2	NS	D,C
Spain	2,633	1,687	1,667	17.6%	-20	-1%	-966	-37%	T2	NS	C
Sweden	597	374	326	3.4%	-48	-13%	-271	-45%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**14,886**	**10,123**	**9,492**	**100.0%**	**-631**	**-6%**	**-5,394**	**-36%**			

Emissions of the UK are inlcuded in 1A2f.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.44 shows activity data and implied emission factors for CO_2 comparing the EU-15 average and the Member States. The largest emissions are reported by France, Italy and Spain; together they cause 65 % of the CO_2 emissions from liquid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 35 % between 1990 and 2007. The implied emission factor of EU-15 was 75.0 t/TJ in 2007.

Figure 3.44 1A2e Food Processing, Beverages and Tobacco, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2e Food Processing Beverages and Tobacco - Solid (CO_2)

In 2007 solid fuels had a share of 6 % within source category 1A2e (compared to 16 % in 1990). Between 1990 and 2007 the emissions decreased by 57 % (Table 3.38) and all Member States reported decreasing CO_2 emissions from this source category.

Table 3.38 1A2e Food Processing, Beverages and Tobacco, solid fuels: Member States' contributions to CO_2 emissionsand information on method applied, activity data and emission factor

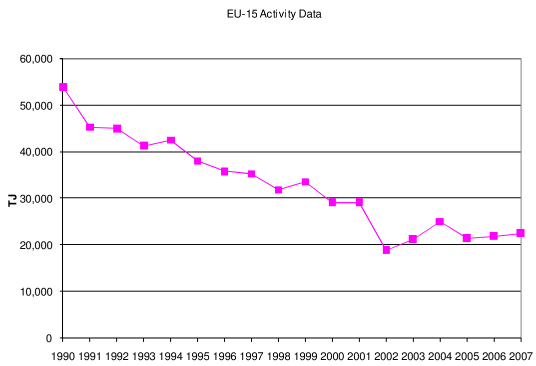
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	18	11	11	0.5%	0	3%	-7	-40%	T2	NS, PS	CS, PS
Belgium	638	135	108	4.8%	-27	-20%	-530	-83%	T1	PS/RS	D
Denmark	455	198	197	8.7%	-2	-1%	-258	-57%	C	NS	CS/C
Finland	257	5	3	0.2%	-2	-34%	-253	-99%	T3	PS	CS
France	1,868	1,074	1,158	51.4%	84	8%	-710	-38%	C	NS/ PS	CS
Germany	1,100	519	537	23.9%	18	4%	-563	-51%	CS	NS	CS
Greece	47	NO	NO	-	-	-	-47	-100%	0.0	0.0	0.0
Ireland	292	52	54	2.4%	3	-	-237	-81%	T1	NS	CS
Italy	86	NO	NO	-	-	-	-86	-100%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	227	91	168	7.4%	77	84%	-60	-26%	T2	NS/Q	CS
Portugal	1	NO	NO	-	-	-	-1	-100%	T2	NS	D,C
Spain	109	NA	NA	-	-	-	-109	-100%	T2	NS	C
Sweden	90	24	16	0.7%	-8	-33%	-74	-82%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**5,186**	**2,109**	**2,253**	**100.0%**	**144**	**7%**	**-2,933**	**-57%**			

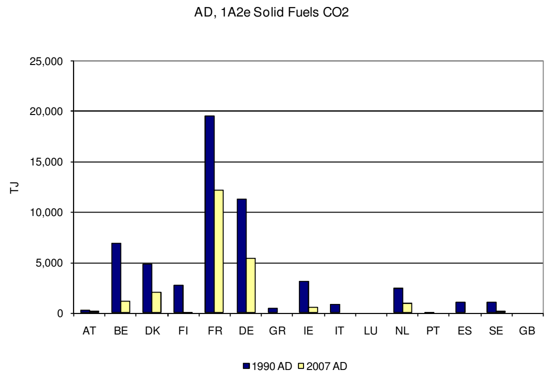
Emissions of the UK are inlcuded in 1A2f.

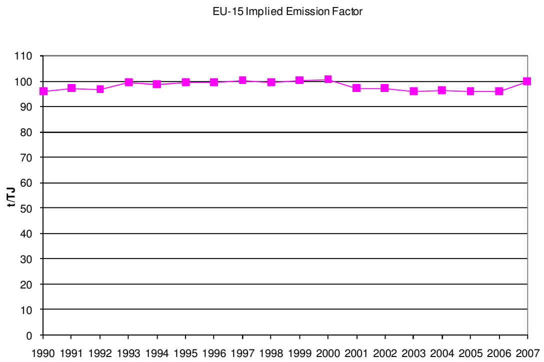
Abbreviations explained in the Chapter 'Units and abbreviations'.

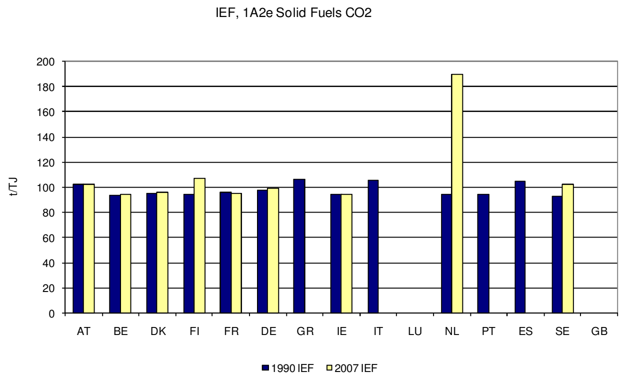
Figure 3.45 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France and Germany; together they cause around 75 % of the CO_2 emissions from solid fuels in 1A2e. Fuel consumption in the EU-15 decreased by 57 % between 1990 and 2007. The implied emission factor of EU-15 was 99.9 t/TJ in 2007. The high implied emission factor of the Netherlands in 2007 needs further checking.

Figure 3.45 1A2e Food Processing, Beverages and Tobacco, solid fuels: Activity Data and Implied Emission Factors for CO_2









1A2e Food Processing Beverages and Tobacco - Gaseous (CO_2)

In 2007 CO_2 from gaseous fuels had a share of 66 % within source category 1A2e (compared to 38 % in 1990). Between 1990 and 2007 the emissions increased by 88 % (Table 3.39). Between 1990 and 2007 all Member States except for Finland reported increasing CO_2 emissions from this source category. Major absolute increases ocurred in Spain, France and Italy. Germany reports emissions for the years 1995 to 2001 only.

Table 3.39 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

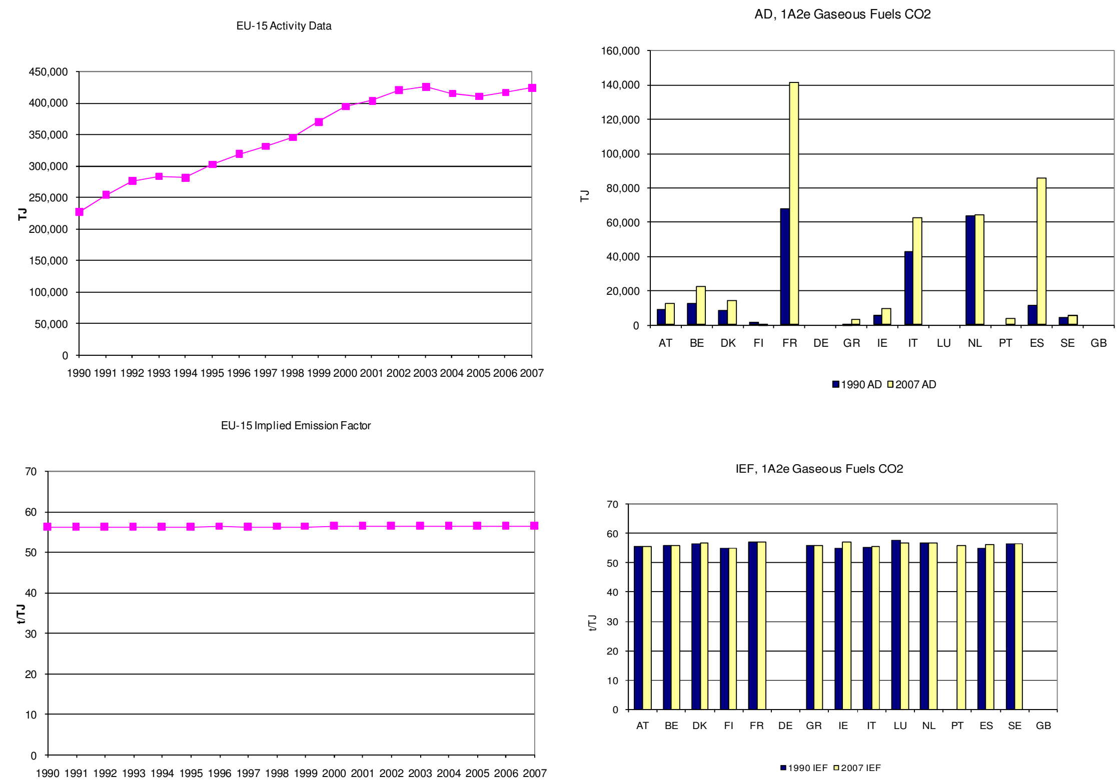
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	507	685	678	2.8%	-7	-1%	172	34%	T2	NS, PS	CS
Belgium	681	1,334	1,239	5.2%	-95	-7%	558	82%	T1	PS/RS	D
Denmark	475	783	787	3.3%	4	1%	312	66%	C	NS	CS/C
Finland	67	19	9	0.0%	-10	-54%	-58	-87%	T3	PS	CS
France	3,861	7,311	8,072	33.7%	762	10%	4,211	109%	C	NS/ PS	CS
Germany	NE	NE	NE	-	-	-	-	-	(NE)	(NE)	(NE)
Greece	9	294	182	0.8%	-111	-38%	173	1929%	T2	NS	PS
Ireland	294	532	547	2.3%	15	3%	254	86%	T1	NS	CS
Italy	2,346	3,514	3,455	14.44%	-59	-2%	1,108	47%	T2	NS	CS
Luxembourg	4	8	8	0.03%	0.1	1%	5	123%	NA	NO	NA
Netherlands	3,617	3,611	3,621	15.1%	10	0%	4	0%	T2	NS/Q	CS
Portugal	NO	173	202	0.8%	30	17%	202	-	T2	NS	D,C
Spain	631	5,012	4,804	20.1%	-208	-4%	4,173	661%	T2	NS	CS
Sweden	253	240	320	1.3%	80	34%	67	26%	T2	PS	CS
United Kingdom	IE	NA	NA	-	-	-	-	-	IE	IE	IE
EU-15	**12,744**	**23,516**	**23,926**	**100.0%**	**410**	**2%**	**11,182**	**88%**			

Emissions of the UK are inlcuded in 1A2f.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.46 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Italy, the Netherlands and Spain; together they cause about 83 % of the CO_2 emissions from gaseous fuels in 1A2e. Fuel consumption in the EU-15 rose by 88 % between 1990 and 2007. The implied emission factor of EU-15 was 56.4 t/TJ in 2007.

Figure 3.46 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



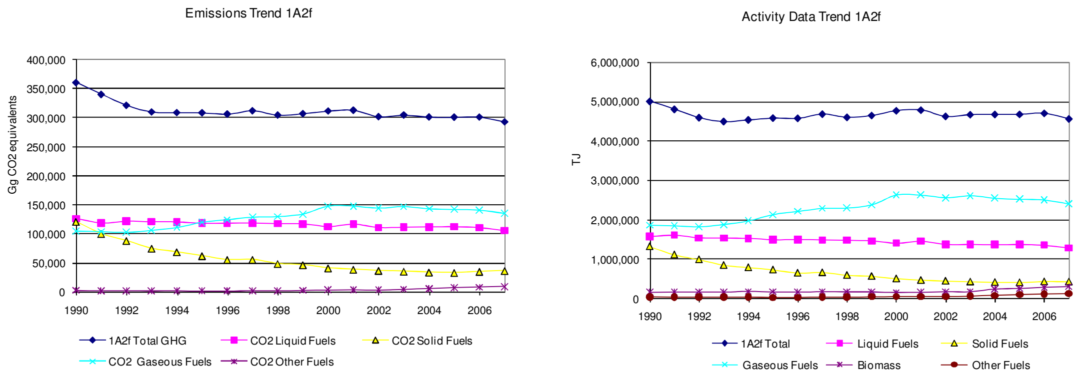
3.2.2.6 Other (1A2f) (EU-15)

In this chapter information about emission trends, Member States contribution, activity data and emission factors is provided for category 1A2f by fuels. CO_2 emissions from 1A2f Other accounted for 55.5 % for 1A2 source category and for 7.1 % of total GHG emissions in 2007.

Figure 3.47 shows the emission trend within the category 1A2f, which is mainly dominated by CO_2

emissions from gaseous and liquid fuels; the decrease in the early 1990s was mainly due to a decline of solid fuel consumption. Total GHG emissions decreased by 19 %, mainly due to decreases in emissions from solid (-69 %) and liquid (-16 %) fuels.

Figure 3.47 1A2f Other: Total and CO_2 emission trends



Between 1990 and 2007, CO_2 emissions from 1A2f Other decreased by 19 % in the EU-15 (Table 3.40), mainly due to decreases in Germany (-41 %) and the United Kingdom (-20%). Spanish emissions increased by 51 % in the same period.

Table 3.40 1A2f Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	3,645	4,567	4,570	1.6%	4	0%	925	25%
Belgium	8,069	7,229	7,031	2.4%	-198	-3%	-1,038	-13%
Denmark	2,658	3,112	3,061	1.1%	-51	-2%	403	15%
Finland	2,904	2,356	2,316	0.8%	-40	-2%	-588	-20%
France	33,762	27,626	26,076	9.1%	-1,551	-6%	-7,686	-23%
Germany	138,312	83,028	82,017	28.6%	-1,012	-1%	-56,295	-41%
Greece	6,126	5,473	6,865	2.4%	1,392	25%	738	12%
Ireland	1,529	2,499	2,753	1.0%	254	10%	1,225	80%
Italy	40,489	42,157	38,508	13.4%	-3,649	-9%	-1,981	-5%
Luxembourg	674	888	979	0.3%	91	10%	305	45%
Netherlands	5,471	5,012	4,896	1.7%	-115	-2%	-574	-10%
Portugal	5,495	6,596	6,702	2.3%	107	2%	1,207	22%
Spain	24,050	37,360	36,329	12.7%	-1,032	-3%	12,278	51%
Sweden	5,670	4,995	4,886	1.7%	-109	-2%	-784	-14%
United Kingdom	74,776	62,337	60,101	20.9%	-2,236	-4%	-14,676	-20%
EU-15	**353,630**	**295,234**	**287,089**	**100.0%**	**-8,146**	**-3%**	**-66,541**	**-19%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A2f Other - Liquid (CO_2)

In 2007 liquid fuels had a share of 36 % within source category 1A2f (compared to 35 % in 1990). Between 1990 and 2007 the emissions decreased by 16 % (Table 3.41). Between 1990 and 2007 the highest absolute decreases were achieved by Germany, the United Kingdom and France. The highest absolut increases were reported from Greece (+80 %) and Spain (+37 %).

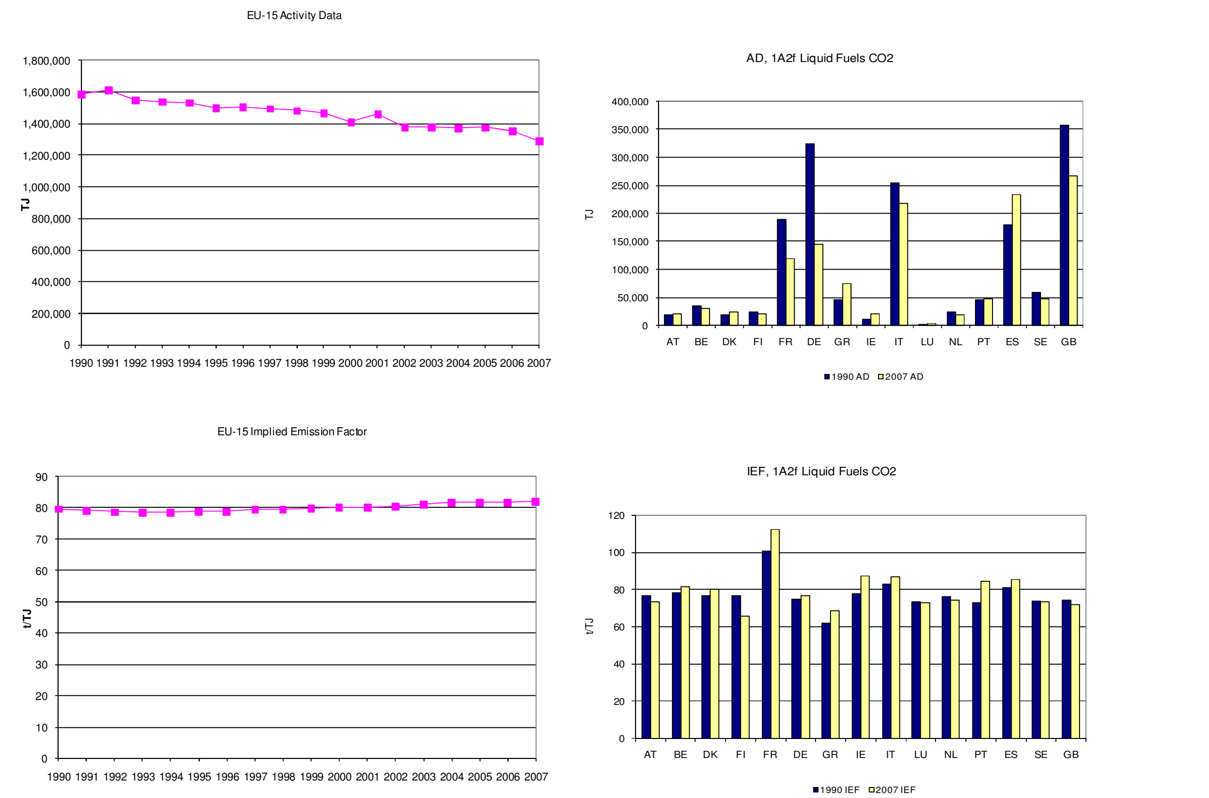
Table 3.41 1A2f Other, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,377	1,649	1,573	1.5%	-76	-5%	196	14%	T2	NS, PS	CS, PS
Belgium	2,698	2,539	2,409	2.3%	-130	-5%	-289	-11%	T1	PS/RS	D
Denmark	1,492	1,909	1,849	1.7%	-60	-3%	357	24%	C	NS	CS/C
Finland	1,809	1,464	1,405	1.3%	-58	-4%	-404	-22%	T3, M	PS, NS	CS, D
France	18,963	14,820	13,332	12.6%	-1,487	-10%	-5,630	-30%	C	NS/ PS	CS
Germany	24,307	11,715	11,065	10.5%	-650	-6%	-13,242	-54%	CS	NS	CS
Greece	2,828	4,220	5,084	4.8%	864	20%	2,256	80%	T2	NS	PS
Ireland	850	1,641	1,865	1.8%	224	14%	1,014	119%	T1	NS	CS
Italy	20,965	20,164	18,943	17.9%	-1,222	-6%	-2,023	-10%	T2	NS	CS
Luxembourg	90	252	248	0.2%	-4	-2%	158	176%	T1	PS	D
Netherlands	1,752	1,555	1,432	1.4%	-123	-8%	-320	-18%	T2	NS/Q	CS
Portugal	3,375	4,609	4,042	3.8%	-567	-12%	667	20%	T2	NS	D,C
Spain	14,539	21,005	19,906	18.8%	-1,100	-5%	5,367	37%	T2, T3	PS, AS, NS, Q	CS, C
Sweden	4,263	3,555	3,528	3.3%	-27	-1%	-735	-17%	T1, T2	PS	CS
United Kingdom	26,524	19,699	19,173	18.1%	-526	-3%	-7,351	-28%	T2	NS,AS	CS
EU-15	**125,832**	**110,796**	**105,855**	**100.0%**	**-4,941**	**-4%**	**-19,978**	**-16%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.48 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy, Spain and the United Kingdom; together they cause 78 % of the CO_2 emissions from liquid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 19 % between 1990 and 2007. The implied emission factor of EU-15 was 82.0 t/TJ in 2007. The low implied emission factor of Greece is because non-energy use is included in activity data. The comparable high implied emission factor of France needs further checking.

Figure 3.48 1A2f Other, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other - Solid (CO_2)

In 2007 CO_2 from solid fuels had a share of 13 % within source category 1A2f (compared to 33 % in 1990). Between 1990 and 2007 the emissions decreased by 69 % (Table 3.42). Between 1990 and 2007 all Member States except for Austria and Ireland reported a significant decrease of emissions; the highest absolute decreases were reported by Germany and the UK. Between 2006 and 2007 EU-15 emissions increased by 4 % .

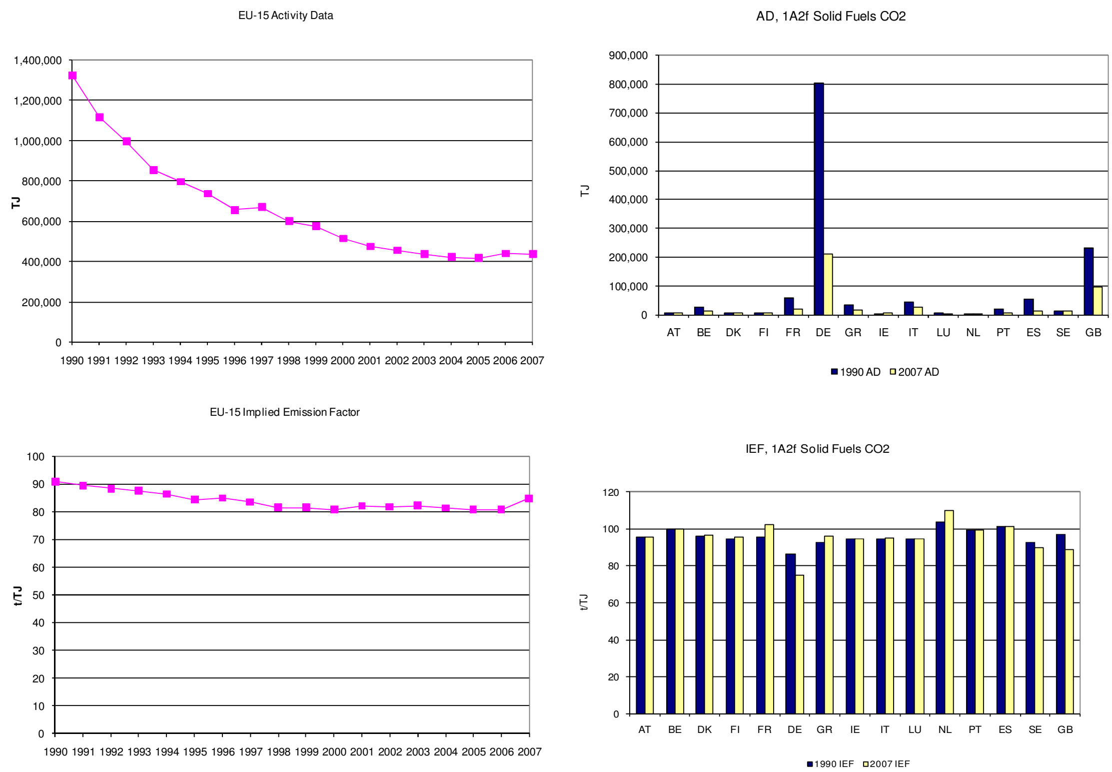
Table 3.42 1A2f Other, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	625	567	665	1.8%	98	17%	40	6%	T2	NS, PS	CS, PS
Belgium	2,600	1,285	1,280	3.5%	-5	0%	-1,321	-51%	T1	PS/RS	D
Denmark	822	645	640	1.7%	-5	-1%	-182	-22%	C	NS	CS/C
Finland	815	491	484	1.3%	-7	-1%	-330	-41%	T3	PS	CS
France	5,486	1,585	1,812	4.9%	227	14%	-3,674	-67%	C	NS/ PS	CS
Germany	69,322	16,258	15,717	42.6%	-541	-3%	-53,605	-77%	CS	NS	CS
Greece	3,295	968	1,471	4.0%	503	52%	-1,823	-55%	T2	NS	PS
Ireland	389	473	500	1.4%	27	6%	112	29%	T1	NS	CS
Italy	4,233	2,507	2,425	6.6%	-82	-3%	-1,808	-43%	T2	NS	CS
Luxembourg	338	193	214	0.6%	21	11%	-124	-37%	T1	PS	D
Netherlands	388	166	213	0.6%	46	28%	-175	-45%	T2	NS/Q	CS
Portugal	2,103	43	620	1.7%	577	1348%	-1,483	-71%	T2	NS	D,C
Spain	5,465	470	1,072	2.9%	602	128%	-4,393	-80%	T2	PS, AS, NS, Q	CS, C
Sweden	1,229	1,272	1,186	3.2%	-86	-7%	-44	-4%	T1, T2	PS	CS
United Kingdom	22,668	8,546	8,598	23.3%	52	1%	-14,069	-62%	T2	NS,AS	CS
EU-15	**119,778**	**35,470**	**36,898**	**100.0%**	**1,429**	**4%**	**-82,880**	**-69%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.49 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany and the United Kingdom; together they cause about 66 % of the CO_2 emissions from solid fuels in 1A2f. Fuel consumption in the EU-15 decreased by 67 % between 1990 and 2007. The implied emission factor of EU-15 was 84.7 t/TJ in 2007. The high implied emission factor in 1990 of Luxembourg is because blast furnace gas is included in this activity.

Figure 3.49 1A2f Other, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A2f Other - Gaseous (CO_2)

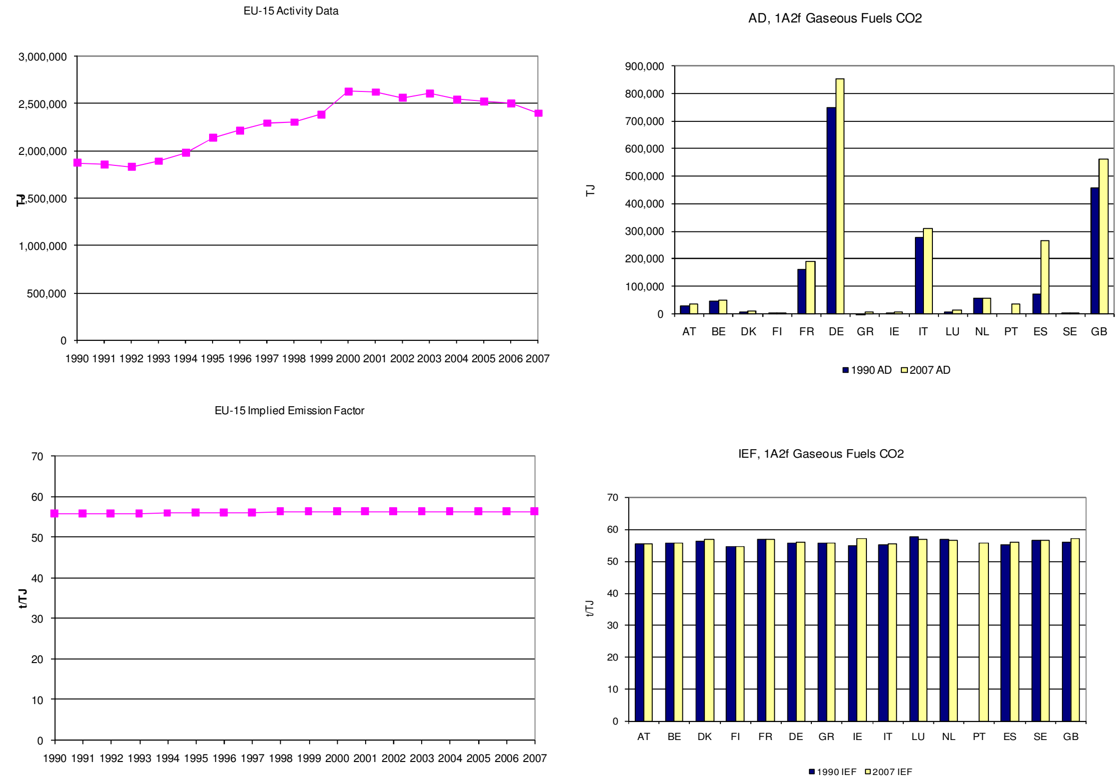
In 2007 CO_2 from gaseous fuels had a share of 46 % within source category 1A2f (compared to 29 % in 1990). Between 1990 and 2007 the emissions increased by 29 % (Table 3.43). Between 1990 and 2007, all Member States showed increasing emissions except for the Netherlands and Sweden. The UK, Spain, Italy and Germany showed the highest absolute increases.

Table 3.43 1A2f Other, gaseous fuels: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,573	1,948	1,910	1.4%	-38	-2%	337	21%	T2	NS, PS	CS
Belgium	2,559	2,780	2,786	2.1%	6	0%	228	9%	T1	PS/RS	D
Denmark	343	524	526	0.4%	3	1%	183	53%	C	NS	CS/C
Finland	171	207	210	0.2%	3	1%	39	23%	T3	PS	CS
France	9,313	11,222	10,931	8.1%	-291	-3%	1,617	17%	C	NS/ PS	CS
Germany	41,787	48,438	47,832	35.4%	-606	-1%	6,045	14%	CS	NS	CS
Greece	4	285	309	0.2%	25	9%	305	7795%	T2	NS	PS
Ireland	289	385	388	0.3%	3	1%	99	34%	T1	NS	CS
Italy	15,290	19,486	17,140	12.7%	-2,346	-12%	1,850	12%	T2	NS	CS
Luxembourg	245	376	467	0.3%	91	24%	222	90%	T1	PS	D
Netherlands	3,331	3,290	3,252	2.4%	-38	-1%	-79	-2%	T2	NS/Q	CS
Portugal	NO	1,877	2,008	1.5%	130	7%	2,008	-	T2	NS	D,C
Spain	4,046	15,540	14,901	11.0%	-639	-4%	10,854	268%	T2	PS, AS, NS, Q	CS
Sweden	178	169	172	0.1%	3	2%	-6	-3%	T1, T2	PS	CS
United Kingdom	25,583	33,912	32,106	23.8%	-1,806	-5%	6,523	25%	T2	NS,AS	CS
EU-15	**104,712**	**140,439**	**134,938**	**100.0%**	**-5,501**	**-4%**	**30,226**	**29%**			

Figure 3.50 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Germany, Italy, Spain and the United Kingdom; together they cause 83 % of the CO_2 emissions from gaseous fuels in 1A2f. Fuel combustion in the EU-15 rose by 28 % between 1990 and 2007. The implied emission factor of EU-15 was 56.3 t/TJ in 2007.

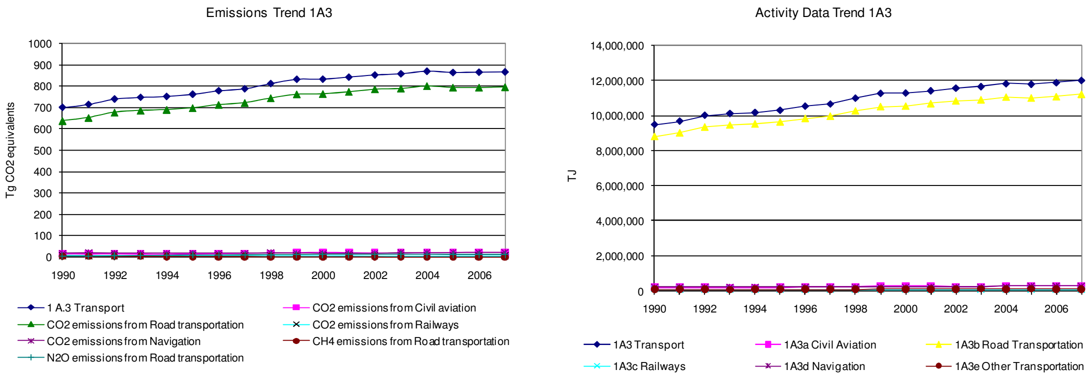
Figure 3.50 1A2f Other, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.3 Transport (CRF Source Category 1A3) (EU-15)

Greenhouse gas emissions from 1A3 Transport are shown in Figure 3.51. CO_2 emissions from this source category account for 21 %, CH_4 for 0.04 %, N_2O for 0.3 % of total GHG emissions. Between 1990 and 2007, greenhouse gas emissions from Transport increased by 24 % in the EU-15.

Figure 3.51 1A3 Transport: Greenhouse gas emissions in CO_2 equivalents (Tg) and Activity Data in TJ



This source category includes ten key categories:

1 A 3 a Civil Aviation: Jet Kerosene (CO_2)
1 A 3 b Road Transportation: Diesel oil (CO_2)
1 A 3 b Road Transportation: Diesel oil (N_2O)
1 A 3 b Road Transportation: Gasoline (CO_2)
1 A 3 b Road Transportation: Gasoline (N_2O)
1 A 3 b Road Transportation: LPG (CO_2)
1 A 3 c Railways: Liquid Fuels (CO_2)
1 A 3 d Navigation: Gas/Diesel Oil (CO_2)
1 A 3 d Navigation: Residual Oil (CO_2)
1 A 3 e Other Transportation: Gaseous Fuels (CO_2)

Table 3.44 shows total GHG, CO_2 and N_2O emissions from 1A3 Transport.

Table 3.44 1A3 Transport: Member States' contributions to CO_2 emissions and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 2007 (Gg CO_2 equivalents)
Austria	14,023	24,224	13,769	23,923	190	281
Belgium	20,576	25,935	20,093	25,065	365	815
Denmark	10,700	14,150	10,528	13,986	116	139
Finland	12,790	14,746	12,517	14,044	174	657
France	118,779	136,864	117,915	136,040	499	712
Germany	164,577	153,176	162,615	151,885	677	1,139
Greece	14,789	23,746	14,506	23,371	169	272
Ireland	5,171	14,378	5,039	14,144	84	205
Italy	103,276	129,189	101,269	127,212	1,110	1,530
Luxembourg	2,764	6,683	2,701	6,571	37	101
Netherlands	26,439	35,688	26,009	35,201	272	440
Portugal	10,149	19,500	9,920	18,839	156	610
Spain	57,483	112,269	56,506	109,142	736	2,957
Sweden	18,582	20,836	18,333	20,642	145	163
United Kingdom	118,592	132,598	116,450	130,826	1,447	1,621
EU-15	**698,690**	**863,981**	**688,170**	**850,892**	**6,175**	**11,643**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.45 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A3 Transport for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 3.45 **1A3 Transport: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	1,343	10.8	845	3.7	Activity data: Update of statistical energy data, particularly the biodiesel consumption. As the new study for off-road traffic (see description for 1.A.4 Other sectors – mobile) concludes that less fuel is used by off-road vehicles, especially in industry and forestry, and that the overall fuel consumption is known, this decrease in fuel consumption had to be counterbalanced by an increase of fuel tourism.
Belgium	2	0.0	-30	-0.1	
Denmark	0	0.0	1	0.0	
Finland	-34	-0.3	-6	0.0	
France	-38	0.0	-333	-0.2	
Germany	156	0.1	-5,356	-3.3	Activity data: Recalculations due to separate reporting of Aviation Gasoline, a changed split factor used for separating national and international aviation, changes due to recalculations because of the newly reported use of bio-ethanol which is reported under biomass.
Greece	131	0.9	-780	-3.3	
Ireland	0	0.0	0	0.0	
Italy	-192	-0.2	-1,380	-1.1	The whole time series has been revised due to the application of the updated version of COPERT model (COPERT 4) for road transport estimates. The whole time series has been revised on the basis of a new methodological study for civil aviation. Figures of the navigation sector have been revised from 1998 on the basis of a new methodological study
Luxembourg	-18	-0.7	-155	-2.2	
Netherlands	0	0.0	-96	-0.3	
Portugal	92	0.9	-214	-1.1	
Spain	0	0.0	-6	0.0	
Sweden	159	0.9	580	2.9	Activity data: The allocation of gasoline and diesel oil to road traffic and diesel oil to fisheries and domestic navigation has been affected by the revision of emissions from off-road vehicles. In addition, for road traffic, there are small changes for emissions of all substances for the years 2002-2006.
UK	-518	-0.4	-738	-0.6	
EU-15	**1,084**	**0.2**	**-7,668**	**-0.9**	

Table 3.46 provides information on the contribution of Member States to EU-15 recalculations in N_2O from 1A3 Transport for 1990 and 2006.

Table 3.46 **1A3 Transport: Contribution of MS to EU-15 recalculations in N_2O for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	10	5.9	6	2.1	
Belgium	-22	-5.6	-12	-1.5	
Denmark	0	0.0	0	0.0	
Finland	0	0.0	0	0.0	
France	0	0.1	-16	-2.2	
Germany	3	0.4	-40	-3.3	
Greece	2	1.2	-308	-52.6	
Ireland	1	1.1	8	3.6	
Italy	-607	-35.4	-2,550	-62.1	Method: The whole time series has been revised due to the application of the updated version of COPERT model (COPERT 4)
Luxembourg	-3	-8.1	-168	-62.4	
Netherlands	0	0.0	-2	-0.5	
Portugal	4	2.7	22	3.7	
Spain	-47	-6.0	-8	-0.3	
Sweden	-16	-9.9	-18	-9.6	
UK	147	11.3	-3,894	-70.0	Change to N2O factors, revised from COPERT4 and Emissions Inventory Guidebook
EU-15	**-528**	**-7.9**	**-6,982**	**-37.5**	

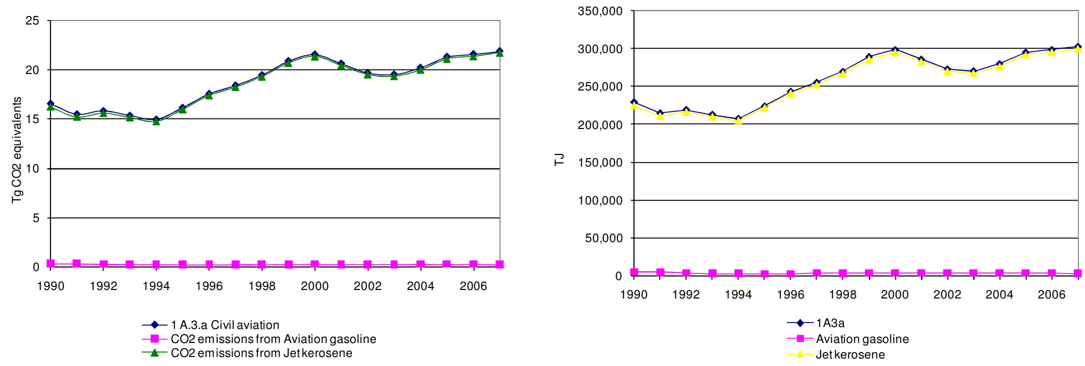
3.2.3.1 Civil Aviation (1A3a) (EU-15)

This source category includes emissions from civil domestic passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.), including take-offs and landings for these flight stages.

CO_2 emissions from 1A3a Civil Aviation account for 2.4% of total transport-related GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from civil aviation increased by 32 % in the EU-15 (Table 3.47).

CO_2 emissions from Jet Kerosine account for 99 % of total CO_2 emissions from 1A3a Civil Aviation. Between 2006 and 2007, CO_2 emissions from civil aviation increased by 1 % in the EU-15 (Table 3.47).

Figure 3.52 1A3a Civil Aviation: CO_2 Emissions in CO_2 equivalents (Tg) and Activity data in TJ



The Member States France, Germany, Italy and Spain alone contributed 77 % to the emissions from this source. Most Member States increased emissions from civil aviation between 1990 and 2007. The Member States with the highest increases in absolute terms were Greece, Italy, Spain and the UK. The countries with most reductions were Denmark, Germany and Finland (Table 3.47).

Table 3.47 1A3a Civil Aviation: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	32	72	74	0.3%	2	3%	42	130%
Belgium	7	6	8	0.0%	2	29%	2	25%
Denmark	243	141	107	0.5%	-35	-24%	-136	-56%
Finland	385	325	306	1.4%	-19	-6%	-79	-21%
France	4,241	4,691	4,555	20.8%	-135	-3%	314	7%
Germany	3,025	2,284	2,330	10.7%	45	2%	-695	-23%
Greece	717	1,280	1,348	6.2%	68	5%	631	88%
Ireland	59	113	122	0.6%	9	8%	63	107%
Italy	1,613	2,291	2,428	11.1%	137	6%	815	50%
Luxembourg	0.2	1	1	0.003%	-0.03	-6%	0.3	132%
Netherlands	41	41	41	0.2%	0	0%	0	0%
Portugal	235	393	390	1.8%	-3	-1%	154	66%
Spain	4,130	7,204	7,582	34.7%	378	5%	3,452	84%
Sweden	673	623	605	2.8%	-18	-3%	-68	-10%
United Kingdom	1,160	2,108	1,976	9.0%	-132	-6%	816	70%
EU-15	**16,561**	**21,573**	**21,871**	**100.0%**	**298**	**1%**	**5,310**	**32%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A3a Civil Aviation – Jet Kerosene (CO_2)

In 2007 CO_2 emissions resulting from jet kerosene within the category 1A3a were responsible for 99 % of CO_2 emissions in 1A3a. Within the EU-15 the emissions increased between 1990 and 2007 by 34 % (Table 3.48). The largest absolute increase occurred in Spain, Italy and Greece. Between 2006 and 2007, the emissions increased by 2 %.

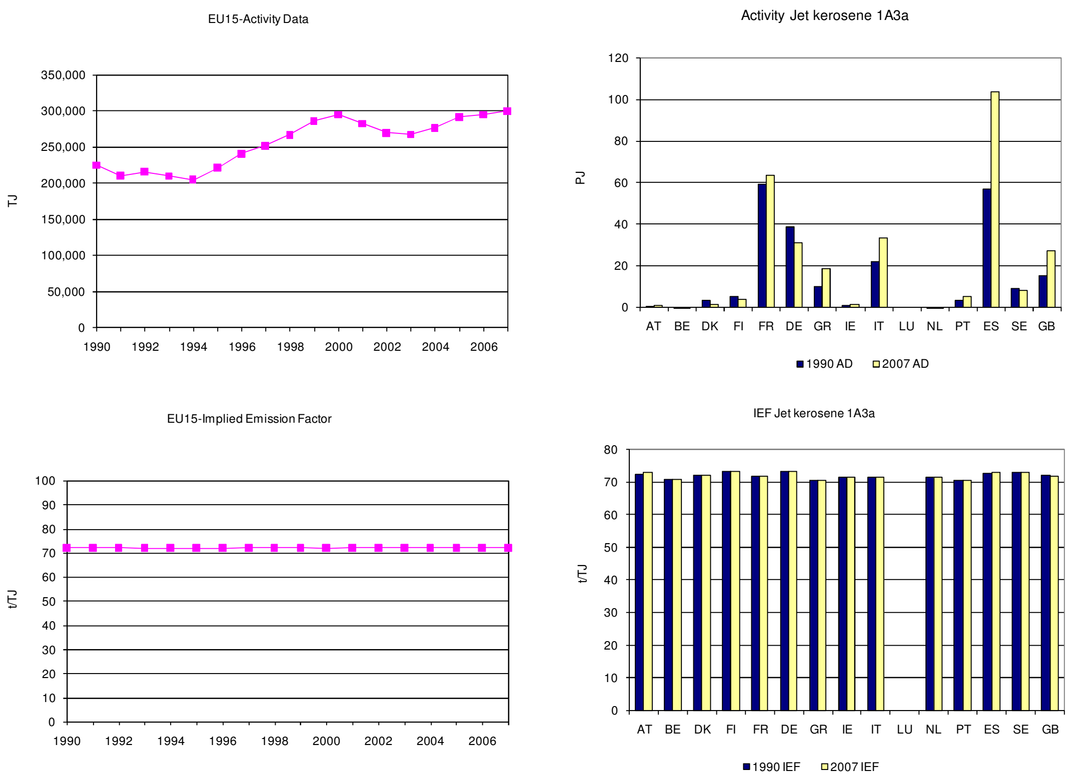
Table 3.48 1A3a Civil Aviation, jet kerosine: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	24	63	65	0,3%	2	3%	41	168%	T3	NS	CS
Belgium	5	4	6	0,03%	2	47%	1	31%	CS	RS	C
Denmark	234	134	100	0,5%	-35	-26%	-135	-58%	C	NS	C
Finland	377	321	303	1,4%	-19	-6%	-75	-20%	T2b	NS	CS
France	4.241	4.691	4.555	21,0%	-135	-3%	314	7%	M	NS	M
Germany	2.853	2.238	2.288	10,5%	49	2%	-565	-20%	T3	NS	CS
Greece	705	1.227	1.337	6,2%	109	9%	632	90%	T2	NS	D
Ireland	59	113	122	0,6%	9	8%	63	107%	T2	NS	CS
Italy	1.579	2.241	2.382	11,0%	140	6%	802	51%	T1, T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	16	16	16	0,1%	0	0%	0	0%	T2	NS	CS
Portugal	234	391	388	1,8%	-3	-1%	154	66%	T2	NS,AS	D
Spain	4.130	7.204	7.582	34,9%	378	5%	3.452	84%	T2	NS	D
Sweden	668	621	603	2,8%	-18	-3%	-65	-10%	T1	NS	CS
United Kingdom	1.106	2.062	1.950	9,0%	-112	-5%	844	76%	T3	NS,AS	CS
EU-15	**16.231**	**21.328**	**21.695**	**100,0%**	**367**	**2%**	**5.464**	**34%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the UK account for 86 % of activity data and 86 % of CO_2 emissions from Jet kerosene in 2007 (Figure 3.53). The IEF for the EU-15 is 72.24 t/TJ Jet kerosene in 2006. Table 3.48 shows, that about 97% of emissions from Civil Aviation, jet kerosene were calculated using a higher tier method.

Figure 3.53 1A3a Civil Aviation, jet kerosine: Activity data and implied emission factors for CO_2



3.2.3.2 Road Transportation (1A3b) (EU-15)

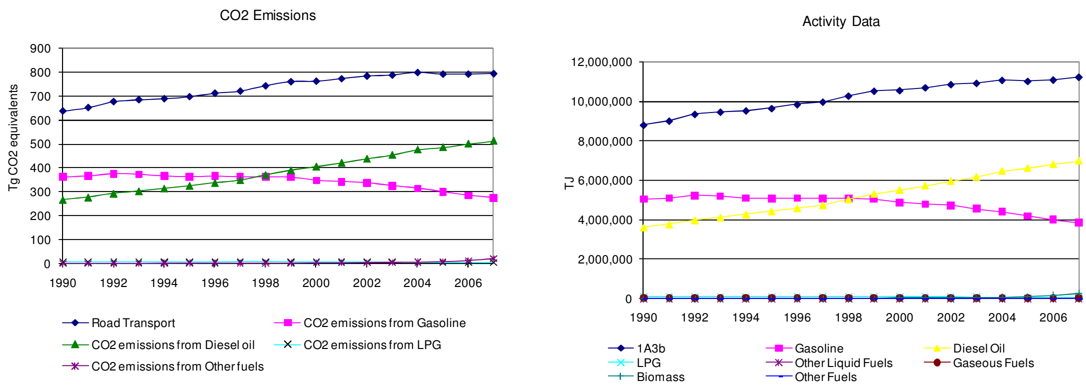
CO_2 emissions from 1A3b Road Transportation

The mobile source category Road Transportation includes all types of light-duty vehicles such as automobiles and light trucks, and heavy-duty vehicles such as tractor trailers and buses, and on-road motorcycles (including mopeds, scooters, and three-wheelers). These vehicles operate on many types of gaseous and liquid fuels.

CO_2 emissions from 1A3b Road Transportation is the second largest key source of all categories in the EU-15 accounting for 20 % of total GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from road transportation increased by 25 % in the EU-15 (Table 3.49). The emissions from this key source are due to fossil fuel consumption in road transport, which increased by 25 % between 1990 and 2007.

Figure 3.54 gives an overview of the CO_2 trend caused by different fuels. The trend is mainly dominated by emissions resulting from gasoline and diesel oil. The decline of gasoline and the strong increase of diesel shows the switch from gasoline passenger cars to diesel in several EU-15 Member States.

Figure 3.54 1A3b Road Transport: CO_2 Emission Trend and Activity Data



The Member States Germany, France, Italy, Spain and the United Kingdom contributed most to the CO_2 emissions from this source (77 %). All Member States, except for Germany (-4%), increased emissions from road transportation between 1990 and 2007. The Member States with the highest increases in absolute terms were Spain, Italy and France and the UK. The countries with the lowest increase in relative terms were Finland, France, Sweden and United Kingdom (Table 3.49).

Table 3.49 1A3b Road Transport: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	13,286	22,899	23,167	2.9%	268	1%	9,882	74%
Belgium	19,270	24,441	24,318	3.1%	-123	-1%	5,048	26%
Denmark	9,275	12,589	13,198	1.7%	609	5%	3,922	42%
Finland	10,839	11,938	12,320	1.6%	382	3%	1,481	14%
France	110,699	128,815	127,356	16.0%	-1,459	-1%	16,657	15%
Germany	150,358	147,120	144,114	18.1%	-3,006	-2%	-6,244	-4%
Greece	11,761	18,895	19,785	2.5%	890	5%	8,024	68%
Ireland	4,701	13,093	13,755	1.7%	662	5%	9,054	193%
Italy	93,387	118,268	118,721	14.9%	452	0%	25,334	27%
Luxembourg	2,676	6,834	6,569	0.8%	-266	-4%	3,893	145%
Netherlands	25,472	34,807	34,458	4.3%	-349	-1%	8,985	35%
Portugal	9,249	18,604	18,165	2.3%	-439	-2%	8,915	96%
Spain	50,442	95,141	97,848	12.3%	2,708	3%	47,406	94%
Sweden	16,869	19,214	19,369	2.4%	156	1%	2,500	15%
United Kingdom	109,228	120,018	121,242	15.3%	1,224	1%	12,014	11%
EU-15	**637,514**	**792,676**	**794,384**	**100.0%**	**1,708**	**0.2%**	**156,870**	**25%**

1A3b Road Transportation – Diesel Oil (CO_2)

CO_2 emissions from Diesel oil account for 64 % of CO_2 emissions from 1A3b Road Transport in 2007 (Figure 3.54). All Member States increased emissions from Diesel oil between 1990 and 2007 (Table 3.50). Member States with the highest increase in percent were Austria, Ireland, Luxembourg (in the wake of tanktourism) and Spain. The countries with the lowest increase were Finland and Germany.

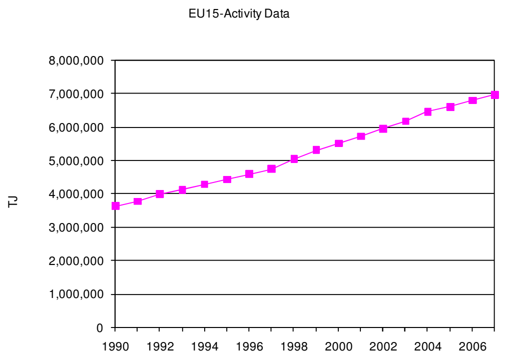
Table 3.50 1A3b Road Transport, diesel oil: Member States' contributions to CO_2 emissions

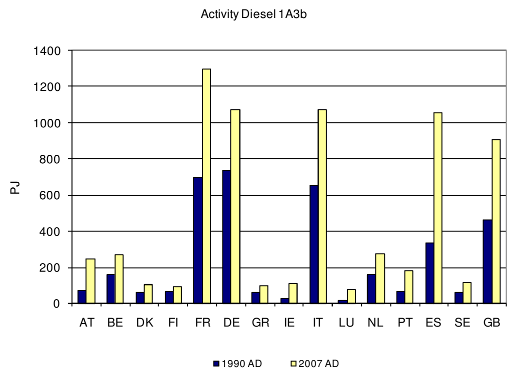
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	5,344	16,748	17,158	3.3%	409	2%	11,814	221%	CS	NS	CS
Belgium	10,892	19,769	19,934	3.9%	166	1%	9,042	83%	Copert3/D	NS/RS	C
Denmark	4,436	7,033	7,692	1.5%	659	9%	3,256	73%	COPERT 4	NS	C
Finland	4,956	6,541	6,937	1.4%	396	6%	1,981	40%	T3, M	NS	CS
France	51,985	96,158	96,945	18.9%	787	1%	44,960	86%	M	NS	M
Germany	54,458	79,752	79,406	15.5%	-346	0%	24,948	46%	T3	NS	CS
Greece	4,326	6,925	7,271	1.4%	347	5%	2,945	68%	COPERT IV	NS	COPERT IV
Ireland	1,922	7,576	8,134	1.6%	559	7%	6,212	323%	T1	NS	CS
Italy	47,776	75,512	78,476	15.3%	2,964	4%	30,700	64%	COPERT IV	NS, AS	CS
Luxembourg	1,364	5,409	5,202	1.0%	-207	-4%	3,838	281%	COPERT IV	NS	D
Netherlands	11,832	20,686	20,496	4.0%	-190	-1%	8,663	73%	T2	NS	CS
Portugal	4,947	13,294	13,179	2.6%	-115	-1%	8,233	166%	T2	NS	C
Spain	24,436	72,962	76,542	14.9%	3,580	5%	52,107	213%	COPERT III	NS	C
Sweden	4,407	7,989	8,393	1.6%	404	5%	3,986	90%	T1	NS	CS
United Kingdom	33,677	63,592	66,513	13.0%	2,921	5%	32,836	98%	T3	NS,AS	CS
EU-15	**266,758**	**499,946**	**512,279**	**100.0%**	**12,334**	**2.5%**	**245,521**	**92%**			

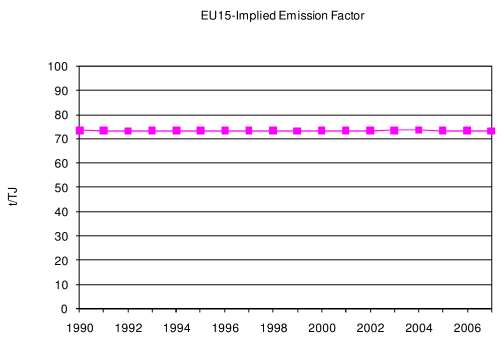
Abbreviations explained in the Chapter 'Units and abbreviations'.

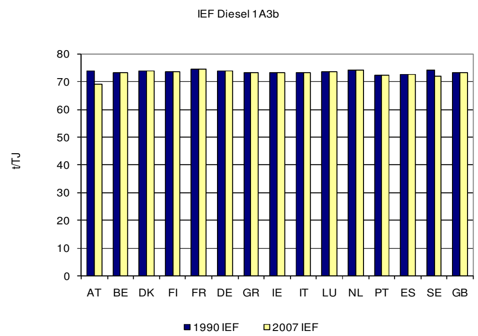
France, Germany, Italy, Spain and the UK account for 78 % of activity data and CO_2 emissions from Diesel oil in 2007 (Figure 3.55). The IEF for the EU-15 is 73.43 t/TJ Diesel in 2007. Table 3.50 shows, that about 96 % of CO_2 emissions from road transportation - diesel oil - were calculated using a higher tier method.

Figure 3.55 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for CO_2 emission









1A3b Road Transportation – Gasoline (CO_2)

Between 1990 and 2007, CO_2 emissions from gasoline decreased by 24 % in the EU-15. The countries with the highest decrease in relative terms were Belgium and France (Table 3.51). Countries with the highest increase were Greece and Ireland.

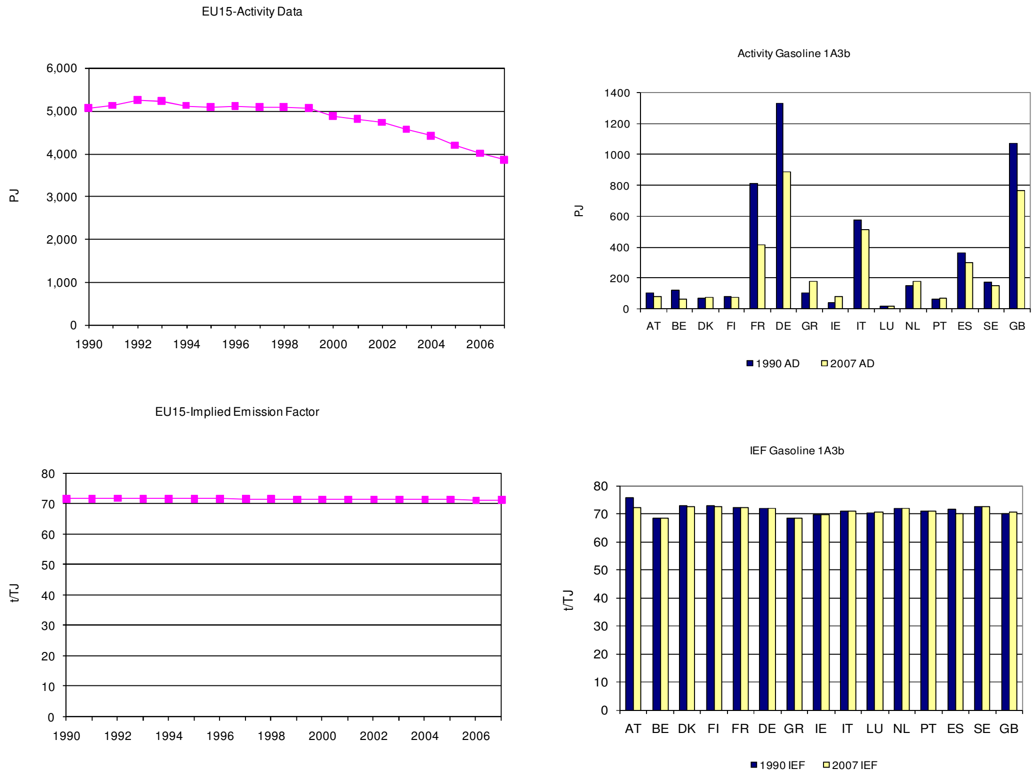
Table 3.511A3b Road Transport, gasoline: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	7,942	6,151	6,010	2.2%	-142	-2%	-1,932	-24%	CS	NS	CS
Belgium	8,223	4,418	4,203	1.5%	-214	-5%	-4,020	-49%	Copert3/D	NS/RS	C
Denmark	4,838	5,556	5,506	2.0%	-50	-1%	668	14%	COPERT 4	NS	C
Finland	5,883	5,388	5,374	2.0%	-14	0%	-508	-9%	T3, M	NS	CS
France	58,564	32,266	30,056	10.9%	-2,210	-7%	-28,508	-49%	M	NS	M
Germany	95,794	66,894	64,073	23.3%	-2,821	-4%	-31,722	-33%	T3	NS	CS
Greece	7,294	11,857	12,391	4.5%	534	5%	5,097	70%	COPERT IV	NS	COPERT IV
Ireland	2,761	5,514	5,618	2.0%	104	2%	2,857	103%	T1	NS	CS
Italy	41,094	38,764	36,276	13.2%	-2,488	-6%	-4,818	-12%	COPERT IV	NS, AS	CS
Luxembourg	1,301	1,421	1,362	0.5%	-59	-4%	61	5%	COPERT IV	NS	D
Netherlands	10,902	13,141	13,000	4.7%	-141	-1%	2,098	19%	T2	NS	CS
Portugal	4,303	5,219	4,889	1.8%	-330	-6%	586	14%	T2	NS	C
Spain	25,928	22,054	21,185	7.7%	-869	-4%	-4,743	-18%	COPERT III	NS	C
Sweden	12,460	11,169	10,919	4.0%	-250	-2%	-1,541	-12%	T1	NS	CS
United Kingdom	75,288	55,883	54,216	19.7%	-1,667	-3%	-21,072	-28%	T3	NS,AS	CS
EU-15	**362,575**	**285,695**	**275,078**	**100.0%**	**-10,617**	**-4%**	**-87,496**	**-24%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy, Spain and the United Kingdom account for 75 % of activity data and CO_2 emissions (Figure 3.56). The IEF for the EU-15 is 71.3 t/TJ Gasoline in 2007. Table 3.51 shows, that about 94% of CO_2 emissions from road transportation - gasoline - were calculated using a higher tier method.

Figure 3.56 1A3b Road Transport, gasoline: Activity data and implied emission factors for CO_2



1A3b Road Transportation –LPG (CO_2)

Between 1990 and 2007, CO_2 emissions from LPG decreased by 27 % in the EU-15. Four Member States report emissions as 'Not occuring' or '0'. Of the remaining twelf Member States, Belgium, France, Germany, Portugal and Spain show increases, the other decreases. Between 2006 and 2007 emissions declined by 2 % (Table 3.52).

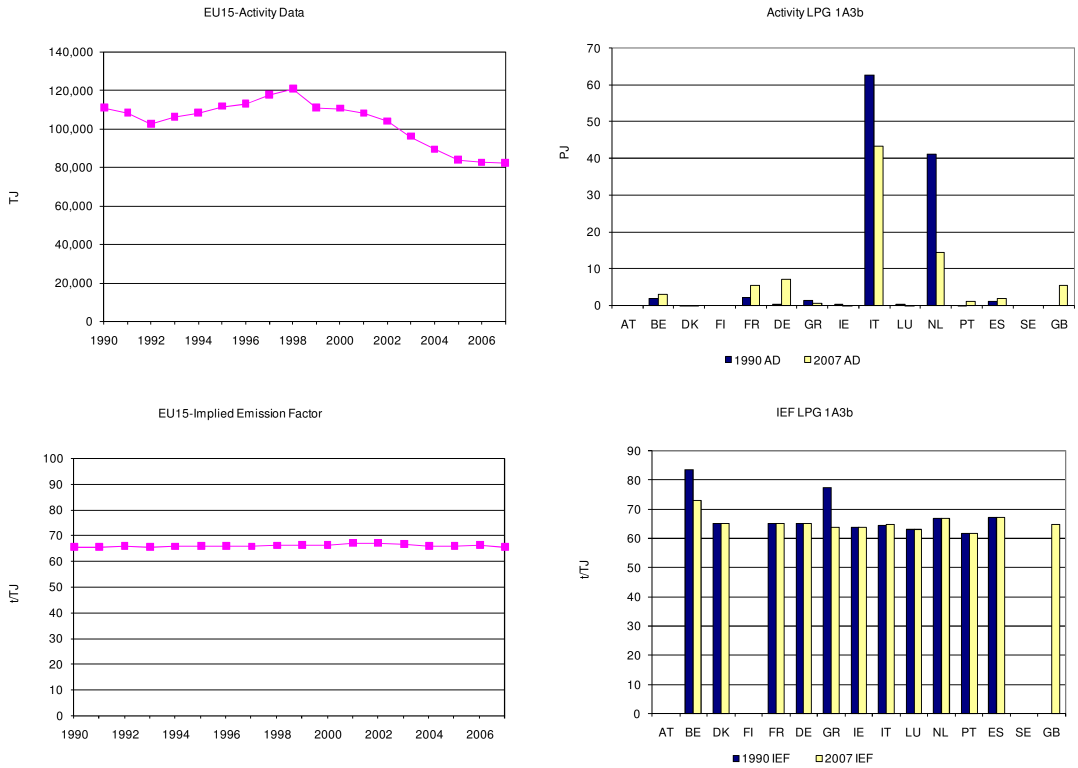
Table 3.52 1A3b Road Transport, LPG: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	CS	NS	CS
Belgium	154	254	180	3.4%	-74	-29%	26	17%	Copert3/D	NS/RS	C
Denmark	1	0	0	0.0%	0	-39%	-1	-98%	COPERT 4	NS	C
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	150	390	354	6.6%	-36	-9%	204	136%	M	NS	M
Germany	9	299	459	8.6%	159	-	450	5014%	T3	NS	CS
Greece	110	33	36	0.7%	3	9%	-74	-67%	COPERT IV	NS	COPERT IV
Ireland	19	3	3	0.1%	0	-2%	-16	-85%	T1	NS	CS
Italy	4,026	2,955	2,817	52.6%	-138	-5%	-1,208	-30%	COPERT IV	NS, AS	CS
Luxembourg	11	5	5	-	0	-2%	-7	-59%	T1	NS	D
Netherlands	2,738	980	962	18.0%	-18	-2%	-1,776	-65%	T2	NS	CS
Portugal	0	62	64	1.2%	2	3%	64	108943%	T2	NS	C
Spain	79	124	121	2.3%	-3	-2%	42	54%	COPERT III	NS	C
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	NO	372	351	6.6%	-20	-5%	351	-	T3	NS,AS	CS
EU-15	**7,296**	**5,478**	**5,353**	**100.0%**	**-125**	**-2%**	**-1,943**	**-27%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Italy and the Netherlands account for 70 % of emission and for 70 % of activity data (Figure 3.57). The IEF for the EU-15 is 65.6 t/TJ LPG in 2007. Table 3.52 shows, that about 99% of CO_2 emissions from road transportation - LPG - were calculated using a higher tier method.

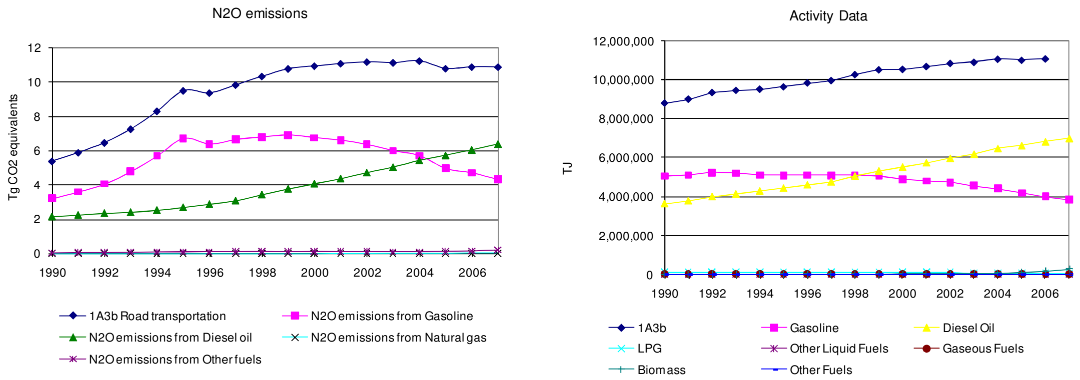
Figure 3.57 1A3b Road Transport, LPG: Activity data and implied emission factors for CO_2



N_2O emissions from 1A3b Road Transportation

N_2O emissions from 1A3b Road Transportation account for 0.3 % of total EU-15 GHG emissions in 2007. Figure 3.58 gives an overview of the N_2O trend caused by different fuels. The trend is mainly dominated by emissions resulting from gasoline and diesel oil.

Figure 3.58 1A3b Road Transport: N_2O Emissions Trend and Activity Data



N_2O emissions increased between 1990 and 2007 by 102 % (Table 3.53). The emissions have been increasing through the 1990s as the number of cars equipped with a catalytic converter (with higher emission factors than cars without a catalytic converter) has increased. Belgium,Finland, Ireland, Luxembourg, Portugal and Spain had an increase higher than 100 %. Between 2006 and 2007 nine Member States reported a slight decrease in N_2O emissions. The reason for these different trends are different estimates of N_2O emission factors. In principle two different models/emission factor sources are being used in EU-15 countries to estimate N_2O emissions: (1) HBEFA - Handbook of emissions factors, (2) COPERT. The Emission Handbook (Austria, Germany, the Netherlands and Sweden) estimates that the N_2O emission factors decrease for every technology generation (Euro 1, Euro 2 etc.). At the moment two versions of the model COPERT are being used in EU-15 countries to estimate emissions. The version COPERT III has a constant N_2O emission factor for cars with catalytic converters, independently of the legislation class. The version COPERT IV (available since 2007) also estimates that the N_2O emission factors decrease for every technology generation.

With the emissions factors of this new COPERT IV model version the IEF are higher in the early nineties (big stock of older technology classes) and lower in recent years (new vehicle fleet). Table 3.54 shows that in the 2009 submission, eleven Member States use recent N_2O emission factors vs. Seven Member States in 2008 (see next table). Four MS dit not yet update N_2O emission factors, they are still using COPERT III or other references like Belgium, Finland, Portugal and Spain.

Table 3.53 1A3b Road Transport: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	178	282	268	2.5%	-14	-5%	90	51%
Belgium	333	789	793	7.4%	4	1%	460	138%
Denmark	97	125	127	1.2%	2	2%	30	31%
Finland	160	617	643	6.0%	26	4%	484	303%
France	433	626	633	5.9%	7	1%	200	46%
Germany	608	1,105	1,077	10.0%	-28	-2%	469	77%
Greece	123	231	227	2.1%	-4	-2%	104	85%
Ireland	55	196	185	1.7%	-11	-6%	130	236%
Italy	996	1,437	1,420	13.2%	-17	-1%	424	43%
Luxembourg	34	101	101	0.9%	0	0%	67	197%
Netherlands	271	449	438	4.1%	-11	-2%	167	62%
Portugal	141	602	600	5.6%	-2	0%	460	327%
Spain	679	2,743	2,851	26.6%	108	4%	2,172	320%
Sweden	99	131	127	1.2%	-4	-3%	27	28%
United Kingdom	1,173	1,298	1,246	11.6%	-52	-4%	73	6%
EU-15	**5,379**	**10,731**	**10,737**	**100.0%**	**6**	**0%**	**5,357**	**100%**

Table 3.54 Methods/models used for road transport by EU-15 MS

1A3b	Method/Emission factors	Remark
Austria	CS / HBEFA	
Belgium	CS / COPERT III	Emissions of N_2O are calculated by compiling the emissions of each region based on the use of the specific models used in the 3 regions (based on COPERT III in the Walloon and the Brussels region and on the MIMOSA III-model in the Flemish region)
Denmark	CS / COPERT IV	An internal NERI model with a structure similar to the European COPERT III emission model (Ntziachristos, 2000) is used to calculate the Danish annual emissions for road traffic. For most vehicle categories, updated fuel use and emission data from the new COPERT IV version is incorporated in the NERI model.
Finland	CS / CS	In the Finnish calculation system, separate models have been developed for different categories of transport, allowing detailed use of traffic data and data on transport equipment fleet. - road transport emissions model LIISA
France	COPERT IV	
Germany	CS / HBEFA	
Greece	COPERT IV	
Ireland	COPERT IV	
Italy	COPERT IV	
Luxembourg	COPERT IV	
Netherlands	CS-T2/CS D	
Portugal	COPERT III	COPERT IV planned for submission 2010
Spain	COPERT III	
Sweden	ARTEMIS	
United Kingdom	COPERT IV	

1A3b Road Transportation – Diesel Oil (N_2O)

N_2O emissions from Diesel oil account for 58 % of N_2O emissions from 1A3b "Road Transportation" in 2007. Between 1990 and 2007 N_2O emissions from Diesel oil increased in all Member States except for in Greece; within the EU-15 the emission increased by 195 %. The smallest increase in absolute terms was reported by Sweden and Finland. Between 2006 and 2007, EU-15 emissions rose by 6 %, with two Member States (Greece, the Netherlands) reporting decreases (Table 3.55).

Table 3.55 1A3b Road Transport, diesel oil: Member States' contributions to N_2O emissions

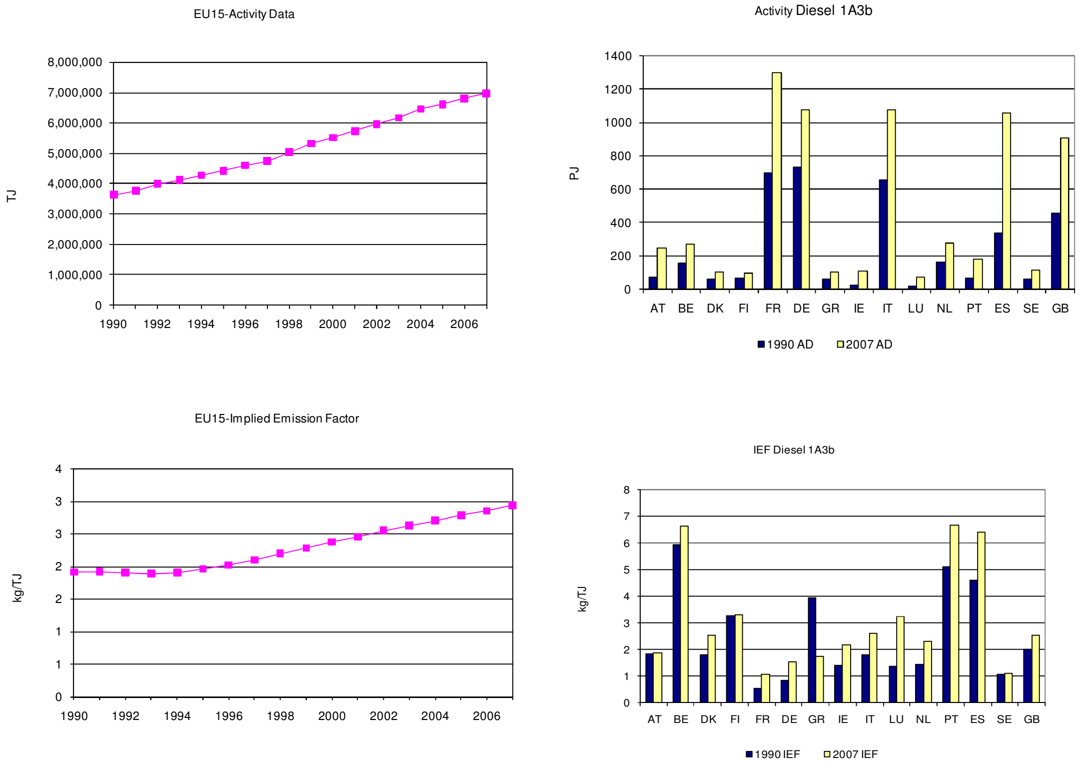
Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	41	142	143	2.3%	1	1%	102	249%	CS	NS	CS
Belgium	273	552	560	8.9%	8	1%	286	105%	Copert3/D	NS/RS	C
Denmark	33	72	81	1.3%	10	14%	48	144%	COPERT 4	NS	C
Finland	68	92	96	1.5%	5	5%	28	42%	T3, M	NS	CS
France	117	412	426	6.8%	14	3%	309	264%	M	NS	M
Germany	188	500	516	8.2%	15	3%	328	175%	T3	NS	CS,M
Greece	72	57	53	0.8%	-4	-6%	-19	-26%	COPERT IV	NS	COPERT IV
Ireland	11	64	74	1.2%	10	16%	63	549%	T3	NS	OPERT 4v5.1
Italy	361	805	864	13.7%	60	7%	503	139%	COPERT IV	NS, AS	CS
Luxembourg	8	64	71	1.1%	7	11%	63	795%	COPERT IV	NS	D
Netherlands	72	201	196	3.1%	-5	-2%	125	174%	T2	NS/Q	CS
Portugal	108	373	376	6.0%	3	1%	269	249%	T3	NS,AS	C
Spain	481	1,907	2,088	33.2%	182	10%	1,608	335%	COPERT III	NS	C
Sweden	19	35	40	0.6%	5	15%	21	108%	M	NS	M
United Kingdom	286	673	710	11.3%	37	5%	424	149%	T3	NS,AS	COPERT IV
EU-15	**2,138**	**5,949**	**6,297**	**100.0%**	**348**	**6%**	**4,159**	**195%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Belgium, France, Germany, Italy, Spain and the United Kingdom account for 74.5 % of the emissions and 81 % of activity data (Figure 3.59). The IEF for the EU-15 is 2.9 kg/TJ Diesel in 2007.

Table 3.55 shows, that all N_2O emissions from road transportation – diesel oil - were calculated using a higher tier method.

Figure 3.59 1A3b Road Transport, diesel oil: Activity Data and Implied Emission Factor for N_2O emission



1A3b Road Transportation – Gasoline (N_2O)

N_2O emissions from Gasoline account for 40 % of N_2O emissions from 1A3b "Road Transportation" in 2007. Between 1990 and 2007, N_2O emissions from gasoline increased by 32 % in the EU-15. All Member States except for Austria, Denmark, France, Italy and the UK reported increased emissions.Belgium, Finland, Portugal and Spain had the highest absolute increases. Between 2006 and 2007, all Member States except for Finland showed a decreasing trend. The EU-15 total sank by 9 % (Table 3.56).

Table 3.56 1A3b Road Transport, gasoline: Member States' contributions to N_2O emissions

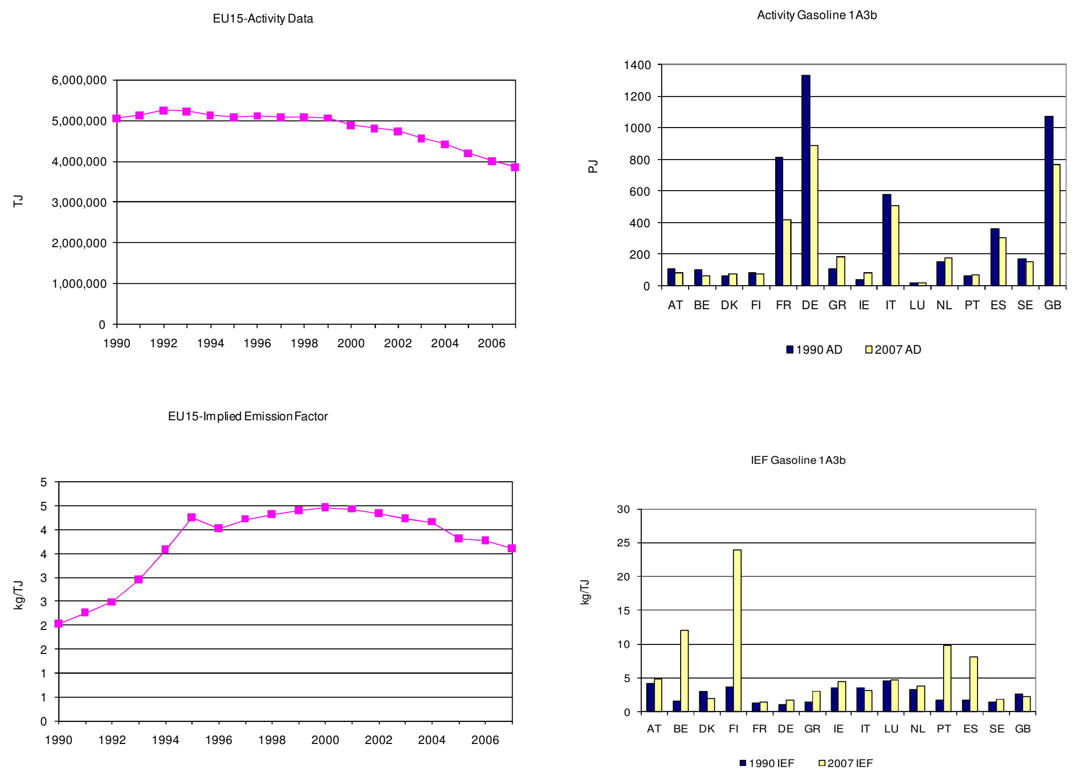
Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	137	139	125	3.0%	-15	-10%	-12	-9%	CS	NS	CS
Belgium	57	232	228	5.4%	-3	-1%	171	302%	Copert3/D	NS/RS	C
Denmark	63	53	45	1.1%	-8	-15%	-18	-28%	COPERT 4	NS	C
Finland	91	525	547	13.0%	22	4%	456	498%	T3, M	NS	CS
France	316	199	178	4.2%	-20	-10%	-138	-44%	M	NS	M
Germany	421	551	478	11.3%	-73	-13%	57	14%	T3	NS	CS,M
Greece	48	171	170	4.0%	-1	0%	122	252%	COPERT IV	NS	COPERT IV
Ireland	44	132	111	2.6%	-22	-17%	67	152%	T3	NS	OPERT 4v5.1
Italy	634	575	500	11.9%	-74	-13%	-134	-21%	COPERT IV	NS, AS	CS
Luxembourg	26	37	28	0.7%	-9	-24%	2	7%	COPERT IV	NS	D
Netherlands	156	223	212	5.0%	-10	-5%	56	36%	T2	NS/Q	CS
Portugal	33	221	209	5.0%	-11	-5%	177	538%	T3	NS,AS	C
Spain	197	833	760	18.0%	-74	-9%	563	286%	COPERT III	NS	C
Sweden	80	96	86	2.0%	-10	-11%	6	8%	M	NS	M
United Kingdom	887	624	536	12.7%	-89	-14%	-352	-40%	T3	NS,AS	COPERT IV
EU-15	**3,191**	**4,610**	**4,213**	**100.0%**	**-397**	**-9%**	**1,022**	**32%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Finland, Germany, Italy, Spain und the United Kingdom accounted for 65 % of emission and for 66 % of activity data (Figure 3.60) in 2007. The IEF for the EU-15 is 3.6 kg/TJ Gasoline in 2007.

Table 3.56 shows, that all N_2O emissions from road transportation – gasoline - were calculated using a higher tier method.

Figure 3.60 1A3b Road Transport, gasoline: Activity data and implied emission factors for N_2O

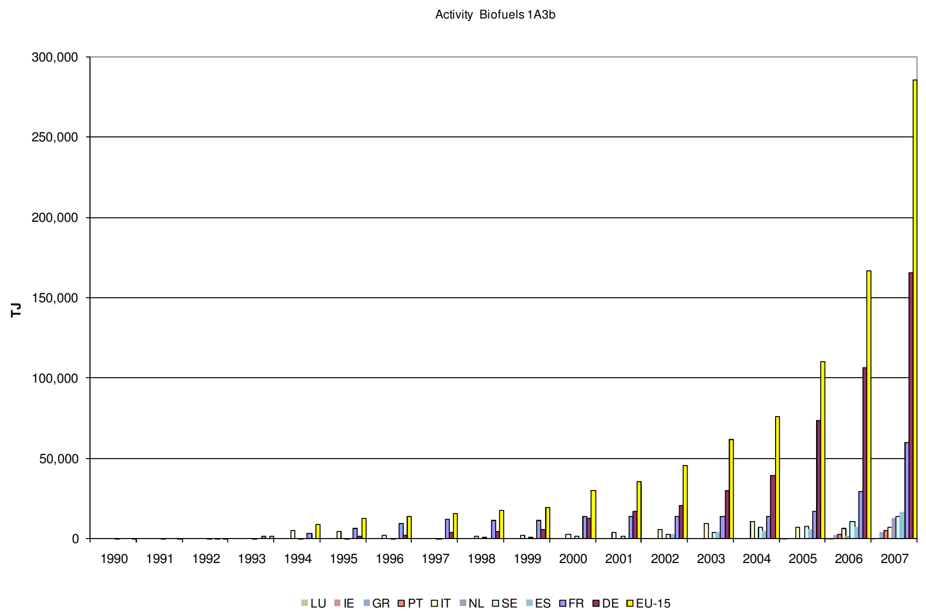


1A3b Road Transportation – Activity Data Biofuels

According to the European Directive on the promotion of the use of biofuels or other renewable fuels for transport (2003/30/EG), Member States should ensure that a minimum proportion of biofuels and other renewable fuels is placed on their markets, and, to that effect, shall set national indicative targets, to reduce greenhouse gas emissions. Member States brought into force the laws, regulations and administrative provisions necessary to comply with this Directive by 31 December 2004. A reference value for these targets shall be 2 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2005. A reference value for these targets shall be 5,75 %, calculated on the basis of energy content, of all petrol and diesel for transport purposes placed on their markets by 31 December 2010. Due to the possibility of different national implementation the MS need to approach partly different targets.

Between 1990 and 2007, activity data of biofuel increased from 25 TJ to 285.787 TJ in the EU-15 (Figure 3.61). Germany reports most of total amount of biofuels (58 % of total EU-15 activity in 2007) over the last years, followed by France. Other countries have also placed biofuels on their markets, but they do not report biofuels separately from gasoline or diesel oil (additive). In this case the use of biofuels is visisble in a decreasing trend of the IEFs of gasoline or diesel (e.g. Austria).

Figure 3.61 1A3b Road Transport, biofuels: Trend of Activity data of biofuels

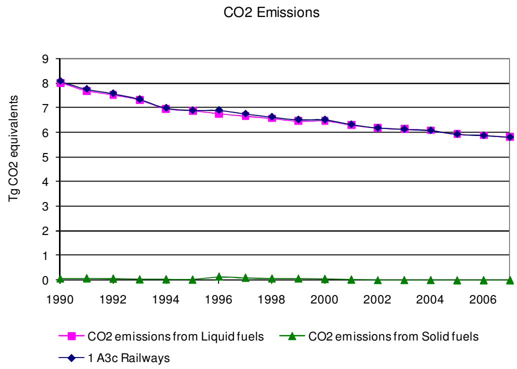


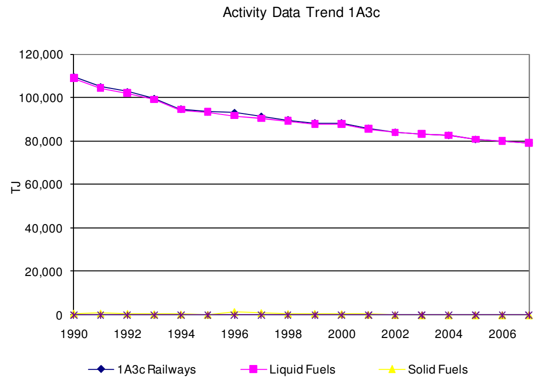
3.2.3.3 Railways (1A3c) (EU-15)

Railway locomotives generally are one of these types: diesel, coal, electric, or steam. Diesel locomotives generally use diesel engines in combination with an alternator or generator to produce the electricity required to power their traction motors. Emissions from Railways arise from the combustion of liquid and solid fuels.

CO_2 emissions from 1A3c Railways account for 0.1 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from rail transportation decreased by 28 % in the EU-15. The total trend is dominated by CO_2 emissions from liquid fuels (99,9%) (Figure 3.62). The emissions from this key source are due to fossil fuel consumption in rail transport, which decreased by 28% between 1990 and 2007.

Figure 3.62 1A3c Railways: CO_2 Emission Trend and Activity Data





The Member States France, Germany and the United Kingdom contributed most to the emissions from this source (70 %). All Member States except for the Netherlands and the UK decreased emissions from rail transportation between 1990 and 2007. Germany and France had the highest decreases in absolute terms (Table 3.57).

Table 3.57 1A3c Railways: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	174	164	163	2.8%	0	0%	-11	-6%
Belgium	224	143	141	2.4%	-2	-1%	-83	-37%
Denmark	297	227	228	3.9%	1	0%	-69	-23%
Finland	191	129	109	1.9%	-20	-16%	-82	-43%
France	1,070	615	572	9.8%	-43	-7%	-498	-47%
Germany	2,879	1,300	1,278	22.0%	-22	-2%	-1,601	-56%
Greece	203	131	118	2.0%	-13	-10%	-85	-42%
Ireland	133	122	132	2.3%	10	8%	-1	-1%
Italy	441	350	328	5.6%	-22	-6%	-113	-26%
Luxembourg	25	7	2	0.0%	-5	-76%	-23	-94%
Netherlands	91	95	97	1.7%	2	2%	6	6%
Portugal	173	74	75	1.3%	1	1%	-99	-57%
Spain	414	296	289	5.0%	-7	-2%	-125	-30%
Sweden	103	68	68	1.2%	0	0%	-35	-34%
United Kingdom	1,682	2,173	2,220	38.1%	47	2%	538	32%
EU-15	**8,100**	**5,893**	**5,819**	**100.0%**	**-74**	**-1%**	**-2,281**	**-28%**

1A3c Railways –Liquid Fuels (CO_2)

Between 1990 and 2007, CO_2 emissions from liquid fuels decreased by 28 % in the EU-15. Only in the Netherlands and the United Kingdom emissions increased. Between 2006 and 2007, EU-15 emissions changed marginally (-1 %) (Table 3.58).

Table 3.58 1A3c Railways, liquid fuels: Member States' contributions to CO_2 emissions

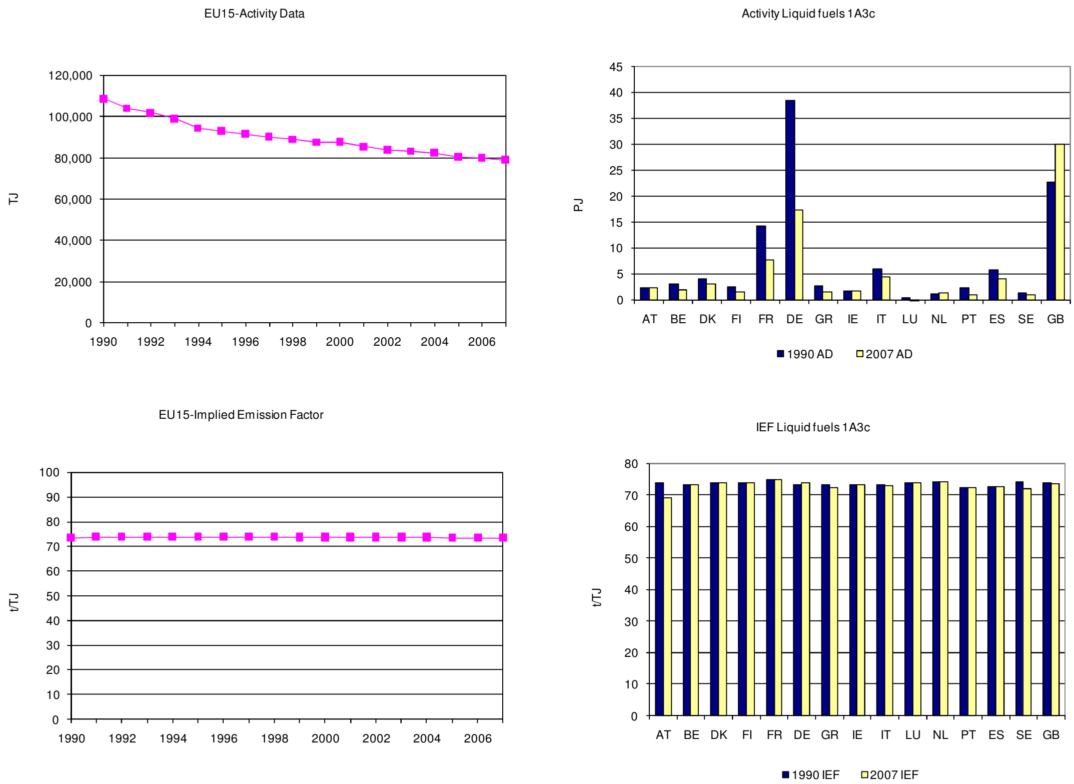
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	167	163	163	2.8%	0	0%	-5	-3%	CS	NS	CS
Belgium	224	143	141	2.4%	-2	-1%	-83	-37%	CS	RS	CS
Denmark	297	227	228	3.9%	1	0%	-69	-23%	C	NS	C
Finland	191	129	109	1.9%	-20	-16%	-82	-43%	T3, M	NS	CS
France	1,070	615	572	9.8%	-43	-7%	-498	-47%	C	NS	CS
Germany	2,826	1,300	1,278	22.0%	-22	-2%	-1,548	-55%	T1	NS	CS
Greece	200	131	118	2.0%	-13	-10%	-82	-41%	T1	NS	D
Ireland	133	122	132	2.3%	10	8%	-1	-1%	T1	NS	CS
Italy	441	350	328	5.6%	-22	-6%	-113	-26%	D	NS	CS
Luxembourg	25	7	2	0.0%	-5	-76%	-23	-94%	T1	NS	D
Netherlands	91	95	97	1.7%	2	2%	6	6%	CS	AS	CS
Portugal	173	74	74	1.3%	1	1%	-98	-57%	T1	NS	OTH
Spain	414	296	289	5.0%	-7	-2%	-125	-30%	T2	Q	C
Sweden	103	68	68	1.2%	0	0%	-35	-34%	CS	NS	CS
United Kingdom	1,682	2,173	2,220	38.2%	47	2%	538	32%	T2	NS,AS	CS
EU-15	**8,037**	**5,892**	**5,818**	**100.0%**	**-74**	**-1%**	**-2,219**	**-28%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Germany, Italy and the United Kingdom account for 76 % of emissions and for 75 % of activity data (Figure 3.63). The IEF for the EU-15 is 73.7 t/TJ Liquid fuels in 2007.

Table 3.58 shows, that about 72% of CO_2 emissions from railways – liquid fels - were calculated using a higher tier method.

Figure 3.63 1A3c Railways, liquid fuels: Activity data and implied emission factors for CO_2



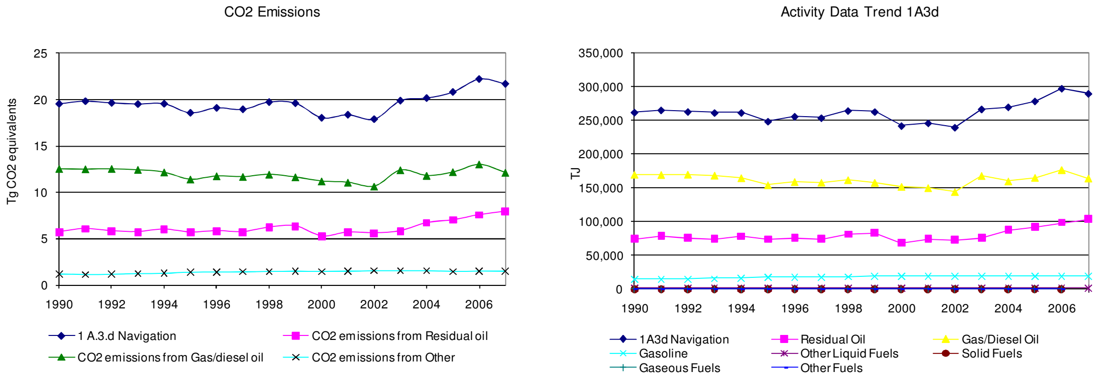
3.2.3.4 Navigation (1A3d) (EU-15)

This source category covers all water-borne transport from recreational craft to large ocean-going cargo ships that are driven primarily by large, slow and medium speed diesel engines and occasionally by steam or gas turbines. Emissions arise from gas/diesel oil, residual oil or other.

CO_2 emissions from 1A3d Navigation account for 0.5 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from navigation increased by 11 % in the EU-15 (Table 3.58).

The emissions from this key source are due to fossil fuel consumption in navigation. The total CO_2 emission trend is dominated by emissions from gas/diesel oil and residual oil (Figure 3.64).

Figure 3.64 1A3d Navigation: CO_2 Emission Trend



Four Member States (Italy, France, Spain and the United Kingdom) contributed the most to the emissions from this source (75%). Most Member States had increasing emissions from navigation between 1990 and 2007, except for Denmark, Germany, Ireland, Portugal and Sweden. The Member States with the highest increases in absolute terms were Spain, France and the United Kingdom (Table 3.59).

Table 3.59 1A3d Navigation: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	53	66	69	0.3%	3	5%	17	31%
Belgium	396	446	472	2.2%	25	6%	76	19%
Denmark	713	461	454	2.1%	-7	-2%	-260	-36%
Finland	441	569	584	2.7%	15	3%	142	32%
France	1,692	2,720	2,996	13.8%	276	10%	1,304	77%
Germany	2,050	856	531	2.5%	-325	-38%	-1,519	-74%
Greece	1,825	2,260	2,113	9.8%	-147	-7%	288	16%
Ireland	84	4	4	0.0%	0	7%	-80	-95%
Italy	5,420	5,204	4,970	23.0%	-234	-4%	-450	-8%
Luxembourg	0	1	0	0.0%	0	-6%	0	95%
Netherlands	405	606	606	2.8%	0	0%	201	50%
Portugal	262	209	210	1.0%	1	0%	-52	-20%
Spain	1,500	2,763	3,260	15.1%	497	18%	1,761	117%
Sweden	540	488	445	2.1%	-43	-9%	-95	-18%
United Kingdom	4,112	5,502	4,931	22.8%	-571	-10%	819	20%
EU-15	**19,493**	**22,155**	**21,646**	**100.0%**	**-509**	**-2%**	**2,153**	**11%**

1A3d Navigation – Residual Oil (CO_2)

CO_2 emissions from Residual oil account for 36 % of CO_2 emissions from 1A3d Navigation in 2007. Between 1990 and 2007, CO_2 emissions from Residual oil increased by 40 % in the EU-15. The countries with the highest increase in absolute terms were Greece, Spain and the United Kingdom. The Member State with the highest absolute decrease was Denmark. Austria, Belgium, Germany, Ireland, Luxembourg and the Netherlands reported emissions as 'Not occuring', 'Not estimated' or '0' (Table 3.60) for 2007.

Table 3.60 1A3d Navigation, residual oil: Member States' contributions to CO_2 emissions

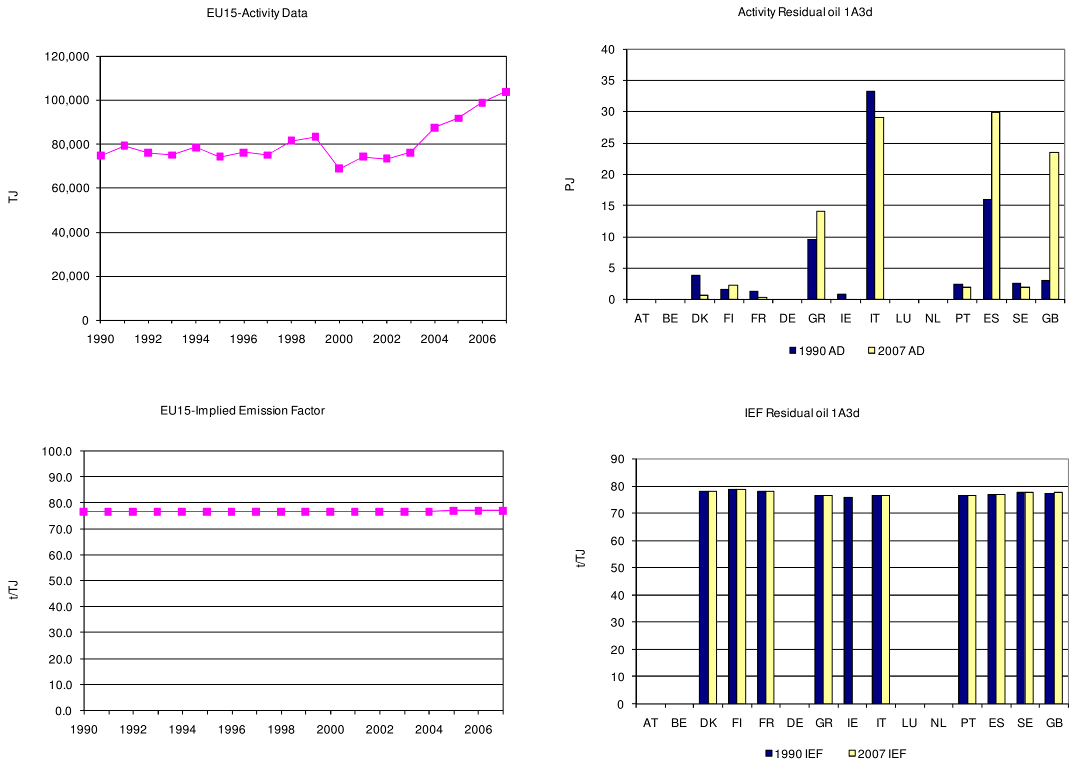
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	CS	NS	CS
Belgium	NO	NO	NO	-	-	-	-	-	M	RS	CS
Denmark	300	49	48	0.6%	-2	-4%	-252	-84%	C	NS	C
Finland	123	164	177	2.2%	13	8%	53	43%	T3, M	NS	CS
France	102	32	27	0.3%	-5	-14%	-75	-73%	C	NS	CS
Germany	NO	NO	NO	-	-	-	-	-	(NO)	(NO)	(NO)
Greece	730	1,105	1,077	13.5%	-28	-3%	348	48%	T1	NS	D
Ireland	63	NO	NO	-	0	-	-63	-100%	T1	NS	CS
Italy	2,553	2,355	2,235	27.9%	-120	-5%	-318	-12%	T1, T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Portugal	188	150	151	1.9%	1	0%	-37	-20%	C	NS,AS	C
Spain	1,234	1,944	2,294	28.7%	350	18%	1,060	86%	T2	NS, AS	C
Sweden	194	182	153	1.9%	-29	-16%	-41	-21%	T1	NS	CS
United Kingdom	242	1,625	1,834	22.9%	209	13%	1,592	659%	CS, T2	NS,AS	CS
EU-15	**5,729**	**7,607**	**7,996**	**100.0%**	**389**	**5%**	**2,267**	**40%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Italy, the United Kingdom and Spain account for 80 % of emissions and for 80 % of activity data (Figure 3.65). The IEF for the EU-15 is 76.9 t/TJ Residual oil in 2007.

Table 3.60 shows, that about 85% of CO_2 emissions from navigation – residual oil - were calculated using a higher tier method.

Figure 3.65 1A3d Navigation, residual oil: Activity data and implied emission factors for CO_2



1A3d Navigation – Gas/Diesel Oil (CO_2)

CO_2 emissions from Gas/Diesel oil account for 57 % of CO_2 emissions from 1A3d "Navigation" in 2007 (Table 3.61). The CO_2 emissions from Gas/Diesel oil decreased by 3 % between 1990 and 2007. Member States with the highest increase in absolute and relative terms were France and Spain. The countries with the highest absolute decrease were Germany and the UK.

Table 3.61 1A3d Navigation, gas/diesel oil: Member States' contributions to CO_2 emissions

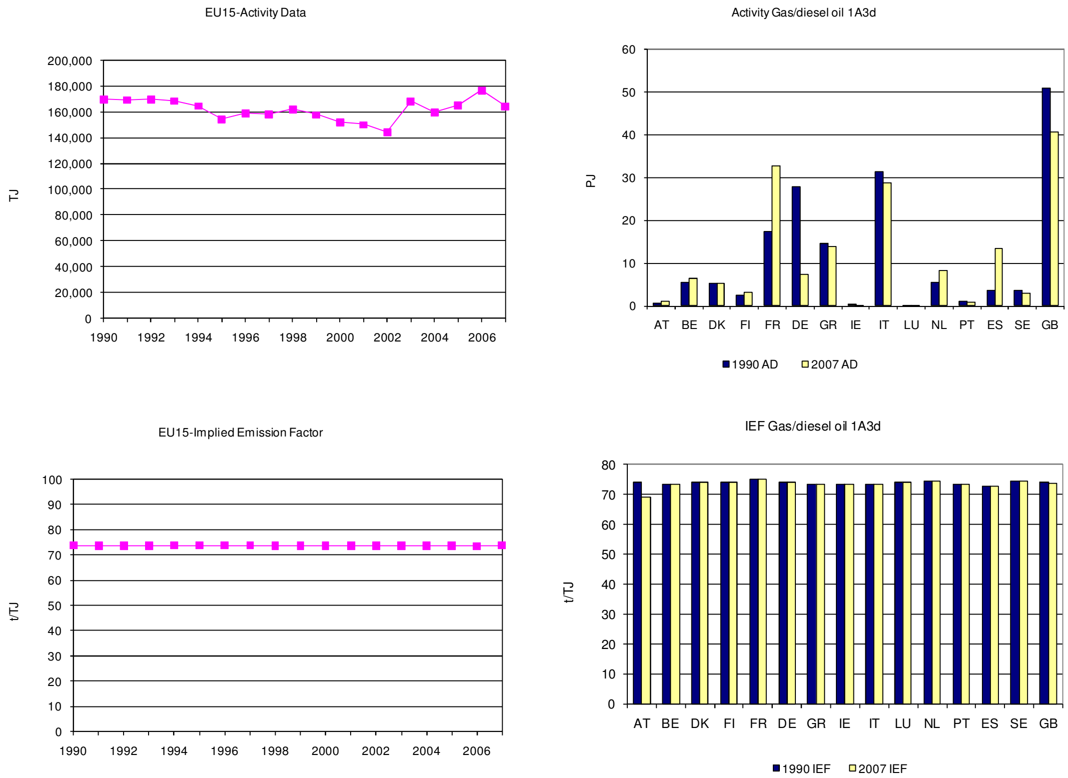
Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	43	57	61	0.5%	4	6%	18	41%	CS	NS	CS
Belgium	396	446	472	3.9%	25	6%	76	19%	M	RS	CS
Denmark	391	383	379	3.1%	-5	-1%	-12	-3%	C	NS	C
Finland	186	237	237	2.0%	0	0%	50	27%	T3, M	NS	CS
France	1,292	2,175	2,456	20.3%	280	13%	1,164	90%	C	NS	CS
Germany	2,050	856	531	4.4%	-325	-38%	-1,519	-74%	T1	NS	CS
Greece	1,068	1,128	1,008	8.3%	-120	-11%	-60	-6%	T1	NS	D
Ireland	21	4	4	0.0%	0	7%	-17	-81%	T1	NS	CS
Italy	2,299	2,227	2,113	17.4%	-113	-5%	-186	-8%	T1, T2	NS	CS
Luxembourg	0	1	0	0.0%	0	-6%	0	95%	T1	TÜV	D
Netherlands	405	606	606	5.0%	0	0%	201	50%	T2	NS/Q	CS
Portugal	73	59	59	0.5%	0	0%	-15	-20%	C	NS,AS	C
Spain	266	819	966	8.0%	147	18%	701	264%	T2	NS, AS	C
Sweden	271	232	218	1.8%	-15	-6%	-54	-20%	T1	NS	CS
United Kingdom	3,763	3,780	3,006	24.8%	-774	-20%	-757	-20%	CS, T2	NS,AS	CS
EU-15	**12,525**	**13,010**	**12,116**	**100.0%**	**-894**	**-7%**	**-410**	**-3%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

France, Greece, Italy, Spain and the United Kingdom account for 79 % of activity data and for 79 % of the CO_2 emissions (Figure 3.66). The IEF for the EU-15 is 73,8 t/TJ residual oil in 2007.

Table 3.61 shows, that about 85% of CO_2 emissions from navigation – gas/diesel oil - were calculated using a higher tier method.

Figure 3.66 1A3d Navigation, gas/diesel oil: Activity data and implied emission factors for CO_2



3.2.3.5 Other (1A3e) (EU-15)

CO_2 emissions from 1A3e Other account for 0.2 % of total EU-15 GHG emissions in 2007. This source includes mainly pipeline transport and ground activities in airports and harbours. The emissions from this key source are due to fossil fuel consumption in other transportation, which increased by 10 % between 1990 and 2007. (Table 3.61). A fuel shift occurred from oil to gas.

Germany contributed more than 50 % of the emissions from this source in 2007, followed by Italy (10.7 %) and Finland (10.1 %). Between 1990 and 2007 the EU-15 reported decreasing emissions (-6 %). Denmark, Luxembourg, the Netherlands, and Portugal report emissions as 'Not occuring' or 'Not applicable' (Table 3.62).

Table 3.62 1A3e Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	224	452	449	6.3%	-3	-1%	225	100%
Belgium	197	156	125	1.7%	-31	-20%	-72	-36%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	661	712	726	10.1%	13	2%	65	10%
France	213	589	561	7.8%	-28	-5%	348	163%
Germany	4,302	3,725	3,632	50.6%	-92	-2%	-670	-16%
Greece	NO	5	7	0.1%	3	51%	7	-
Ireland	62	151	131	1.8%	-21	-14%	69	111%
Italy	407	1,039	766	10.7%	-273	-26%	359	88%
Luxembourg	NA	NA	NA	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	20	182	162	-	-20	-11%	142	702%
Sweden	147	156	155	2.2%	-1	-1%	8	5%
United Kingdom	268	451	458	6.4%	7	1%	190	71%
EU-15	**6,502**	**7,619**	**7,172**	**100.0%**	**-446**	**-6%**	**670**	**10%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.2.4 Other Sectors (CRF Source Category 1A4) (EU-15)

Category 1A4 mainly includes emissions from 'small scale fuel combustion' used for space heating and hot water prodution in commercial and institutional buildings, households, agriculture and forestry. It includes also emissions from mobile machinery used within these categories (e.g mowers, harvesters, tractors, chain saws, motor pumps) as well as fuel used for grain drying, horticultural greenhouse heating or CO_2 fertilisation and stall heatings. Category 1A4c includes emissions from domestic inland, coastal and deep sea fishing wheras emissions from international fishing are included under category 1A3d. Emissions from transportation of agricultural goods are reported under category 1A3 Transport.

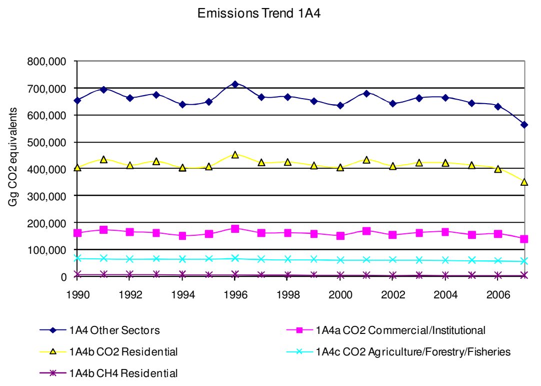
The following enumeration shows the correspondence of 1A4 sub categories and ISIC codes:

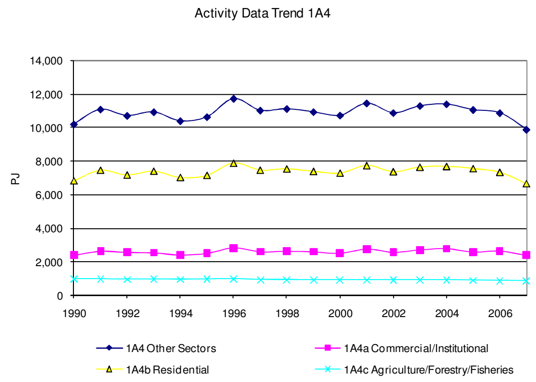
- 1 A 4 a Commercial/Institutional: ISIC categories 4103, 42, 6, 719, 72, 8, and 91-96
- 1 A 4 b Residential: All emissions from fuel combustion in households
- 1 A 4 b Agriculture/Forestry/Fishing: ISIC categories 05, 11, 12, 1302

In 2007 category 1A4 contributed to 566 653 Gg CO_2 equivalents of which 97.7% CO_2, 1.2% CH_4 and 1.1% N_2O.

Figure 3.67 shows the trend of total GHG emissions within source category 1A4 and the dominating sources: CO_2 emissions from 1A4b Residential and from 1A4a Commercial/Residential. The emissions of the large key sources fluctuated between 1990 and 2007, all emissions from 1A4 decreased.

Figure 3.67 1A4 Other Sectors: Total, CO_2 and CH_4 emission trends





In 2007 GHG emissions from source category 1A4 accounted for 14 % of total GHG emissions. This source category includes ten key sources:

1 A 4 a Commercial/Institutional: Gaseous Fuels (CO_2)
1 A 4 a Commercial/Institutional: Liquid Fuels (CO_2)
1 A 4 a Commercial/Institutional: Solid Fuels (CO_2)
1 A 4 b Residential: Biomass (CH_4)
1 A 4 b Residential: Gaseous Fuels (CO_2)
1 A 4 b Residential: Liquid Fuels (CO_2)
1 A 4 b Residential: Solid Fuels (CO_2)
1 A 4 c Agriculture/Forestry/Fisheries: Gaseous Fuels (CO_2)
1 A 4 c Agriculture/Forestry/Fisheries: Liquid Fuels (CO_2)
1 A 4 c Agriculture/Forestry/Fisheries: Solid Fuels (CO_2)

Table 3.63 shows total GHG, CO_2 and CH_4 emissions from 1A4 Other sectors. Between 1990 and 2007 CO_2 emissions from 1A4 Other Sectors decreased by 13 % , CH_4 decreased by 38% and N_2O emissions decreased by 10%.

Table 3.63 1A4 Other Sectors: Member States' contributions to total GHG, CO_2 and CH_4 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH4 emissions in 2007 (Gg CO_2 equivalents)
Austria	14,432	11,096	13,811	10,580	386	269
Belgium	27,390	26,718	27,011	26,425	241	164
Denmark	9,150	6,483	8,954	6,148	90	227
Finland	7,310	5,183	7,040	4,918	183	193
France	98,875	95,781	93,636	92,629	3,926	1,830
Germany	207,921	128,592	204,341	127,528	2,593	611
Greece	8,592	13,092	8,126	12,666	84	80
Ireland	10,463	10,565	10,059	10,196	95	47
Italy	78,387	82,173	76,677	79,746	309	694
Luxembourg	1,378	1,416	1,366	1,398	8	8
Netherlands	38,712	36,055	38,217	34,989	450	1,029
Portugal	4,610	5,645	4,025	5,180	348	315
Spain	26,400	37,737	25,281	36,747	819	658
Sweden	10,831	4,452	10,311	3,898	243	308
United Kingdom	111,431	101,667	108,942	100,528	1,535	537
EU-15	**655,882**	**566,653**	**637,798**	**553,577**	**11,312**	**6,970**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.64 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A4 Other sectors for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 3.64 **1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	-585	-4.1	-864	-6.3	Activity data: Activity data for mobile machineries were updated with data from a new study (old data based on a study from the year 2000), it is based on the most recent "Nutz-Energie-Analyse" by Statistik Austria (which is a survey analysing the energy use); now the activity of mobile machineries in forestry is considerably lower.
Belgium	-205	-0.8	-9	0.0	
Denmark	0	0.0	-46	-0.7	
Finland	0	0.0	-54	-1.1	
France	-43	0.0	375	0.4	
Germany	0	0.0	-4,319	-2.5	Activity data: new available data
Greece	0	0.0	13	0.1	
Ireland	-6	-0.1	-64	-0.6	
Italy	169	0.2	-124	-0.1	
Luxembourg	76	5.9	153	11.7	
Netherlands	349	0.9	-235	-0.6	
Portugal	0	0.0	-16	-0.3	
Spain	1	0.0	-112	-0.3	
Sweden	-410	-3.8	-149	-3.5	
UK	-456	-0.4	-836	-0.8	Activity data: Revision to activity data presented in UK National Statistics (DUKES)
EU-15	**-1,109**	**-0.2**	**-6,288**	**-1.0**	

Table 3.65 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1A4 Other sectors for 1990 and 2006.

Table 3.65 **1A4 Other Sectors: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

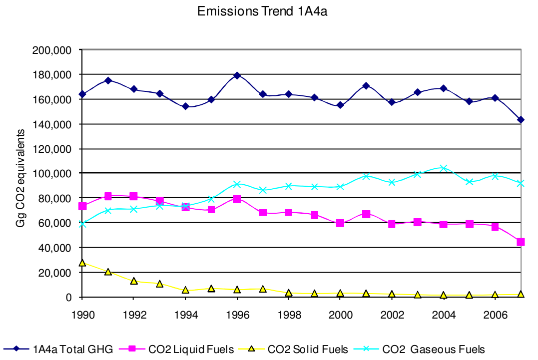
	1990		2006	
	Gg	Percent	Gg	Percent
Austria	-2	-0.6	56	22.8
Belgium	0	-0.1	4	2.3
Denmark	0	0.0	6	3.0
Finland	0	0.0	0	0.0
France	-107	-2.7	-74	-3.4
Germany	0	0.0	-135	-18.0
Greece	6	7.4	7	9.9
Ireland	0	0.0	0	-0.2
Italy	0	0.0	0	0.0
Luxembourg	-2	-23.7	0	2.7
Netherlands	57	14.6	426	117.1
Portugal	0	0.0	0	0.0
Spain	0	0.0	2	0.4
Sweden	-5	-2.0	20	8.5
UK	-3	-0.2	32	6.8
EU-15	**-56**	**-0.5**	**346**	**5.4**

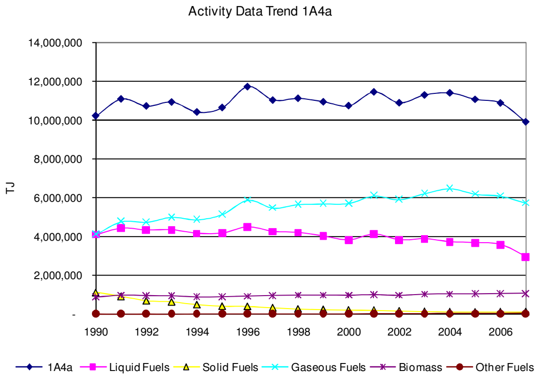
3.2.4.1 Commercial/Institutional (1A4a) (EU-15)

In this chapter information about emission trends, Member states' contribution, activity data, and emission factors is provided for category 1A4a by fuels. CO_2 emissions from 1A4a Commercial/Institutional was the fifth largest key source of GHG emissions in the EU-15 and accounted for 3.5 % of total GHG emissions in 2007.

Figure 3.68 shows the emission trend within the category 1A4a, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total emissions decreased by 13 %, mainly due to decreases in emissions from solid (-92 %) and liquid (-40 %) fuels.

Figure 3.68 1A4a Commercial/Institutional: Total and CO_2 emission and activity trends





Between 1990 and 2007, CO_2 emissions from 1A4a decreased by 12 % in the EU-15 (Table 3.66). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of offices, (3) building codes, (4) age distribution of the existing building stock, and (5) fuel split for heating and warm water. Fossil fuel consumption in Commercial/Institutionaldecreased by 3 % between 1990 and 2007, with a fuel switch from coal and oil to gas.

France, Germany, Italy and the United Kingdom contributed the most to the emissions from this source (75 %). The Member States with the highest increases in absolute terms were Spain, Italy, France, Portugal and Denmark. The Member State with the highest reduction in absolute terms was Germany.

Table 3.66 1A4a Commercial/Institutional: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,651	2,936	1,952	1.4%	-985	-34%	-699	-26%
Belgium	4,272	5,813	5,500	3.9%	-313	-5%	1,228	29%
Denmark	1,403	947	790	0.6%	-158	-17%	-613	-44%
Finland	1,951	1,131	1,104	0.8%	-27	-2%	-847	-43%
France	27,863	29,948	27,413	19.3%	-2,535	-8%	-450	-2%
Germany	63,950	45,390	35,850	25.2%	-9,540	-21%	-28,099	-44%
Greece	527	1,599	1,501	1.1%	-98	-6%	974	185%
Ireland	2,332	2,635	2,603	1.8%	-31	-1%	271	12%
Italy	16,187	23,505	22,400	15.8%	-1,105	-5%	6,213	38%
Luxembourg	675	712	682	0.5%	-30	-4%	6	1%
Netherlands	7,501	11,814	10,230	7.2%	-1,583	-13%	2,729	36%
Portugal	744	2,364	2,381	1.7%	18	1%	1,638	220%
Spain	3,746	8,699	8,230	5.8%	-470	-5%	4,484	120%
Sweden	2,541	839	839	0.6%	0	0%	-1,703	-67%
United Kingdom	25,434	21,230	20,551	14.5%	-680	-3%	-4,883	-19%
EU-15	**161,776**	**159,561**	**142,025**	**100.0%**	**-17,536**	**-11%**	**-19,752**	**-12%**

1A4 a Commercial/Institutional – Liquid Fuels (CO_2)

In 2007 CO_2 emissions from liquid fuels had a share of 31 % within source category 1A4a (compared to 45 % in 1990). Between 1990 and 2007 the emissions decreased by 40 % (Table 3.67). Four Member States had increases in this periode, with the highest absolute increase in Spain and Portugal. The highest absolute decrease was achieved in Germany. Between 2006 and 2007 EU-15 total emission decreased by 21 %. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oiltanks in 2007 because of high outdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

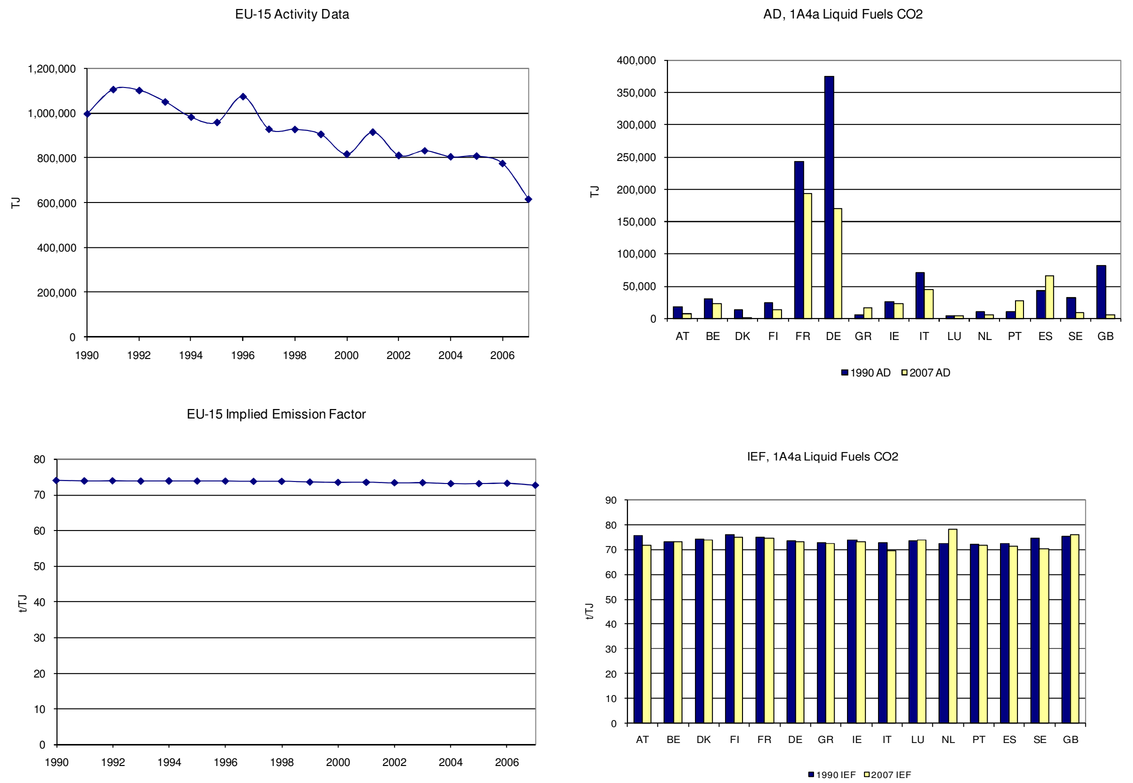
Table 3.67 1A4a Commercial/Institutional, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,448	1,616	593	1.3%	-1,023	-63%	-855	-59%	T2	NS	CS
Belgium	2,312	1,972	1,714	3.8%	-258	-13%	-598	-26%	T1	RS	D
Denmark	1,008	265	159	0.4%	-106	-40%	-850	-84%	C	NS	CS/C
Finland	1,885	1,005	993	2.2%	-12	-1%	-892	-47%	T1	NS	CS
France	18,252	15,897	14,392	32.2%	-1,505	-9%	-3,860	-21%	C	NS	CS
Germany	27,633	19,924	12,460	27.8%	-7,463	-37%	-15,172	-55%	CS	NS	CS
Greece	505	1,392	1,256	2.8%	-136	-10%	751	149%	T2	NS	D
Ireland	1,977	1,794	1,687	3.8%	-107	-6%	-290	-15%	T1	NS	CS
Italy	5,157	3,689	3,166	7.1%	-523	-14%	-1,991	-39%	T2	NS	CS
Luxembourg	474	383	368	0.8%	-15	-4%	-106	-22%	T1	NS	D
Netherlands	739	311	192	0.4%	-120	-38%	-547	-74%	T2	NS	CS
Portugal	744	1,993	1,972	4.4%	-21	-1%	1,228	165%	T2	NS	D,C
Spain	3,197	5,459	4,725	10.6%	-734	-13%	1,529	48%	T2	NS	C
Sweden	2,455	612	622	1.4%	10	2%	-1,833	-75%	T1, T2, T3	NS	CS
United Kingdom	6,212	508	461	1.0%	-46	-9%	-5,751	-93%	T2	NS,AS	CS
EU-15	**73,998**	**56,820**	**44,760**	**100.0%**	**-12,060**	**-21%**	**-29,238**	**-40%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.69 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany and Spain; together they cause 71 % of the CO_2 emissions from liquid fuels in 1A4a. Fuel consumption in the EU-15 decreased by 40 % between 1990 and 2007. The implied emission factor of EU-15 was 72.7 t/TJ in 2007.

Figure 3.69 1A4a Commercial/Institutional, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4a Commercial/Institutional – Solid Fuels (CO_2)

In 2007, CO_2 from solid fuels had a share of 2 % within source category 1A4a (compared to 17 % in 1990). Between 1990 and 2007 the emissions decreased by 92 % (Table 3.68). Denmark, Finland, Greece, Italy, Portugal and Sweden report emissions as 'Not occuring' in 2007; all other Member States reduced emissions between 1990 and 2007. Between 2006 and 2007 EU-15 emissions increased by 18 %.

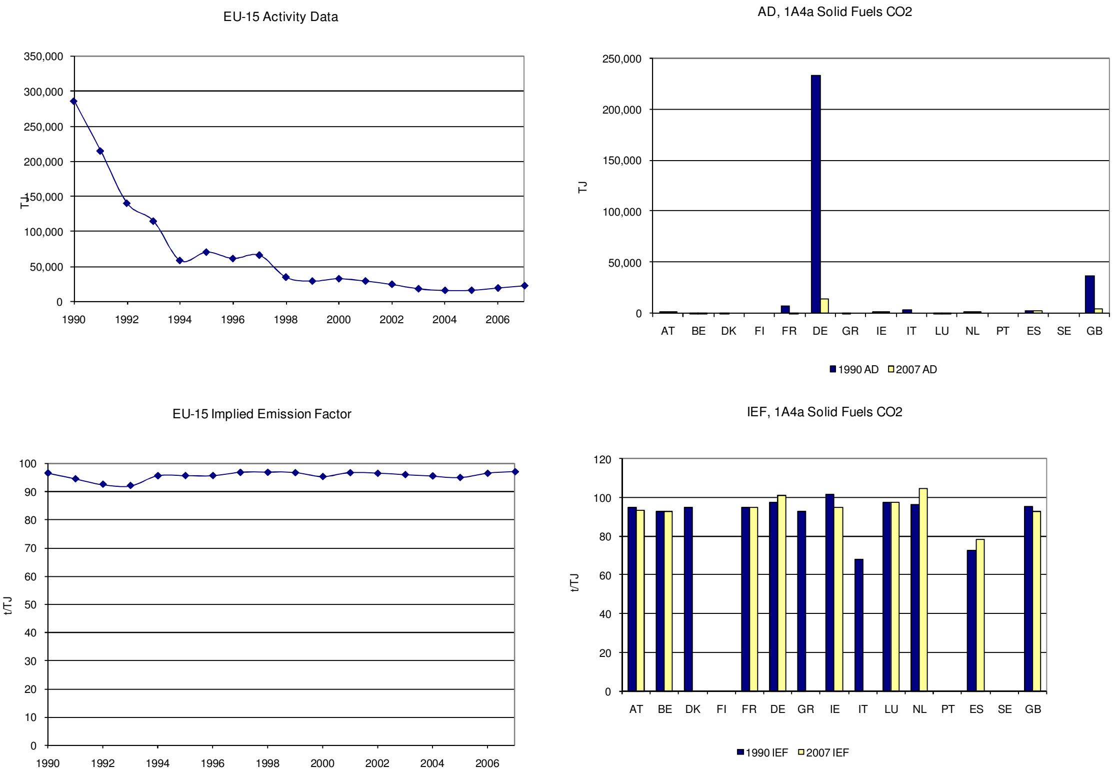
Table 3.68 1A4a Commercial/Institutional, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	90	63	57	2.6%	-5	-9%	-33	-36%	T2	NS	CS
Belgium	9	NO	2	0.1%	2	-	-7	-81%	T1	RS	D
Denmark	8	NO	NO	-	-	-	-8	-100%	C	NS	CS/C
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	698	4	8	0.4%	4	90%	-690	-99%	C	NS	CS
Germany	22,712	1,117	1,418	65.1%	302	27%	-21,293	-94%	CS	NS	CS
Greece	10	NO	NO	-	-	-	-10	-100%	0.0	0.0	0.0
Ireland	138	105	104	4.8%	-2	-2%	-35	-25%	T1	NS	CS
Italy	218	NO	NO	-	-	-	-218	-100%	T2	NS	CS
Luxembourg	12	1	0	0.0%	0	-21%	-11	-96%	T1	NS	D
Netherlands	128	23	68	3.1%	46	203%	-59	-46%	T2	NS	CS
Portugal	NO	NO	NO	-	-	-	-	-	T2	NS	D,C
Spain	154	123	133	6.1%	10	8%	-22	-14%	T2	NS	C
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	3,441	417	389	17.9%	-28	-7%	-3,052	-89%	T2	NS,AS	CS
EU-15	**27,618**	**1,852**	**2,180**	**100.0%**	**328**	**18%**	**-25,439**	**-92%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.70 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are still reported by Germany and the Unitded Kingdom in 2007; together they cause up to 83 % of the CO_2 emissions from solid fuels in 1A4a. Fuel consumptionin the EU-15 decreased by 92 % between 1990 and 2007. The implied emission factor of EU-15 was 97.2 t/TJ in 2007. The 1990 implied emission factor of Italy is comparatively low because of a high share of gas works gas is included.

Figure 3.70 1A4a Commercial/Institutional, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4a Commercial/Institutional – Gaseous Fuels (CO_2)

In 2007 CO_2 from gaseous fuels had a share of 64 % within source category 1A4a (compared to 36 % in 1990). Between 1990 and 2007 the emissions increased by 56 % (Table 3.69). All Member States reported increasing emissions. The highest absolute increases occurred in Germany and Italy. Between 2006 and 2007 EU-15 emissions decreased by -6 %.

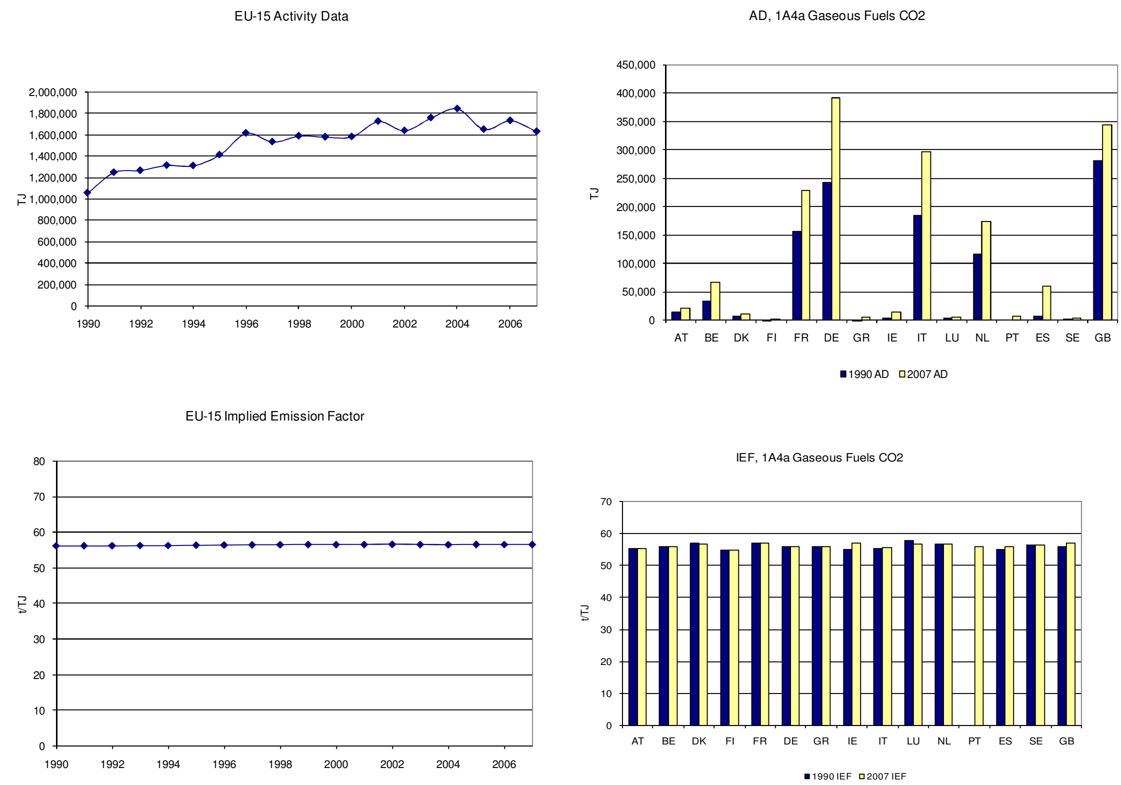
Table 3.69 1A4a Commercial/Institutional, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	763	1,182	1,148	1.2%	-34	-3%	385	51%	T2	NS	CS
Belgium	1,921	3,745	3,689	4.0%	-56	-2%	1,768	92%	T1	RS	D
Denmark	365	667	630	0.7%	-37	-5%	265	72%	C	NS	CS/C
Finland	50	111	96	0.1%	-15	-13%	46	91%	T1	NS	CS
France	8,910	14,047	13,012	14.1%	-1,035	-7%	4,102	46%	C	NS	CS
Germany	13,605	24,350	21,972	23.9%	-2,378	-10%	8,366	61%	CS	NS	CS
Greece	12	206	245	0.3%	39	19%	233	1935%	T2	NS	D
Ireland	217	736	813	0.9%	77	11%	596	274%	T1	NS	CS
Italy	10,243	17,012	16,488	17.9%	-524	-3%	6,245	61%	T2	NS	CS
Luxembourg	189	328	313	0.3%	-15	-5%	124	65%	T1	NS	D
Netherlands	6,634	11,480	9,970	10.8%	-1,510	-13%	3,336	50%	T2	NS	CS
Portugal	NO	370	409	0.4%	39	11%	409	-	T2	NS	D,C
Spain	395	3,117	3,372	3.7%	254	8%	2,977	754%	T2	NS	CS
Sweden	86	226	217	0.2%	-10	-4%	131	152%	T1, T2, T3	NS	CS
United Kingdom	15,721	20,264	19,659	21.4%	-605	-3%	3,938	25%	T2	NS	CS
EU-15	**59,112**	**97,842**	**92,033**	**100.0%**	**-5,809**	**-6%**	**32,921**	**56%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.71 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy, the Netherlands and the UK; together they cause 88 % of the CO_2 emissions from gaseous fuels in 1A4a. Fuel combustion in the EU-15 rose by 51 % between 1990 and 2007. The implied emission factor of EU-15 was 56.4 t/TJ in 2007.

Figure 3.71 1A4a Commercial/Institutional, gaseous fuels: Activity Data and Implied Emission Factors for CO_2

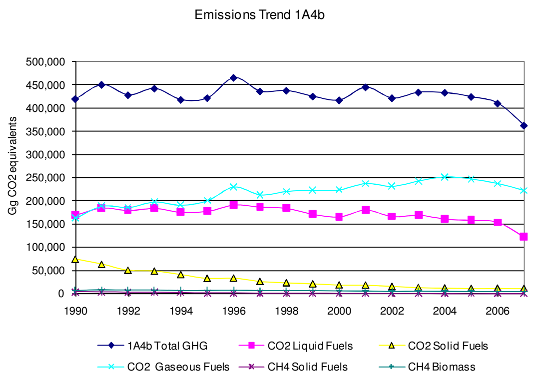


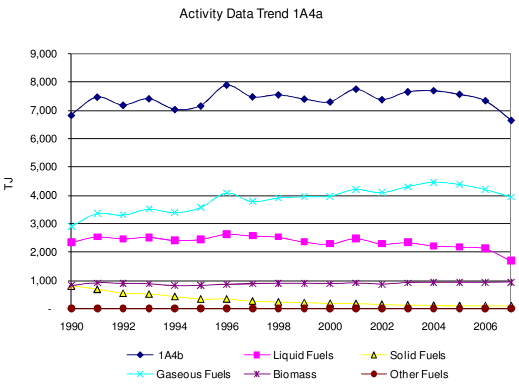
3.2.4.2 Residential (1A4b) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4b by fuels. CO_2 emissions from 1A4b Residential are the fourth largest key source of GHG emissions in the EU-15 and account for 9 % of total GHG emissions in 2007.

Figure 3.72 shows the emission trend within the category 1A4b, which is mainly dominated by CO_2 emissions from liquid and gaseous fuels. Total GHG emissions are at a similar level as in 1990, although CO_2 emissions from gaseous fuels increased strongly (+37 %) which was counterbalanced by decreasing emissions from all other fuels.

Figure 3.72 1A4 Residential: Total, CO_2 and CH_4 emission and activity trends





CO_2 emissions from 1A4b Residential

Between 1990 and 2007, CO_2 emissions from households decreased by 13 % in the EU-15 (Table 3.70). Main factors influencing CO_2 emissions from this source category are (1) outdoor temperature, (2) number and size of dwellings, (3) building codes, (4) age distribution of the existing building stock, and (5) fuel split for heating and warm water. Fossil fuel consumption in households decreased by 5 % between 1990 and 2007, with a fuel shift from coal and oil to gas.

Between 1990 and 2007, the largest reduction in absolute terms was reported by Germany reducing emissions by 43 million tonnes. Austria, Belgium, Denmark, Finland, Italy, the Netherlands, and Sweden also showed reductions of emissions of one to nearly five million tonnes. In absolute terms Greece, Spain and France had the largest emission increases. One reason for the performance of the Nordic countries and Austria is increased use of district heating. As district heating replaces heating boilers in households, an increase in the share of district heating reduces CO_2 emissions from households (but increases emissions from energy industries if fossil fuels are used). In Germany, efficiency improvements and the fuel switch in eastern German households are two reasons for the emission reductions.

Table 3.70 1A4b Residential: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	9,908	8,890	7,709	2.2%	-1,181	-13%	-2,199	-22%
Belgium	20,213	20,512	18,797	5.3%	-1,715	-8%	-1,417	-7%
Denmark	5,059	3,695	3,368	1.0%	-327	-9%	-1,691	-33%
Finland	3,072	2,120	2,040	0.6%	-80	-4%	-1,032	-34%
France	55,157	61,843	56,456	16.0%	-5,387	-9%	1,298	2%
Germany	129,474	113,435	85,950	24.3%	-27,485	-24%	-43,524	-34%
Greece	4,671	9,540	8,597	2.4%	-943	-10%	3,925	84%
Ireland	7,066	7,039	6,818	1.9%	-221	-3%	-249	-4%
Italy	52,118	54,222	49,497	14.0%	-4,725	-9%	-2,621	-5%
Luxembourg	675	705	666	0.2%	-40	-6%	-10	-1%
Netherlands	19,495	17,407	16,020	4.5%	-1,388	-8%	-3,475	-18%
Portugal	1,621	2,190	2,064	0.6%	-126	-6%	442	27%
Spain	12,979	18,113	18,435	5.2%	322	2%	5,456	42%
Sweden	6,236	1,612	1,420	0.4%	-192	-12%	-4,816	-77%
United Kingdom	78,363	79,591	75,847	21.4%	-3,744	-5%	-2,516	-3%
EU-15	**406,109**	**400,915**	**353,683**	**100.0%**	**-47,232**	**-12%**	**-52,426**	**-13%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Liquid Fuels (CO_2)

In 2007 CO_2 from liquid fuels had a share of 34 % within source category 1A4b (compared to 40 % in 1990). Between 1990 and 2007 the emissions decreased by 28 % (Table 3.71). The highest absolute increases showed Greece, Ireland and the UK. The highest absolute decreases were reported by Germany and Italy. Between 2006 and 2007 EU-15 emissions decreased by 21 %. The strong decrease from 2006 to 2007 for Germany is due to low gasoil sales to end consumers. Many end consumers did not restock their oiltanks in 2007 because of high outdoor temperatures and rising oil prices. Additionally end consumer gasoil stocks were comparatively high in 2007 due to a mild winter 2006. It is assumed that the circumstances were similar for other MS (e.g. Austria).

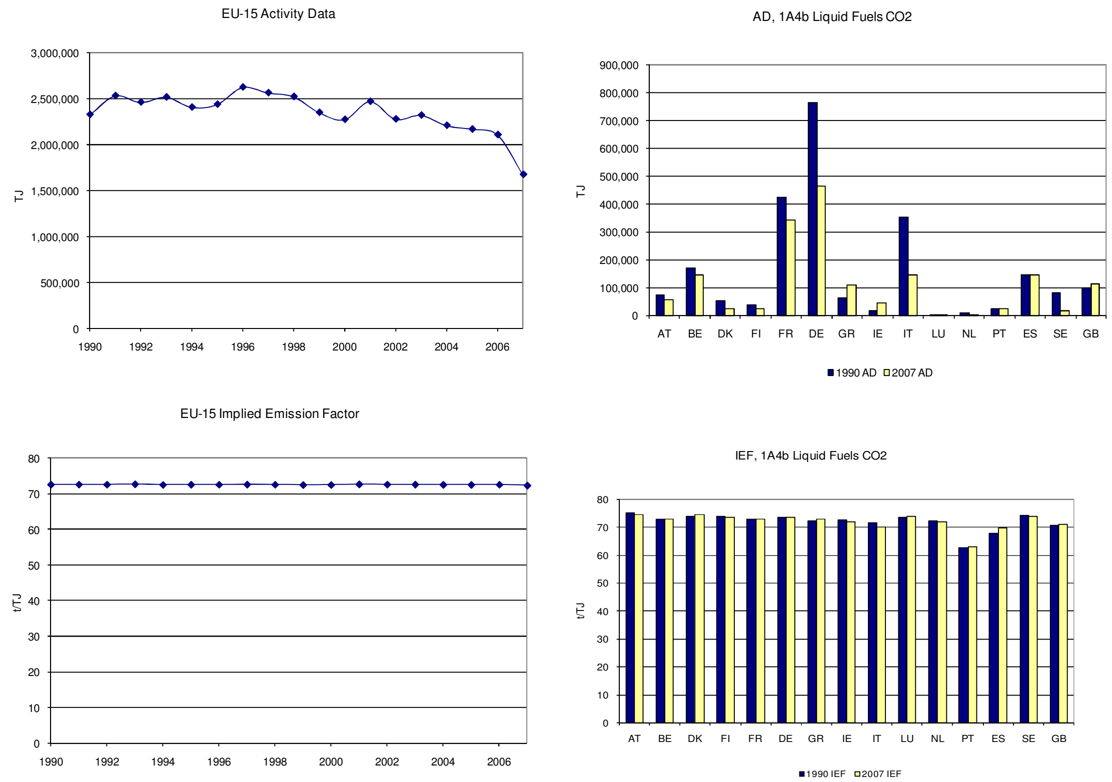
Table 3.71 1A4b Residential, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	5,605	5,167	4,294	3.5%	-873	-17%	-1,312	-23%	T2	NS	CS
Belgium	12,609	11,803	10,618	8.7%	-1,185	-10%	-1,991	-16%	T1	RS	D
Denmark	3,999	1,987	1,782	1.5%	-205	-10%	-2,216	-55%	C	NS	CS/C/D
Finland	2,951	1,993	1,907	1.6%	-86	-4%	-1,044	-35%	T1	NS	CS
France	30,976	28,038	25,106	20.6%	-2,932	-10%	-5,871	-19%	C	NS	CS
Germany	56,344	55,779	34,095	28.0%	-21,684	-39%	-22,249	-39%	CS	NS	CS
Greece	4,585	9,214	8,177	6.7%	-1,036	-11%	3,592	78%	T2	NS	D
Ireland	1,190	3,443	3,402	2.8%	-41	-1%	2,212	186%	T1	NS	CS
Italy	25,292	12,282	10,344	8.5%	-1,938	-16%	-14,948	-59%	T2	NS	CS
Luxembourg	474	376	352	0.3%	-24	-6%	-122	-26%	T1	NS	D
Netherlands	737	266	255	0.2%	-11	-4%	-482	-65%	T2	NS	CS
Portugal	1,621	1,761	1,597	1.3%	-164	-9%	-25	-2%	T2	NS	D,C
Spain	9,971	10,598	10,278	8.4%	-320	-3%	308	3%	T2	NS	C
Sweden	6,150	1,534	1,345	1.1%	-188	-12%	-4,805	-78%	T1, T2, T3	NS	CS
United Kingdom	7,049	9,275	8,236	6.8%	-1,039	-11%	1,187	17%	T2	NS,AS	CS
EU-15	**169,554**	**153,515**	**121,788**	**100.0%**	**-31,728**	**-21%**	**-47,766**	**-28%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.73 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Belgium, France, Germany, Italy and the UK; together they cause 74 % of the CO_2 emissions from liquid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 28 % between 1990 and 2007. The implied emission factor of EU-15 was 72.4 t/TJ in 2007. The implied emission factor of Portugal is lower than for other countries because a high share of city gas and LPG is used by the domestic sector.

Figure 3.73 1A4b Residential, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4b Residential –Solid Fuels (CO_2)

In 2007 CO_2 from solid fuels had a share of 3 % within source category 1A4b (compared to 18 % in 1990). Between 1990 and 2007 the emissions decreased by 87 % (Table 3.72). All Member States reported decreasing emissions with the highest reductions in absolute terms in Germany, the UK, Ireland and France. Between 2006 and 2007 EU-15 emissions declined by 5 %, although five Member States reported rising emissions. Sweden and Portugal report emissions as 'Not occuring'.

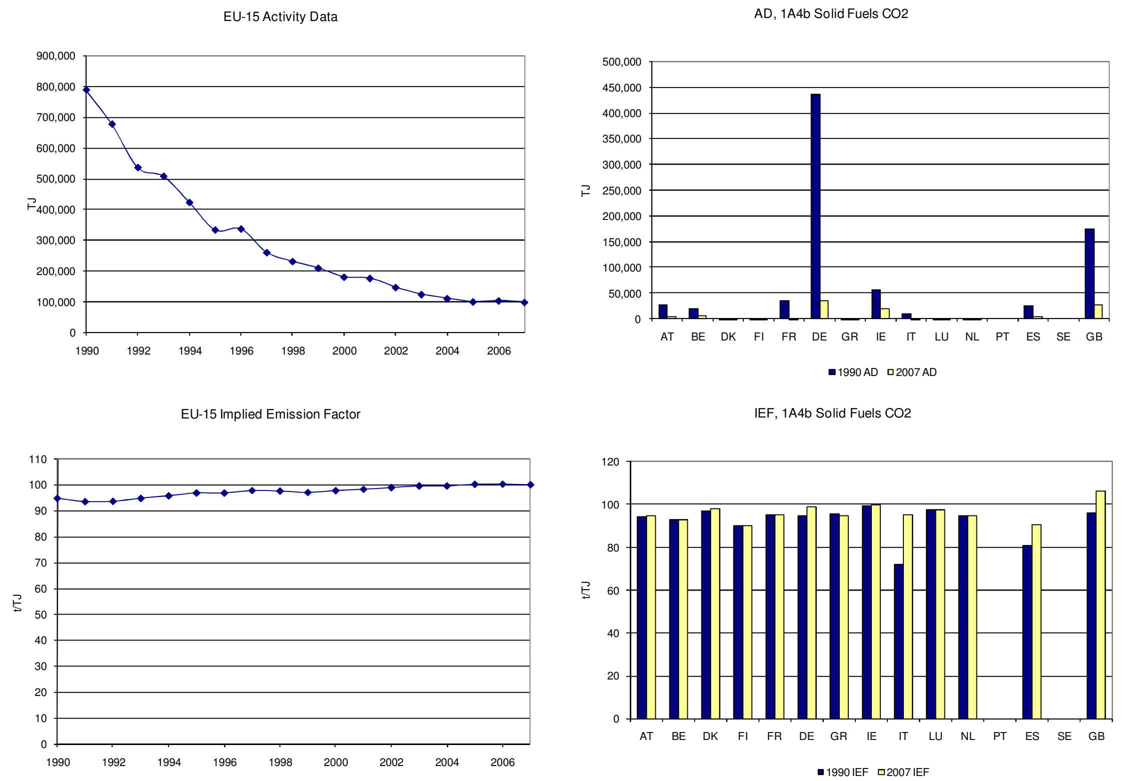
Table 3.72 1A4b Residential, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2,512	472	431	4.4%	-42	-9%	-2,082	-83%	T2	NS	CS
Belgium	1,759	541	532	5.4%	-8	-2%	-1,227	-70%	T1	RS	D
Denmark	72	0	1	0.0%	0	109%	-71	-99%	C	NS	CS/C/D
Finland	33	1	1	0.0%	0	-38%	-33	-98%	T1	NS	D
France	3,350	16	30	0.3%	14	90%	-3,320	-99%	C	NS	CS
Germany	41,415	3,907	3,480	35.4%	-426	-11%	-37,935	-92%	CS	NS	CS
Greece	82	6	7	0.1%	1	24%	-75	-92%	T2	NS	D
Ireland	5,607	2,092	1,998	20.3%	-94	-4%	-3,609	-64%	T1	NS	CS
Italy	702	33	27	0.3%	-6	-18%	-676	-96%	T2	NS	CS
Luxembourg	12	1	0	0.0%	0	-21%	-11	-96%	T1	NS	D
Netherlands	61	19	18	0.2%	-1	-4%	-43	-71%	T2	NS	CS
Portugal	NO	NO	NO	-	-	-	-	-	T2	NS	D,C
Spain	2,091	423	421	4.3%	-2	0%	-1,670	-80%	T2	NS	C
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	16,807	2,823	2,897	29.4%	74	3%	-13,910	-83%	T2	NS,AS	CS
EU-15	**74,504**	**10,332**	**9,842**	**100.0%**	**-490**	**-5%**	**-64,661**	**-87%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.74 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions – Germany, Ireland and the United Kingdom; together cause 85 %of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 87 % between 1990 and 2007. The implied emission factor of EU-15 was 100,0 t/TJ in 2007. The 1990 implied emission factor of Italy is comparatively low because of a high share of gas works gas is included.

Figure 3.74 1A4b Residential, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4b Residential – Gaseous Fuels (CO_2)

In 2007, CO_2 from gaseous fuels had a share of 61 % within source category 1A4b (compared to 39 % in 1990). Between 1990 and 2007 the emissions increased by 37 % (Table 3.73). All Member States reported increasing emissions except for the Netherlands and Sweden. The highest absolute increase occurred in Germany, Italy, France and the UK. Between 2006 and 2007, EU-15 emissions dercreased by 6 %; four Member States reported an increase.

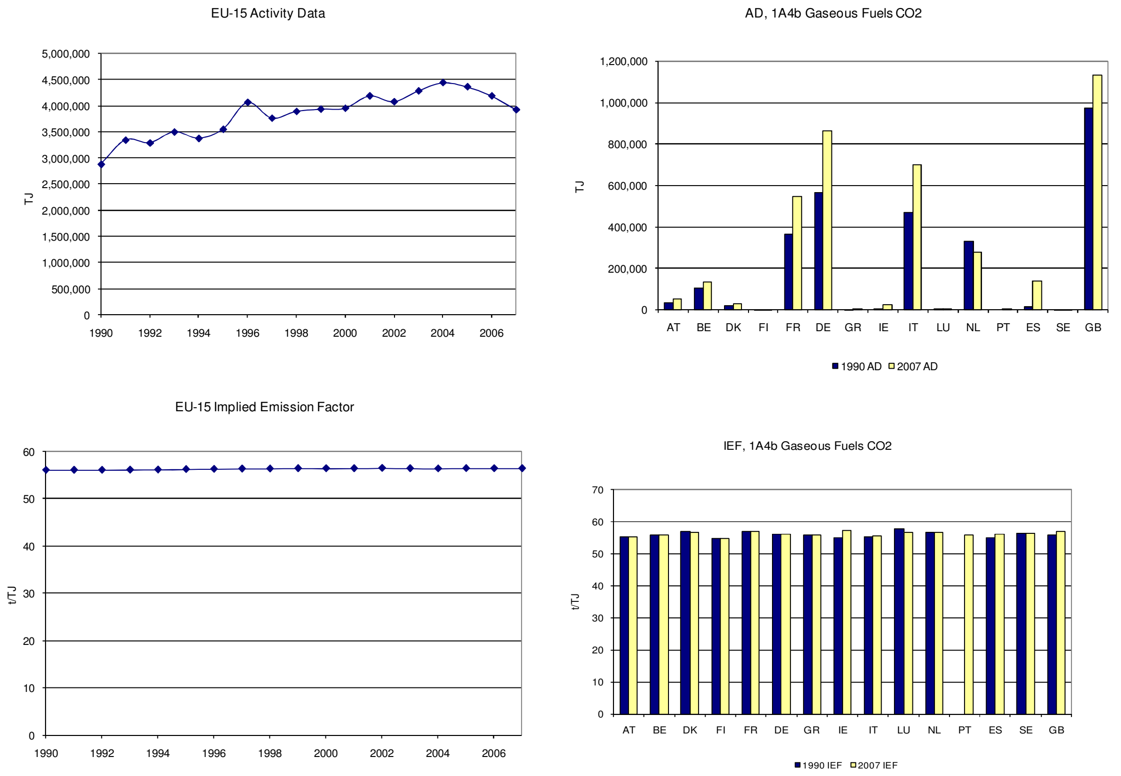
Table 3.73 1A4b Residential, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,791	3,251	2,985	1.3%	-266	-8%	1,194	67%	T2	NS	CS
Belgium	5,824	8,150	7,628	3.4%	-522	-6%	1,804	31%	T1	RS	D
Denmark	988	1,707	1,585	0.7%	-122	-7%	597	60%	C	NS	CS/C/D
Finland	22	78	84	0.0%	7	8%	62	285%	T1	NS	CS
France	20,764	33,703	31,221	14.1%	-2,483	-7%	10,457	50%	C	NS	CS
Germany	31,714	53,750	48,375	21.8%	-5,375	-10%	16,660	53%	CS	NS	CS
Greece	5	321	413	0.2%	92	29%	408	8284%	T2	NS	D
Ireland	270	1,504	1,418	0.6%	-86	-6%	1,148	426%	T1	NS	CS
Italy	26,123	41,908	39,126	17.6%	-2,781	-7%	13,003	50%	T2	NS	CS
Luxembourg	189	328	313	0.1%	-15	-5%	124	65%	T1	NS	D
Netherlands	18,696	17,123	15,747	7.1%	-1,376	-8%	-2,949	-16%	T2	NS	CS
Portugal	NO	429	467	0.2%	38	9%	467	-	T2	NS	D,C
Spain	918	7,092	7,736	3.5%	644	9%	6,818	743%	T2	NS	CS
Sweden	86	78	75	0.0%	-3	-4%	-11	-13%	T1, T2, T3	NS	CS
United Kingdom	54,507	67,493	64,715	29.2%	-2,778	-4%	10,208	19%	T2	NS	CS
EU-15	**161,897**	**236,916**	**221,887**	**100.0%**	**-15,029**	**-6%**	**59,990**	**37%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.75 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and the United Kingdom; together they cause 83 % of the CO_2 emissions from gaseous fuels in 1A4b. Fuel consumption in the EU-15 rose 37 % between 1990 and 2007. The implied emission factor of EU-15 was 56.4 t/TJ in 2007.

Figure 3.75 1A4b Residential, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



CH_4 emissions from 1A4b Residential

CH_4 emissions from 1A4b Residential accounted for 0.1 % of total GHG emissions in 2007. Between 1990 and 2007, CH_4 emissions from households decreased by 40 % in the EU-15 (Table 3.74). In 2007 France was reponsible for 32 % of EU-15 CH_4 emissions even though emissions were reduced by 47 % between 1990 and 2007. All Member States except for Denmark, Italy and Sweden reported a decrease in emissions. Between 2006 and 2007 EU-15 emissions decreased by 2%.

Table 3.74 1A4b Residential: Member States' contributions to CH_4 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	377	263	232	4.1%	-31	-12%	-145	-38%
Belgium	208	141	133	2.4%	-8	-5%	-75	-36%
Denmark	67	160	185	3.3%	25	16%	118	177%
Finland	164	180	177	3.1%	-2	-1%	14	8%
France	3,858	2,021	1,779	31.5%	-242	-12%	-2,079	-54%
Germany	1,200	535	522	9.3%	-12	-2%	-678	-56%
Greece	80	74	72	1.3%	-2	-2%	-8	-10%
Ireland	90	41	39	0.7%	-2	-4%	-51	-57%
Italy	260	443	544	9.7%	101	23%	284	109%
Luxembourg	4	4	4	0.1%	0	-2%	0	-3%
Netherlands	355	317	297	5.3%	-20	-6%	-58	-16%
Portugal	344	311	311	5.5%	0	0%	-34	-10%
Spain	775	613	613	10.9%	0	0%	-162	-21%
Sweden	234	214	267	4.7%	53	25%	33	14%
United Kingdom	1,445	430	463	8.2%	33	8%	-982	-68%
EU-15	**9,462**	**5,745**	**5,639**	**100.0%**	**-106**	**-2%**	**-3,824**	**-40%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4b Residential – Biomass (CH_4)

In 2007 CH_4 from biomass had a share of 1.2 % within source category 1A4b (compared to 1.5 % in 1990). Between 1990 and 2007 the emissions decreased by 26 % (Table 3.75). France reported the highest absolute decrease, while Denmarks's (178 %), Germany's (69 %) and Italys (308 %) CH_4 emissions increased significantly. Between 2006 and 2007, EU-15 emissions decreased by -2 %.

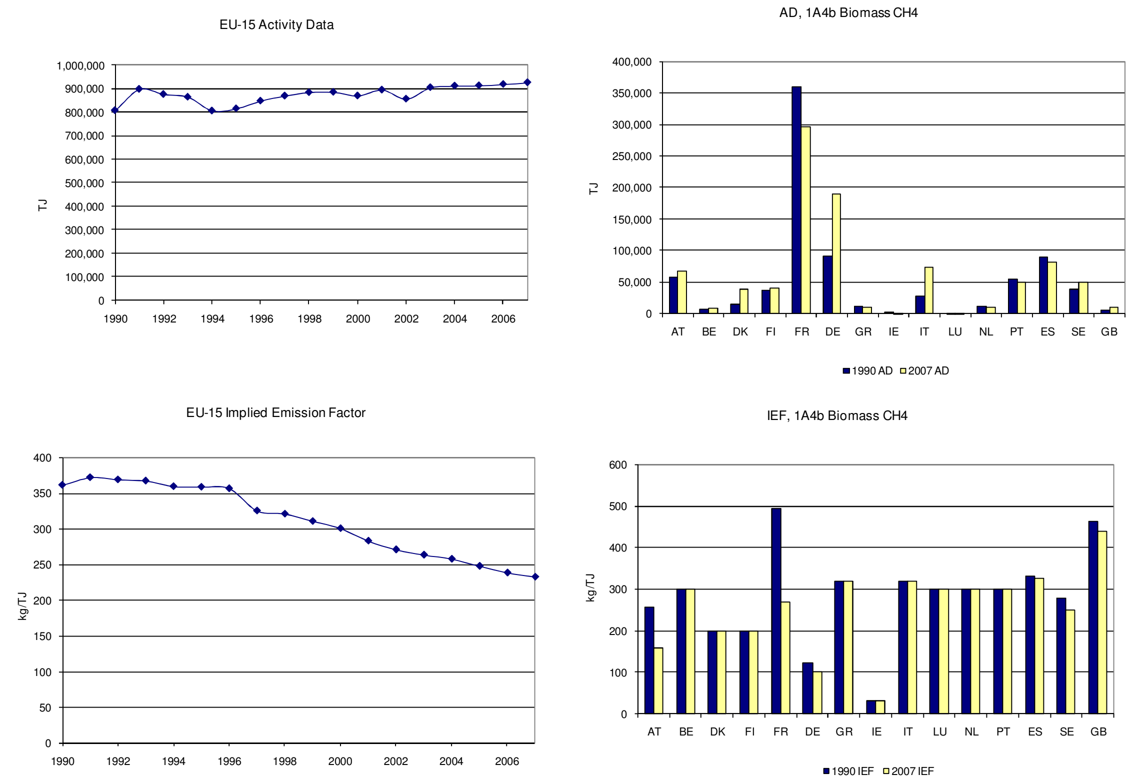
Table 3.75 1A4b Residential, biomass: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	313	250	221	4.9%	-30	-12%	-92	-29%
Belgium	42	55	53	1.2%	-3	-5%	10	25%
Denmark	59	136	164	3.6%	28	21%	105	178%
Finland	152	173	171	3.8%	-2	-1%	19	12%
France	3,746	1,901	1,669	36.9%	-232	-12%	-2,077	-55%
Germany	235	403	397	8.8%	-7	-2%	162	69%
Greece	77	66	65	1.4%	-1	-1%	-11	-15%
Ireland	1	0	1	0.0%	0	34%	-1	-50%
Italy	183	384	492	10.9%	108	28%	308	168%
Luxembourg	2	2	2	0.0%	0	0%	0	0%
Netherlands	73	59	59	1.3%	0	0%	-14	-19%
Portugal	343	310	310	6.8%	0	0%	-34	-10%
Spain	621	562	562	12.4%	0	0%	-59	-9%
Sweden	229	211	264	5.8%	53	25%	35	15%
United Kingdom	46	85	95	2.1%	9	11%	49	106%
EU-15	**6,123**	**4,599**	**4,523**	**100.0%**	**-76**	**-2%**	**-1,600**	**-26%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.76 shows activity data and implied emission factors for CH_4 for EU-15 and the Member States. The largest emissions are reported by France, Germany and Spain; together they cause 60 % of the CH_4 emissions from biomass fuels in 1A4b. Fuel consumptionin the EU-15 rose by 15 % between 1990 and 2007. The implied emission factor of EU-15 was 232,7 kg/TJ in 2007.

Figure 3.76 1A4b Residential, biomass: Activity Data and Implied Emission Factors for CH_4

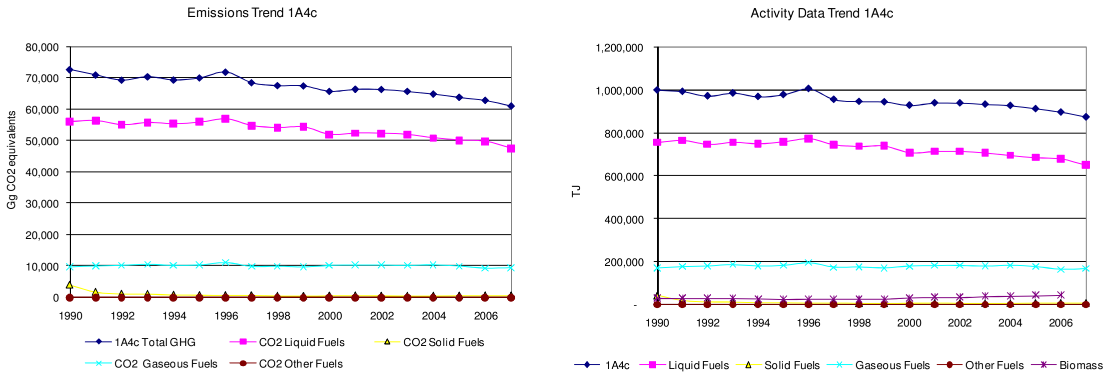


3.2.4.3 Agriculture/Forestry/Fisheries (1A4c) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A4c by fuels. CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries accounted for 1.4 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from 1A4c Agriculture/Forestry/Fisheries decreased by 17 % in the EU-15 (Table 3.76).

Figure 3.77 shows the emission trend within source category 1A4c, which is mainly dominated by CO_2 emissions from liquid fuels. Total GHG emissions decreased by 17 %, mainly due to decreases in CO_2 emissions from liquid fuels (-15 %).

Figure 3.77 1A4c Agriculture/Forestry/Fisheries: Total and CO_2 emission trends



Only four Member States, France, Germany, Italy, the Netherlands and Spain together contributed 71 % to the emissions from this source. Spain was the Member State with the highest increase in absolute terms between 1990 and 2007, while the highest decreases were achieved in Germany, France the Netherlands and the UK. In the Netherlands, this decrease was due to significant energy conservation measures in the greenhouse horticulture which account for approximately 85 % of the primary energy use of the Dutch agricultural sector.

Table 3.76 1A4c Agriculture/Forestry/Fisheries: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	1,252	955	919	1.6%	-36	-4%	-333	-27%
Belgium	2,525	2,156	2,129	3.7%	-27	-1%	-397	-16%
Denmark	2,493	2,091	1,990	3.4%	-101	-5%	-502	-20%
Finland	2,017	1,732	1,775	3.1%	43	2%	-242	-12%
France	10,616	8,990	8,760	15.1%	-230	-3%	-1,856	-17%
Germany	10,917	6,494	5,728	9.9%	-766	-12%	-5,189	-48%
Greece	2,927	2,894	2,568	4.4%	-326	-11%	-359	-12%
Ireland	660	825	775	1.3%	-51	-6%	114	17%
Italy	8,372	8,239	7,849	13.6%	-390	-5%	-523	-6%
Luxembourg	16	48	51	0.1%	3	6%	35	219%
Netherlands	11,221	8,619	8,739	15.1%	119	1%	-2,482	-22%
Portugal	1,660	874	735	1.3%	-139	-16%	-925	-56%
Spain	8,556	9,986	10,082	17.4%	96	1%	1,526	18%
Sweden	1,534	1,702	1,640	2.8%	-62	-4%	105	7%
United Kingdom	5,144	4,279	4,130	7.1%	-149	-3%	-1,014	-20%
EU-15	**69,913**	**59,887**	**57,870**	**100.0%**	**-2,017**	**-3%**	**-12,043**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A4c Agriculture/Forestry/Fisheries – Liquid Fuels (CO_2)

In 2007 CO_2 from liquid fuels had a share of 78 % within source category 1A4c (compared to 77 % in 1990). Between 1990 and 2007 the emissions decreased by 15 % (Table 3.77). Three Member States (Ireland, Spain and Sweden) reported increasing emissions with the highest increases in absolute terms in Spain. Between 2006 and 2007 EU-15 emissions declined by 4 %, the highest relative change reported from Portugal (-16 %).

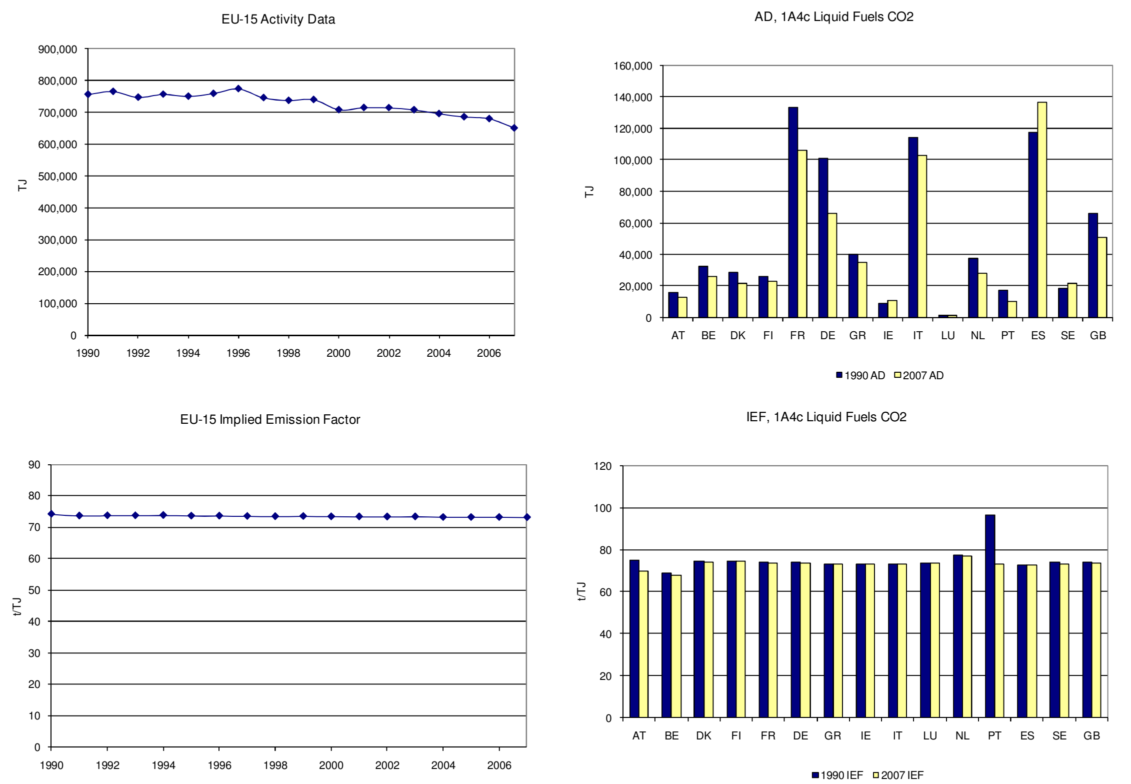
Table 3.77 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,181	914	881	1.9%	-33	-4%	-300	-25%	T2	NS	CS
Belgium	2,251	1,750	1,749	3.7%	-1	0%	-502	-22%	T1	RS	D
Denmark	2,121	1,682	1,620	3.4%	-62	-4%	-501	-24%	C	NS	CS/C
Finland	1,932	1,637	1,683	3.5%	46	3%	-249	-13%	T1, M	NS	CS
France	9,880	8,009	7,779	16.3%	-230	-3%	-2,101	-21%	C	NS	CS
Germany	7,484	5,601	4,879	10.3%	-722	-13%	-2,605	-35%	CS	NS	CS
Greece	2,917	2,866	2,568	5.4%	-298	-10%	-348	-12%	T2	NS	D
Ireland	660	825	775	1.6%	-51	-6%	114	17%	T1	NS	CS
Italy	8,321	7,890	7,483	15.7%	-407	-5%	-838	-10%	T2	NS	CS
Luxembourg	16	48	51	0.1%	3	6%	35	219%	T1	TÜV	D
Netherlands	2,893	2,321	2,153	4.5%	-167	-7%	-740	-26%	T2	NS/Q	CS,D
Portugal	1,660	865	724	1.5%	-141	-16%	-936	-56%	T2	NS	D,C
Spain	8,513	9,818	9,907	20.8%	89	1%	1,394	16%	T2, T3	NS, Q	C
Sweden	1,344	1,645	1,585	3.3%	-60	-4%	241	18%	T1, T2, T3	NS	CS
United Kingdom	4,914	3,895	3,752	7.9%	-144	-4%	-1,163	-24%	T2	NS,AS	CS
EU-15	**56,086**	**49,765**	**47,587**	**100.0%**	**-2,178**	**-4%**	**-8,499**	**-15%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.78 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by France, Germany, Italy and Spain; together they cause 63 % of the CO_2 emissions from liquid fuels in 1A4c. Fuel consumption in the EU-15 decreased by 14 % between 1990 and 2007. The implied emission factor of EU-15 was 73.1 t/TJ in 2007.

Figure 3.78 1A4c Agriculture/Forestry/Fisheries, liquid fuels: Activity Data and Implied Emission Factors for CO_2



1A4c Agriculture/Forestry/Fisheries – Solid Fuels (CO_2)

In 2007 CO_2 from solid fuels had a share of 1 % within source category 1A4c (compared to 6 % in 1990). Between 1990 and 2007 the emissions decreased by 82 % (Table 3.78). Greece, Ireland, Italy, the Netherlands, Luxembourg, Portugal and Spain reported CO_2 emissions from this source category as ‘Not ocurring’ in 2007. All other Member States reported decreasing emissions. Between 2006 and 2007 EU-15 emissions increasedby 1 %. The long term emissions trend is dominated by the emissions trend of Germany.

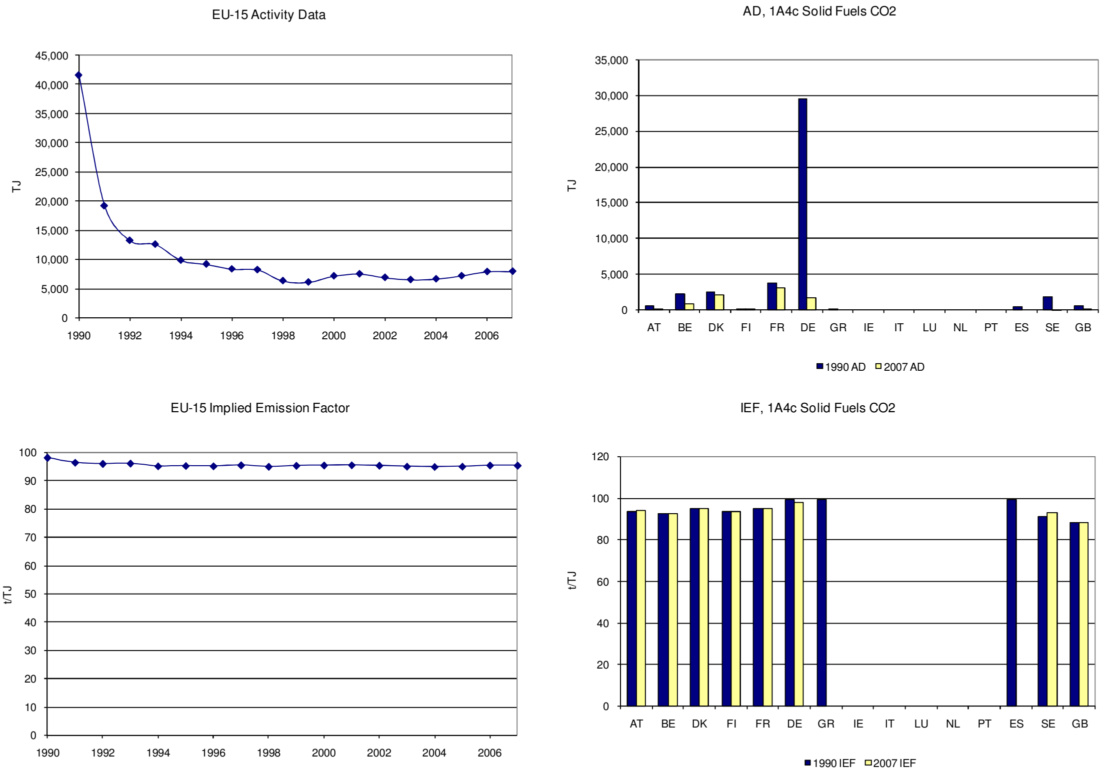
Table 3.78 1A4c Agriculture/Forestry/Fisheries, solid fuels: Member States’ contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	51	8	8	1.1%	0	3%	-43	-84%	T2	NS	CS
Belgium	208	76	76	10.1%	0	0%	-132	-64%	T1	RS	D
Denmark	239	190	195	26.0%	5	2%	-44	-18%	C	NS	CS/C
Finland	13	10	11	1.4%	1	6%	-2	-18%	T3	NS	CS
France	353	287	287	38.2%	0	0%	-66	-19%	C	NS	CS
Germany	2,948	135	164	21.9%	29	22%	-2,784	-94%	CS	NS	CS
Greece	11	28	NO	-	-28	-100%	-11	-100%	T2	NS	D
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	NO	NO	NO	-	-	-	-	-	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Portugal	NO	NO	NO	-	-	-	-	-	T2	NS	D,C
Spain	37	NA	NA	-	-	-	-37	-100%	T2	NS	C
Sweden	157	1	1	-	-	-	-156	-100%	T1, T2, T3	NS	CS
United Kingdom	48	12	9	1.2%	-2	-20%	-39	-81%	T2	NS,AS	CS
EU-15	**4,066**	**747**	**751**	**100.0%**	**4**	**1%**	**-3,315**	**-82%**			

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Figure 3.79 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Denmark, France and Germany; together they cause 86 % of the CO_2 emissions from solid fuels in 1A4b. Fuel consumption in the EU-15 decreased by 81 % between 1990 and 2007. The implied emission factor of EU-15 was 95.3 t/TJ in 2007.

Figure 3.79 1A4c Agriculture/Forestry/Fisheries, solid fuels: Activity Data and Implied Emission Factors for CO_2



1A4c Agriculture/Forestry/Fisheries –Gaseous Fuels (CO_2)

In 2007, CO_2 from gaseous fuels had a share of 16 % within source category 1A4c (compared to 13 % in 1990). Between 1990 and 2007 the emissions decreased by 3 % (Table 3.79). All Member States reported increasing emissions except for Finland, Luxembourg and the Netherlands (-1.743Gg). The highest relative increase ocurred in Spain (+2265 %). Between 2006 and 2007 EU-15 emissions increased by 2 %.

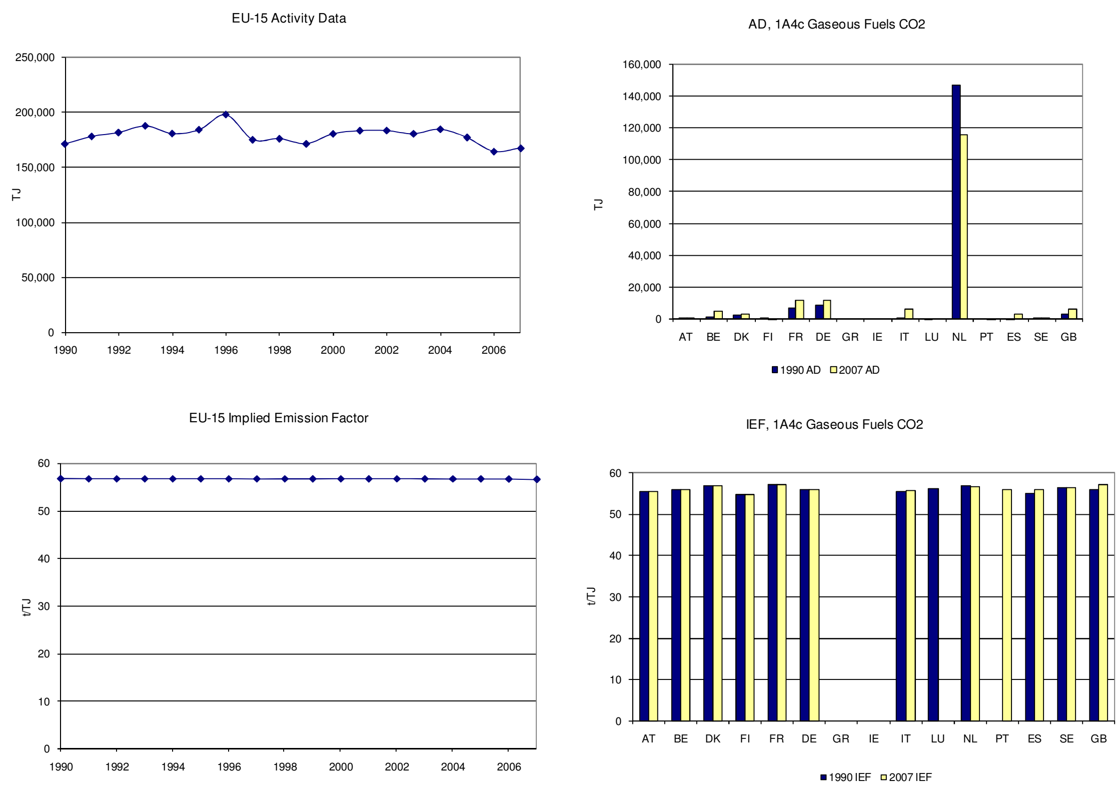
Table 3.79 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	20	33	30	0.3%	-3	-8%	10	49%	T2	NS	CS
Belgium	67	331	305	3.2%	-26	-8%	237	354%	T1	RS	D
Denmark	132	219	176	1.9%	-44	-20%	43	33%	C	NS	CS/C
Finland	32	30	26	0.3%	-4	-13%	-6	-19%	T1	NS	CS
France	383	694	694	7.3%	0	0%	311	81%	C	NS	CS
Germany	485	758	684	7.2%	-74	-10%	199	41%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	52	350	367	3.9%	17	5%	315	611%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	T1	EJ	D
Netherlands	8,328	6,299	6,585	69.5%	287	5%	-1,743	-21%	T2	NS/Q	CS
Portugal	NO	9	11	0.1%	2	23%	11	-	T2	NS	D,C
Spain	6	168	175	1.8%	7	4%	169	2744%	T2	NS	CS
Sweden	33	56	54	0.6%	-2	-4%	21	63%	T1, T2, T3	NS	CS
United Kingdom	182	372	369	3.9%	-3	-1%	188	103%	T2	NS	CS
EU-15	**9,720**	**9,319**	**9,476**	**100.0%**	**157**	**2%**	**-244**	**-3%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.80 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by the Netherlands, accounting for 70 % of the CO_2 emissions from gaseous fuels in 1A4c. Fuel consumption in the EU-15 decreased by 2 % between 1990 and 2007. The implied emission factor of EU-15 was 56.6 t/TJ in 2007.

Figure 3.80 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: Activity Data and Implied Emission Factors for CO_2



3.2.5 Other (CRF Source Category 1A5) (EU-15)

Source category 1A5 Other includes emissions from stationary and mobile military fuel use including air craft. Under category '1A5a solid fuels' Sweden reports transformation losses of energy in 'iron ore based iron and steel industry' as activity data without any emissions (for reason of consistency with the Reference Approach).

In 2007 category 1A5 contributed to 8092 Gg CO_2 equivalents of which 94.8% CO_2, 0.1% CH_4 and 5.0% N_2O.

Table 3.80 provides an overview of Member States' source allocation to Source Category 1A5 Other.

Table 3.801A5 Other: Member States' allocation of sources

Member State	Source allocation to 1A5 Other	Source
Austria	Mobile: Military use	CRF Table 1.s.2
Belgium	Mobile: Military use	CRF Table 1.s.2
Denmark	Mobile: Military use	CRF Table 1.s.2
Finland	Stationary: Other non-specified, Non-specified emissions of Fuels from non-energy use, Indirect N_2O emissions from NOx Mobile: other non-specified	CRF Table 1.s.2
France	Emissions are 'Not occuring'	CRF Table 1.s.2
Germany	Military: stationary and mobile	CRF Table 1.s.2
Greece	Emissions are 'Not occuring'	CRF Table 1.s.2
Ireland	Emissions are 'Not occuring'	CRF Table 1.s.2
Italy	Mobile: other non-specified	CRF Table 1.s.2
Luxembourg	Emissions are 'Included elsewhere' or 'Not occuring'	CRF Table 1.s.2
Netherlands	Mobile: military use	CRF Table 1.s.2
Portugal	Stationary: emissions are reported for 1990-1994 and 'Not occuring' from 1995 on. Mobile: other non-specified	CRF Table 1.s.2
Spain	Emissions are 'Not occuring'	CRF Table 1.s.2
Sweden	Stationary: other non-specified Mobile: Military use and Other non-specified	CRF Table 1.s.2
United Kingdom	Mobile: military use	CRF Table 1.s.2

Figure 3.81 shows the total trend within source category 1A5 and the dominating emission sources: CO_2 emissions from 1A5b Mobile and from 1A5a Stationary. Total GHG emissions of source category 1A5 decreased by 63 % between 1990 and 2007.

Figure 3.81 1A5 Other: Total and CO_2 emission and activity trends

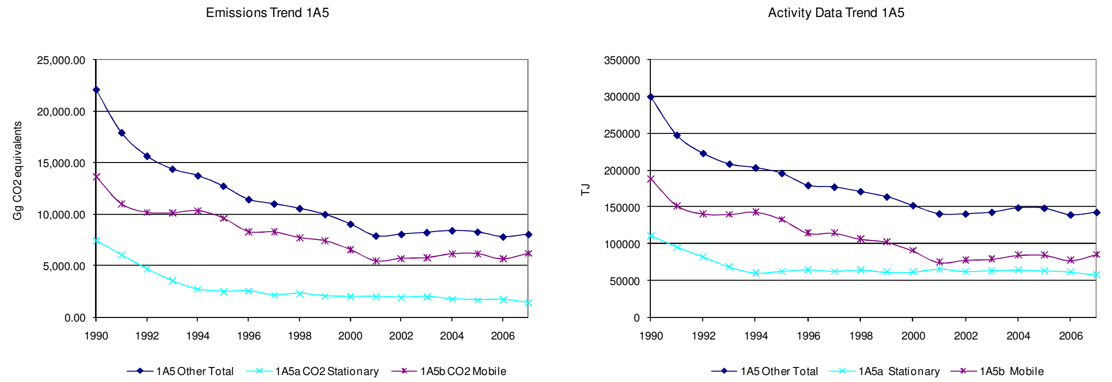


Table 3.81 shows total GHG and CO_2 emissions by Member State from 1A5. CO_2 emissions from 1A5 Other accounted for 0.2 % of total GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from this source decreased by 64 % in the EU-15. Between 1990 and 2007, the largest reduction in absolute terms was reported by Germany, which was partly due to reduced military operations after German reunification.

Table 3.81 1A5 Other: Member States' contributions to CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)
Austria	36	46	35	45
Belgium	193	102	191	102
Denmark	120	177	119	175
Finland	1,639	1,305	1,187	1,024
France	NO	NO	NO	NO
Germany	12,099	1,298	11,798	1,285
Greece	NO	NO	NO	NO
Ireland	NO	NO	NO	NO
Italy	1,120	969	1,046	896
Luxembourg	57	14	51	13
Netherlands	577	323	566	317
Portugal	104	73	103	73
Spain	0	0	NA,NO	NA,NO
Sweden	872	262	845	256
United Kingdom	5,337	3,524	5,285	3,489
EU-15	**22,153**	**8,092**	**21,227**	**7,674**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.82 provides information on the contribution of Member States to EU-15 recalculations in CO_2 from 1A5 Other for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

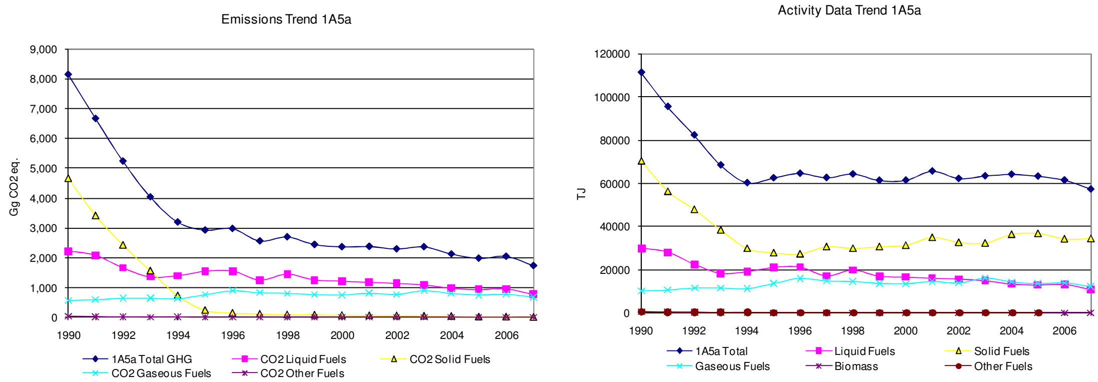
Table 3.82 1A5 Other: Contribution of MS to EU-15 recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006	
	Gg	Percent	Gg	Percent
Austria	0	0.0	-81	-64.9
Belgium	25	15.1	34	35.9
Denmark	0	0.0	0	0.0
Finland	-3	-0.3	-122	-9.7
France	NE	0.0	NE	0.0
Germany	0	0.0	5	0.3
Greece	0	0.0	0	0.0
Ireland	0	0.0	0	0.0
Italy	5	0.5	0	0.0
Luxembourg	-	0.5	-	0.0
Netherlands	0	0.0	0	0.0
Portugal	0	0.0	NE	0.0
Spain	0	0.0	NE	0.0
Sweden	0	0.0	5	2.2
UK	0	0.0	0	0.0
EU-15	**78**	**0.4**	**-149**	**-2.0**

3.2.5.1 Stationary (1A5a) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5a Stationary accounted for 0.04 % of total EU-15 GHG emissions in 2007. Figure 3.82 shows the emission trend within the categories 1A5a, which is mainly dominated by CO_2 emissions from liquid fuels. The reduction in the early 1990s was driven by CO_2 from solid fuels. Total emissions decreased by 79 %, mainly due to decreases in emissions from solid fuels (-99.8 %) and liquid fuels (-65 %).

Figure 3.82 1A5a Stationary: Total and CO_2 emission and activity trends



Only four Member States (Finland, Germany, Luxembourg and Sweden) reported emissions from this key source in 2007 (Table 8.83). Between 1990 and 2007 Finland had a decrease of 26 % and Germany a decrease of 90 %. Portugal reports emissions from 1990 to 1994 only. This led to an EU-15 decrease of 80 %. Between 2006 and 2007 Finland had a decrease of 13 % and Germany of 22 % leading to an overall decrease of 17 %.

Table 3.83 1A5a Stationary: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA	NA	NA	-	-	-	-	-
Belgium	NA	NA	NA	-	-	-	-	-
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	1,129	959	837	57.4%	-122	-13%	-293	-26%
France	NO	NO	NO	-	-	-	-	-
Germany	6,329	781	606	41.6%	-175	-22%	-5,724	-90%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NA	NA	NA	-	-	-	-	-
Luxembourg	3	NO	6	0.4%	6	-	3	115%
Netherlands	NA	NA	NA	-	-	-	-	-
Portugal	8	NO	NO	-	-	-	-8	-100%
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	NA,NO	5	8	0.6%	3	52%	8	-
United Kingdom	NA	NA	NA	-	-	-	-	-
EU-15	**7,470**	**1,746**	**1,457**	**100.0%**	**-288**	**-17%**	**-6,013**	**-80%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5a Stationary – Solid Fuels (CO_2)

In 2007 CO_2 from solid fuels had a share of 0 % within source category 1A5a (compared to 57 % in 1990). Between 1990 and 2007 the emissions decreased by nearly 100 % (Table 3.84). In 2007 only Germany reported emissions for this key source.

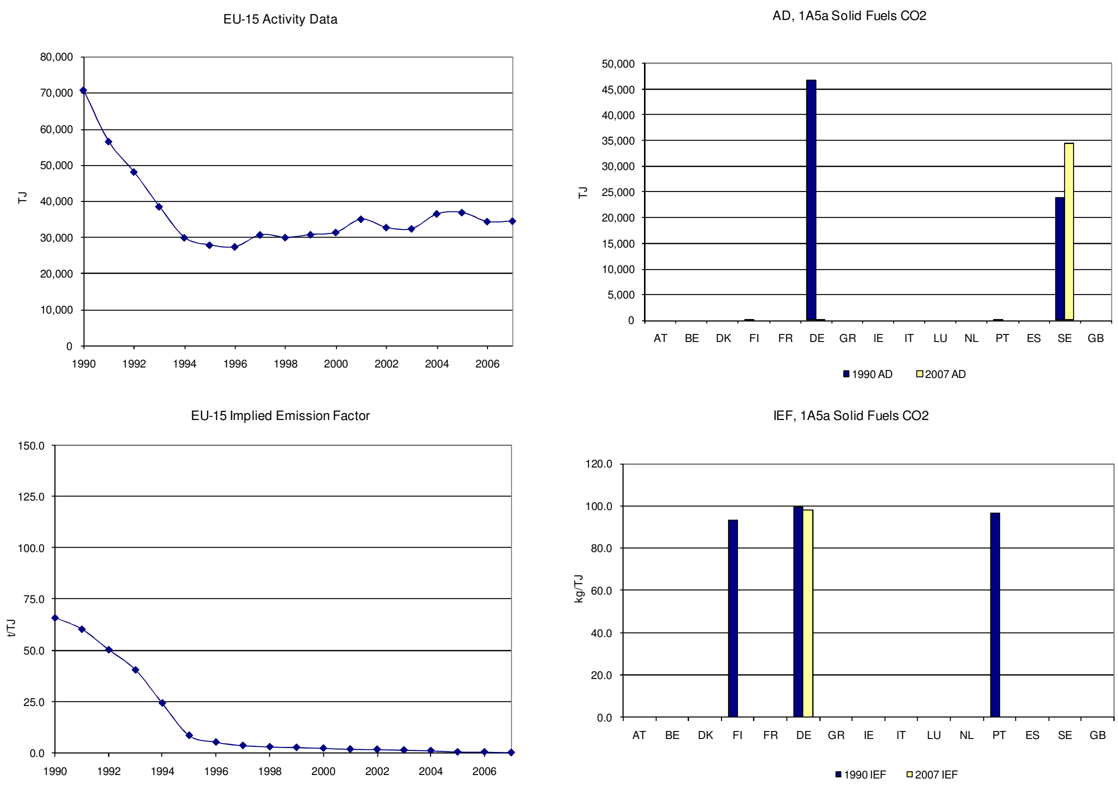
Table 3.84 **1A5a Stationary, solid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor**

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Belgium	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	1	NO	NO	-	-	-	-1	-100%	NO	NO	NO
France	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Germany	4,657	18	7	100.0%	-11	-60%	-4,650	-100%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NO	NA
Portugal	8	NO	NO	-	-	-	-8	-100%	T1	NS	D,C
Spain	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Sweden	NA	NA	NA	-	-	-	-	-	NA	NA	NA
United Kingdom	NA	NA	NA	-	-	-	-	-	NO	NO	NO
EU-15	**4,667**	**18**	**7**	**100.0%**	**-11**	**-60%**	**-4,659**	**-100%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.83 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. Germany accounting for 100 % of EU-15 CO_2 emissions from this source category in 2007. Fuel combustion in the EU-15 decreased by 51 % between 1990 and 2007. The implied emission factor is 0.21 t/TJ in 2007. Sweden reports transformation losses of energy in iron ore based iron and steel industry as activity data without any emissions (for reason of consistency with the Reference Approach).

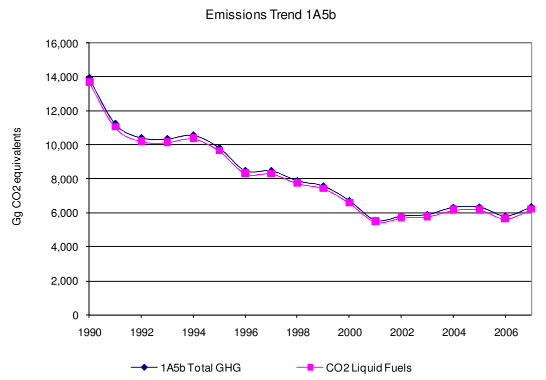
Figure 3.83 **1A5a Stationary, solid fuels: Activity Data and Implied Emission Factors for CO_2**

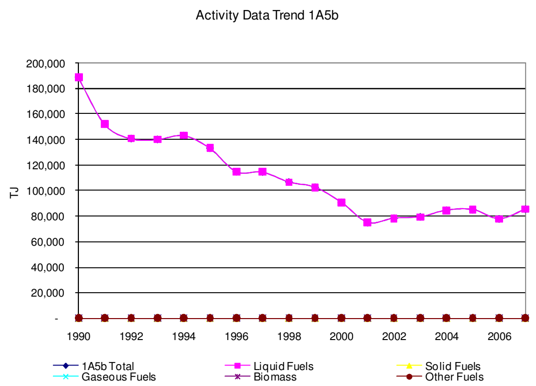


3.2.5.2 Mobile (1A5b) (EU-15)

In this chapter information about emission trends, Member States' contribution, activity data, and emission factors is provided for category 1A5a by fuels. CO_2 emissions from 1A5b Mobile accounted for 0.2 % of total EU-15 GHG emissions in 2007. Figure 3.84 shows the emission trend within the category 1A5b, which is dominated by CO_2 emissions from liquid fuels. Total CO_2 emissions decreased by 54 %.

Figure 3.84 1A5b-Mobile: Total and CO_2 emission trends





Five Member States reported emissions as 'Not occuring' and/or "Included elsewhere". The UK had the highest emissions in 2007 and – together with Germany - decreased the most between 1990 and 2007. Finland reported an increase of more than 100 %. Between 2006 and 2007 the UK had the highest absolute increase. The EU-15 emissions increased by 10% between 2006 and 2007 (Table 3.85).

Table 3.85 1A5b Mobile: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	35	44	45	0.7%	1	1%	10	27%
Belgium	191	129	102	1.6%	-28	-21%	-90	-47%
Denmark	119	126	175	2.8%	48	38%	56	47%
Finland	58	170	187	3.0%	17	10%	129	223%
France	NO	NO	NO	-	-	-	-	-
Germany	5,468	770	679	10.9%	-91	-12%	-4,789	-88%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	1,046	982	896	14.4%	-85	-9%	-150	-14%
Luxembourg	48	10	6	-	-	-	-	-
Netherlands	566	381	317	5.1%	-64	-17%	-248	-44%
Portugal	95	75	73	1.2%	-3	-4%	-23	-24%
Spain	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Sweden	845	241	248	4.0%	7	3%	-597	-71%
United Kingdom	5,285	2,747	3,489	56.1%	742	27%	-1,796	-34%
EU-15	**13,757**	**5,676**	**6,217**	**100.0%**	**541**	**10%**	**-7,540**	**-55%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

1A5b Mobile – Liquid Fuels (CO_2)

In 2007, CO_2 from liquid fuels had a share of 98 % within source category 1A5b (compared to 98 % in 1990). Between 1990 and 2007 the emissions decreased by 55 % (Table 3.86). France, Greece, Ireland, Luxembourg and Spain report emissions as 'Not occuring', or 'Included Elsewhere'. The highest decrease was achieved in Germany (-88 %), while Finland had increases by more than 200 %.

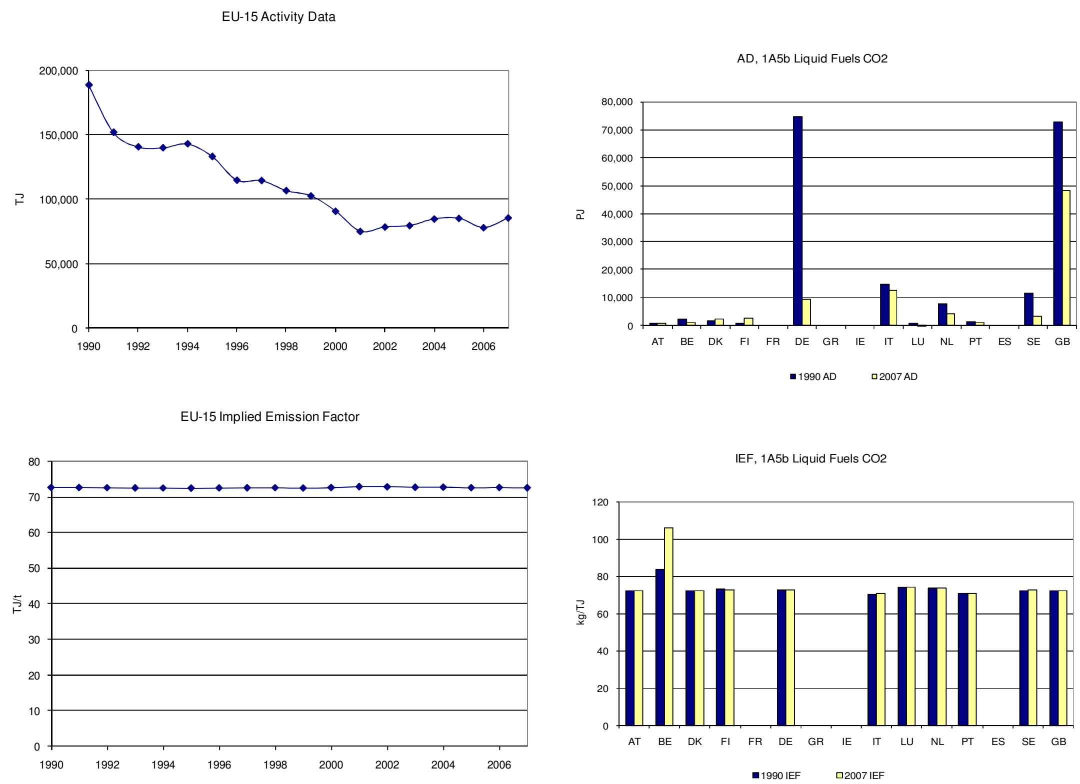
Table 3.86 1A5b Mobile, liquid fuels: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	35	44	45	0.7%	1	1%	10	27%	M	AS	CS
Belgium	191	129	102	1.6%	-28	-21%	-90	-47%	C	RS	C
Denmark	119	126	175	2.8%	48	38%	56	47%	C	NS	CS/C
Finland	58	170	187	3.0%	17	10%	129	223%	T1	NS	CS
France	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Germany	5,468	770	679	10.9%	-91	-12%	-4,789	-88%	CS	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	1,046	982	896	14.4%	-85	-9%	-150	-14%	T2	NS	CS
Luxembourg	48	10	6	-	-	-	-	-	NA	IE	NA
Netherlands	566	381	317	5.1%	-64	-17%	-248	-44%	T2	NS/Q	D
Portugal	95	75	73	1.2%	-3	-4%	-23	-24%	T1	NS	D,C
Spain	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Sweden	845	241	248	4.0%	7	3%	-597	-71%	T1	NS	CS
United Kingdom	5,285	2,747	3,489	56.1%	742	27%	-1,796	-34%	T2,T3	NS,AS	CS
EU-15	**13,757**	**5,676**	**6,217**	**100.0%**	**541**	**10%**	**-7,540**	**-55%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.85 shows activity data and implied emission factors for CO_2 for EU-15 and the Member States. The largest emissions are reported by Italy and the United Kingdom; together they cause 67 % of the CO_2 emissions from liquid fuels in 1A5b. Fuel consumption in the EU-15 decreased by 55 % between 1990 and 2007. The implied emission factor of EU-15 was 72.6 t/TJ in 2007. The highimplied emission factor for Belgium has to be investigated further more.

Figure 3.85 1A5b Mobile, liquid fuels Activity Data and Implied Emission Factors for CO_2

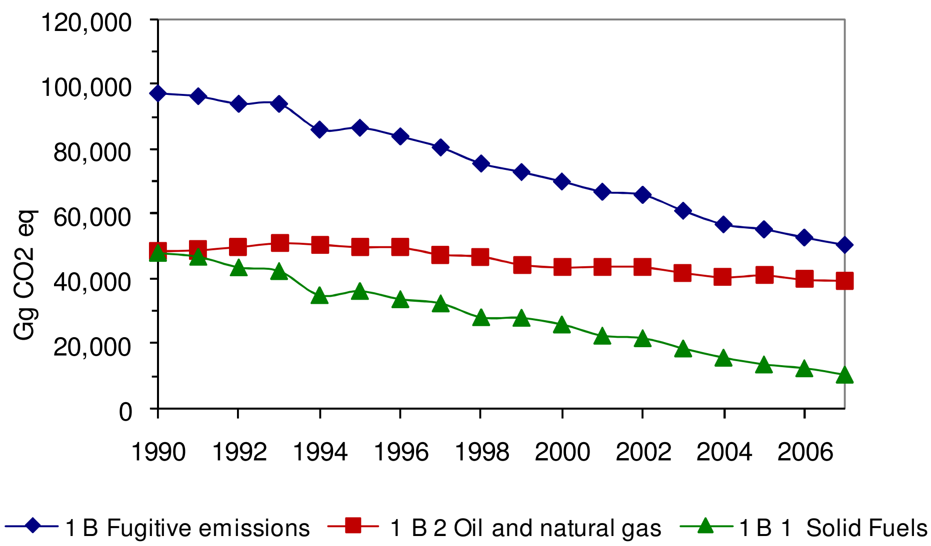


3.2.6 Fugitive emissions from fuels (CRF Source Category 1.B) (EU-15)

This chapter describes gaseous or volatile emissions which occur during extraction, handling and consumption of fossil fuels. In the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions are defined as intentional or unintentional releases of gases from anthropogenic activities that in particular may arise from the production, processing, transmission, storage and use of fuels. Emissions from combustion is only included where it does not support a productive activity (e.g., flaring of natural gases at oil and gas production facilities). Evaporative emissions from vehicles are included under Road Transport as Subsection 1A3bv (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

In 2007, in terms of CO_2 equivalents, almost two thirds of emissions from source category 1B were fugitive CH_4 emissions while more than a third were fugitive CO_2 emissions. Together, they represented 1.2% of total GHG emissions in the EU-15. Fugitive greenhouse gas emissions have been steadily declining (Figure 3.86) since 1990. Between 1990 and 2007, the total fugitive GHG emissions decreased by 48 %. This was mainly due to the decrease in underground mining activities: the source category 1B1a.i Underground mines is responsible for three fourths of the total decrease in absolute terms. Between 1990 and 2007, emissions from 1B1 Solid Fuels decreased by 78 %, while emissions from 1B2 Oil and Natural Gas decreased only by 18 %. As a result, while emissions from the two sources (1B1 Solid Fuels and 1B2 Oil and Natural Gas) represented each 50% of total fugitive emissions in 1990, fugitive emissions from 1B1 Solid Fuels represented only 21% of total fugitive emissions in 2007.

Figure 3.86 1B Fugitive Emission from Fuel: GHG Emissions trend

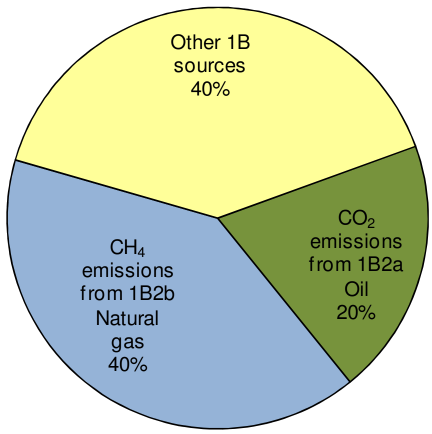


Fugitive emissions include four key sources:

- 1B1a Coal Mining (CH_4),
- 1B2a Oil (CO_2),
- 1B2b Natural Gas (CH_4),
- 1B2c Venting and Flaring (CO_2).

The two largest key sources, i.e. CH_4 emissions from 1B2b Natural Gas and CO_2 emissions from 1B2a Oil account together for 60 % of total fugitive GHG emissions (Figure 3.87).

Figure 3.87 **1B-Fugitive Emissions of Fuels: Proportion of fugitive emissions within source category**



3.2.6.1 Fugitive emissions from Solid Fuels (1B1) (EU-15)

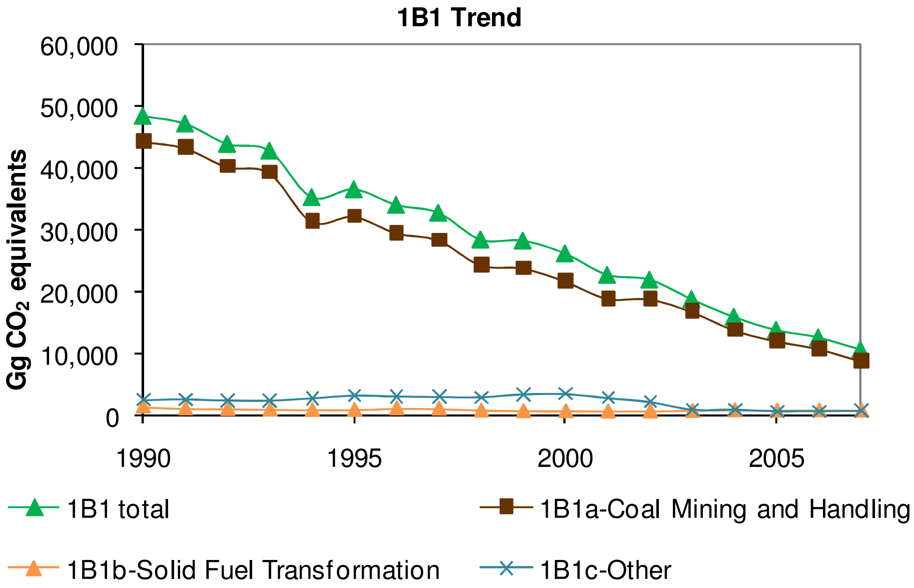
In the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories fugitive emissions from solid fuels are defined as the total release of methane during coal mining and post-mining activities. Combustion emissions from colliery methane recovered and used are excluded here and reported under Fuel Combustion Emissions.

Fugitive emissions from solid fuels accounted for 0.3 % of the total GHG emissions in the EU-15 and 21 % of total fugitive emissions in the EU-15:

- 85 % of these emissions were CH_4 emissions from coal mining. The emissions arise by the natural production of methane when coal is formed. Methane is partly stored within the coal seam and escapes when mined. Most CH_4 emissions resulted from underground mines; surface mines were a smaller source.
- 13% of these emissions were CO_2 emissions due to both solid fuel transformation (6 %) and other activities (7 %).

Since 1990 CH_4 fugitive emissions from 1B1 Solid fuels have been steadily decreasing, caused by the reduction of coal mining (Figure 3.88)

Figure 3.88 **1B1 Fugitive Emissions from Solid Fuels: Trend**



In 2007, nine EU-15 Member States reported positive fugitive emissions from solid fuels: nine reported positive fugitive CH_4 emissions and five reported positive fugitive CO_2 emissions (Table 3.87). Three countries represented 79 % of total fugitive emissions from solid fuels: Germany (39 %), United Kingdom (26 %) and Greece (14%).

Table 3.871B1 Fugitive Emissions from Solid Fuels: Member States Contribution

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)
Austria	11	IE,NA,NO	11	IE,NA,NO	IE,NA,NO	IE,NA,NO
Belgium	330	10	330	10	NA,NE	NA,NO
Denmark	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Finland	NO	NO	NO	NO	NO	NO
France	4,331	37	4,331	37	NA,NO	NA,NO
Germany	20,240	4,065	20,240	4,065	NE,NO	NE,NO
Greece	1,095	1,510	1,095	1,403	NO	107
Ireland	NE, NO	NO	NE,NO	NO	NE,NO	NO
Italy	122	84	122	84	NA	NA
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	433	467	30	23	403	444
Portugal	75	IE, NO	66	IE,NO	9	IE,NO
Spain	1,835	978	1,818	884	18	94
Sweden	791	617	0.1	0.1	789	615
United Kingdom	19,148	2,789	18,290	2,650	856	138
EU-15	**48,411**	**10,555**	**46,333**	**9,156**	**2,074**	**1,397**

Emissions of Ireland for 1990 were not estimated because they were negligeable.
Greece included CO_2 emissions from SO_2 scrubbing
Austria included CO_2 and CH_4 emissions from 1B1b Solid Fuel Transformation under 1A2a Iron and Steel
Abbreviations explained in the Chapter ‘Units and abbreviations’

Between 1990 and 2007 fugitive CH_4 emissions from solid fuels decreased by almost 80 % (Table 3.87). Large reductions (in absolute terms) were observed in Germany and in the United Kingdom, while emissions actually increased by almost a third in Greece. Table 3.88 provides information on the methodologies used by EU-15 Member States.

Table 3.88 1B1 Fugitive Emissions from Solid Fuels: Methodological Issues according to NIRs (submitted in 2009) of EU-15 Member States

Member State	**Methodology**
Austria	**General:** Emissions from solid fuel transformation (production of coke oven coke) were included in the energy sector (subcategory Iron and Steel), because the only solid fuel transformation occurring in Austria was one coking plant as part of an integrated iron and steel site. **Activity data**: taken form the national energy balance. **Emission factor:** CORINAIR default emission factor 214g CH_4/Mg coal
Belgium	**General:** During the in-country review in June 2007, the expert review team of UNFCCC detected some missing underground mining activities in the Belgian greenhouse gas emission inventory. In the beginning of the nineties untill 1992 there still was some mining activity in the Flemish region. Untill 1999 energetic mining activities remained existient. These activities consisted of an auto-producer of electricity that was active untill 1996 (the waste of the coal was used to produce electricity) and of energy needed for the sorting machines which were active untill 1999. The latter energetic activities are allocated to the category 1A1c. **Activity data:** federal statistics, delivered by corresponding industry, Association of minig and steel **Emission factor:** IPCC 2006 guidelines, EMEP/CORINAIR Handbook (400 g CH_4/ton cokes)
Denmark	**General:** Coal mining did not occur
Finland	**General**: Emissions from the peat production were reported in LULUCF sector (category Wetlands, CRF 5.D 2) as suggested in GPG LULUCF (IPCC 2003) (see chapter 7.5). There were no coal mines in Finland.
France	**General:** closure of surface mines 2002, closure of underground mines 2004 **Activity data:** bottom up approach according to site specific data, Tier 2/3 depending on site **Emission factor:** specific EF for sites, Tier 2/3 depending on site, EMEP/CORINAIR 350 g CH_4/Mg coke
Germany	**General:** hard coal mining Tier 3, brown coal Tier 2 **Activity data:** Statistik der Kohlenwirtschaft, national statistics **Emission factor:** country specific EF for all sub source categories, German lignite-industry association
Greece	**General:** only brown coal surface mines **Activity data:** national statistics **Emission factor:** IPCC Good Practice Guidance (Default)
Ireland	**General:** coal mining does not
Italy	**General**: CH_4 emissions from coal mining refered to only two mines with very low production in the last ten years, one of which was underground and produced coal and the other, on the surface, produced lignite. The surface mine stopped the activity in 2001. CH_4 emissions from solid fuel transformation refered to the coke production in the iron and steel industry, which is also decreasing in the last years. **Activity Data:** National Energy Balance, National Statistical Yearbook **Emission Factor**: IPCC Guidelines (1997), Corinair Guidebook
Luxembourg	**General:** no extraction or consumption of solid fuels
Netherlands	**General:** The Netherlands had only one on-site coke production facility at the iron and steel plant of Corus. A

Member State	Methodology
	second independent coke producer in Sluiskil discontinued its activities in 1999. Fugitive emissions from both coke production sites were included. There were no fugitive emissions from coal mining and handling activities (1B1a) in the Netherlands during the years 1990-2007; these activities ceased with the closing of the last coal mine in the early 1970s. With respect to fugitive emissions from 'Charcoal Production', the Netherlands had one large state of the art production location. These emissions were presently not accounted for in the inventory 2009. **Activity data:** national energy statistics **Emission factor:** country specific, carbon balance
Portugal	**General:** coal mining activity stopped in 1994 **Activity data:** General-Directorate for Energy and Geology (DGEG). **Emission factor**: Default
Spain	**Activity Data**: Energy balances (International Energy Agency), international coal questionnaires sent to the International Energy Agency, CARBUNION, Red Eléctrica Española, national Statistics **Emission Factor**: country specific, EMEP/CORINAIR
Sweden	**General:** no coal mines. SO_2 emissions from quenching and extinction at coke ovens are reported in CFR 1B1b. Flaring of coke oven gas, blast furnace gas and steel converter gas are reported in CRF 1B1c since Submission 2004 .
United Kingdom	**General:** Methane emissions from closed coal mines are accounted for within Sector 1B1a of the UK inventory. Carbon emissions from coke ovens are based on a carbon balance approach with calculations arranged so that the total carbon emission, plus carbon in products and wastes, corresponds to the carbon content of the input fuels. Emissions of carbon from Solid Smokeless Fuel (SSF) production are also based on a carbon balance approach. **Activity data:** saleable coal production statistics (national study) **Emission factor:** UK Coal Mining Ltd data, national studies, default emission factors (solid fuel transformation)

CH_4 from Coal Mining (1B1a)

Fugitive emissions from coal mining correspond to the total emissions from:

- underground mining (emissions from underground mines, brought to the surface by ventilation systems),
- surface mining (emissions primarily from the exposed coal surfaces and coal rubble, but also emissions associated with the release of pressure on the coal),
- post-mining (emissions from coal after extraction from the ground, which occur during preparation, transportation, storage, or final crushing prior to combustion).

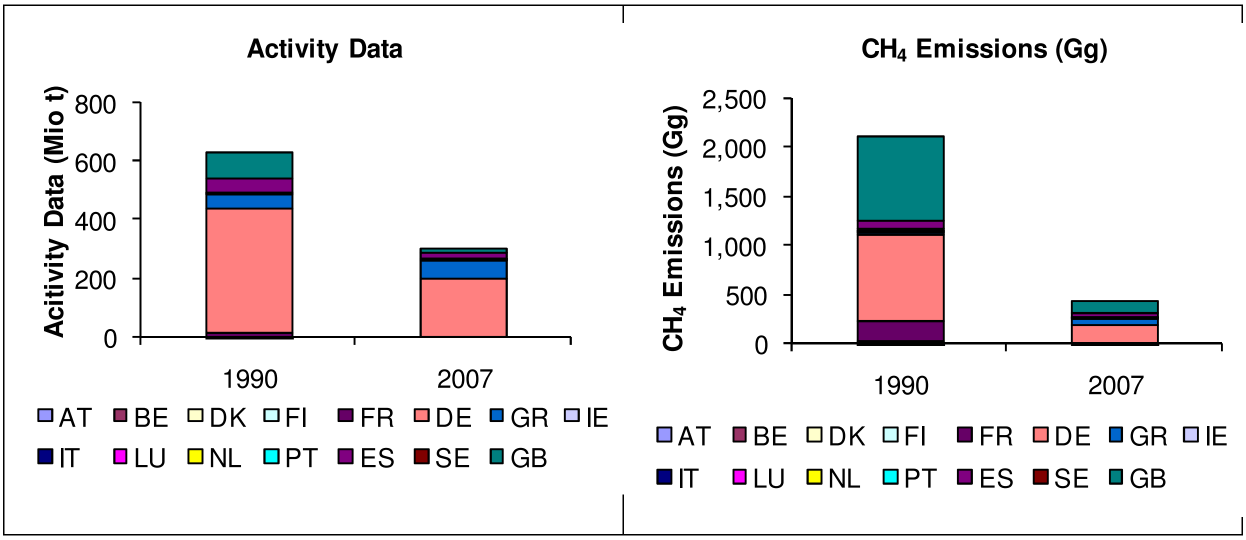
CH_4 emissions from 1B1a Coal-Mining accounted for 0.2 % of total GHG emissions in 2007 and for 18 % of all fugitive emissions in the EU-15. CH_4 emissions from this source decreased by 80 % in the EU-15 between 1990 and 2007 and by 18 % just between 2006 and 2007 (Figure 3.88). Six Member States reported emissions occuring from this source. In 2007, the largest share on total emissions from this source had Germany and the United Kingdom, both together accounting for 74 % of EU-15 emissions (Table 3.88). They both used higher tier methods for the estimation of emissions from 1B1a and both had substantially reduced their emissions between 1990 and 2007 due to the decline of coal mining (Figure 3.89).

Table 3.89 1B1a Coal Mining: Member States contribution for CH_4

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	11	0.03	IE,NO	-	-	-	-11	-100%	T1	NS	C
Belgium	299	NO	NO	-	-	-	-299	-100%	D	NS	D
Denmark	NO	NO	NO	-	-	-	-	-	0.0	Not Occuring	0.0
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	4,279	4	4	0.0%	0	0%	-4,275	-100%	C	AS	CS
Germany	18,415	4,835	3,982	44.6%	-853	-18%	-14,433	-78%	T2	NS	CS
Greece	1,095	1,362	1,403	15.7%	41	3%	307	28%	T1	NS	D
Ireland	NE,NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	55	5	34	0.4%	30	652%	-20	-37%	T1	NS	D, CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NA	NA	NA	-	-	-	-	-	NA	NO	NA
Portugal	66	IE,NO	IE,NO	-	-	-	-66	-100%	T1	NS	D
Spain	1,794	909	864	9.7%	-45	-5%	-930	-52%	T2, CS	NS, AS	CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	18,271	3,779	2,640	29.6%	-1,138	-30%	-15,630	-86%	T3	AS	CS
EU-15	**44,285**	**10,893**	**8,928**	**100.0%**	**-1,965**	**-18%**	**-35,357**	**-80%**			

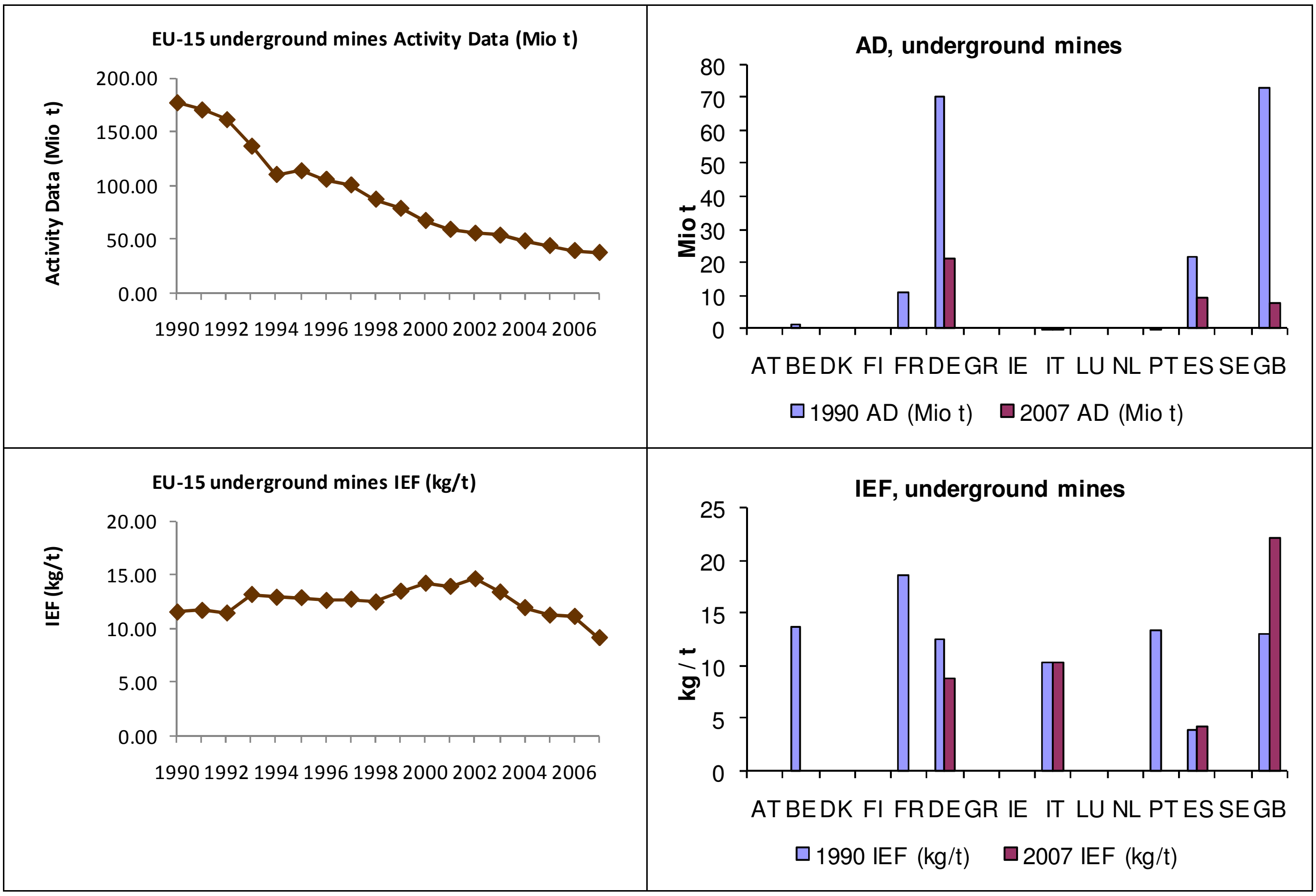
Abbreviations explained in the Chapter 'Units and abbreviations'.

Figure 3.89 1B1a Coal Mining and Handling: Contribuition of MS to CH_4 Emission and Activity Data



In 2007 most fugitive emissions from coal mines were due to underground mines. Within the EU-15 coal mining in underground mines decreased substantially (78%) (Figure 3.90). The strong change in mining activities is opposed by a moderate change in the implied emissions factor for CH_4 emissions (decreased from 12 to 9 kg/t coal produced between 1990 and 2007)

Figure 3.90 1B1ai Underground Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4



Overall, in the EU-15 coal production from surface mines decreased by 41 % between 1990 and 2007 (Figure 3.91). Coal mining in surface mines decreased in all Member States except in Greece.

Figure 3.91 1B1aii Surface Mines: Activity Data and Implied Emission Factors for EU-15 and the emitting countries of CH_4

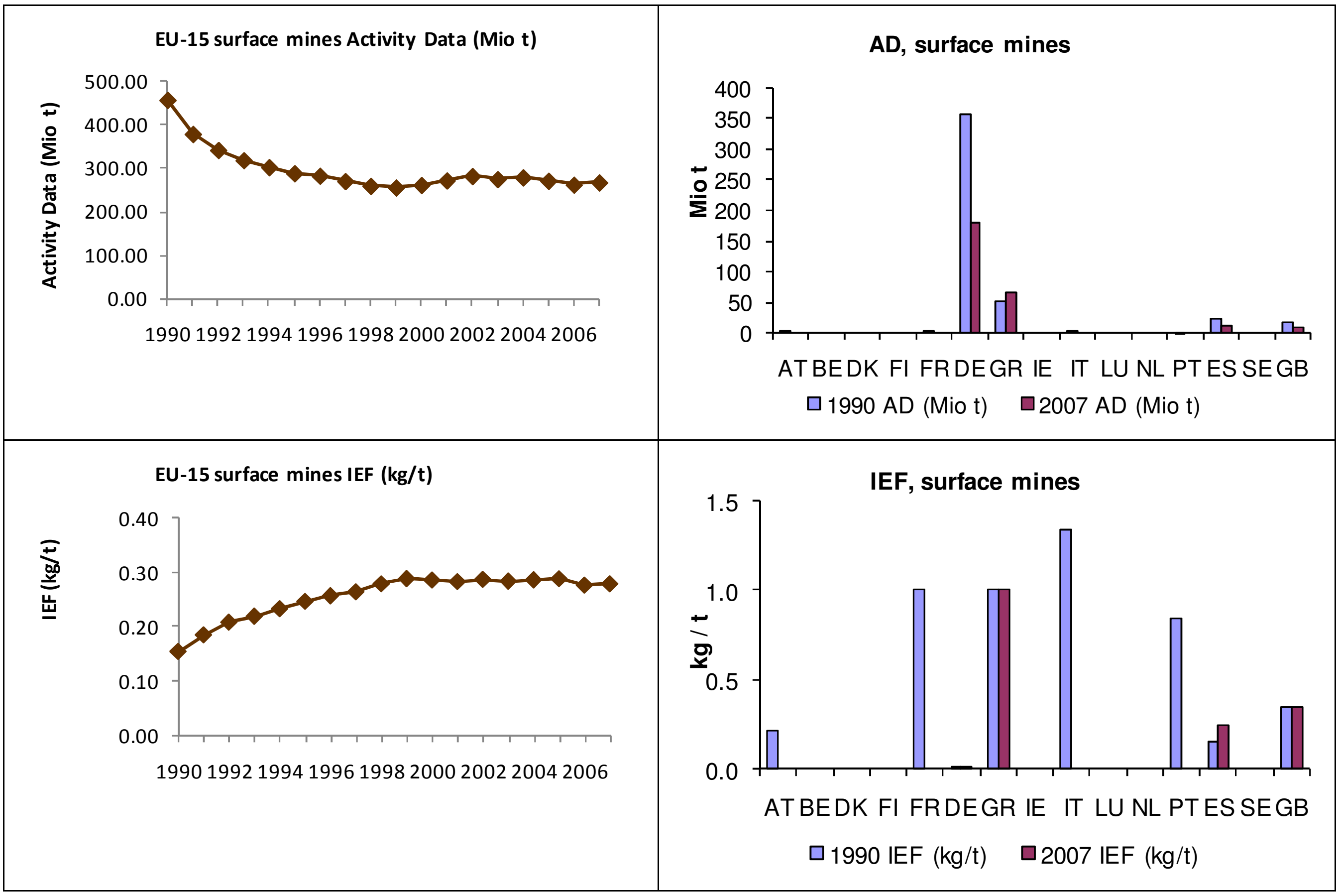


Table 3.90 provides information on the contribution of Member States to EU-15 recalculations in CH_4 from 1B1 Solid fuels for 1990 and 2006. Belgium was the only Member State that recalculated emissions from 1B1 Solid Fuels.

Table 3.90 1B1 Fugitive Emissions from Solid Fuels: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006	
	Gg	Percent	Gg	Percent
Austria	0.0	0.0	0.0	0.0
Belgium	-4.9	-1.5	-0.1	-0.8
Denmark	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0
France	0.0	0.0	0.0	0.0
Germany	0.0	0.0	0.0	0.0
Greece	0.0	0.0	0.0	0.0
Ireland	-	-	0.0	0.0
Italy	0.0	0.0	0.0	0.0
Luxembourg	0.0	0.0	0.0	0.0
Netherlands	0.0	0.0	0.0	0.0
Portugal	0.0	0.0	0.0	0.0
Spain	0.0	0.0	0.0	0.0
Sweden	0.0	0.0	0.0	0.0
UK	0.0	0.0	-0.1	0.0
EU-15	**-4.9**	**0.0**	**-0.2**	**0.0**

3.2.6.2 Fugitive emissions from oil and natural gas (1B2) (EU-15)

Fugitive emissions from oil and natural gas correspond to the total fugitive emissions from oil and gas activities. Fugitive emissions may arise from equipment exhaust (non-combustion), leakages, upsets and mishaps at any point in the chain from production through final use. Emissions from flaring are included (the combustion is considered a nonproductive activity) (Revised 1996 IPCC Guidelines for

National Greenhouse Gas Inventories).

Fugitive emissions from 1B2 Oil and natural gas include all emissions from exploration, production, processing, transport, and use of oil and natural gas. They account for 1 % of the total GHG emissions in 2007 and for 79 % of all fugitive emissions in the EU-15.

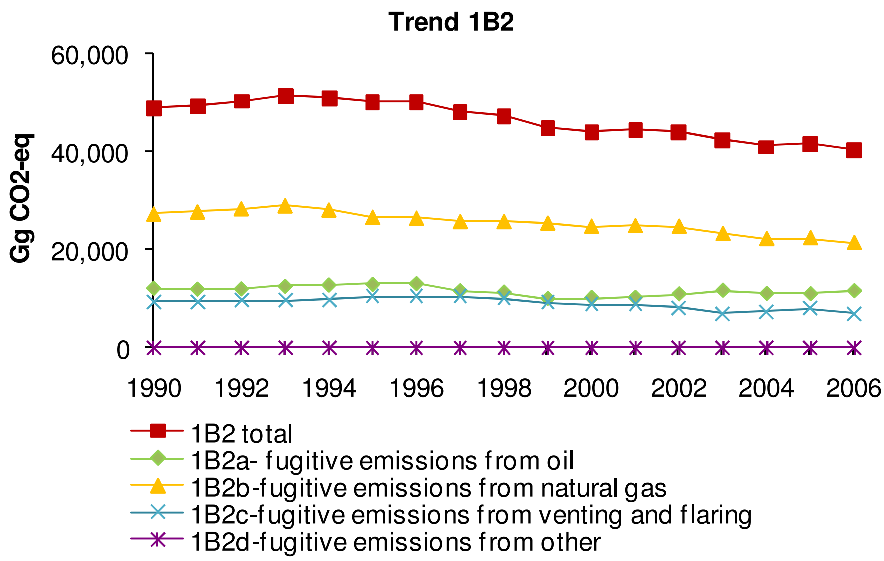
Of all fugitive emissions from oil and natural gas, in 2007:

- 51 % were CH_4 emissions from natural gas (exploration, production, processing, transport and distribution).
- 21 % were CO_2 emissions from oil refining and storage.
- 16 % were CO_2 emissions due to venting and flaring

This source category includes three key source categories:

- CO_2 from 1B2a Oil,
- CH_4 from 1B2b Natural Gas,
- CO_2 from 1B2c Venting and flaring.

Figure 3.92 **1B2-Fugitive Emissions Oil and Natural Gas: Trend**



Fugitive emissions from oil and natural gas arose in all Member States (Table 3.91). Total greenhouse gas emissions from 1B2 decreased by 18 % between 1990 and 2007 (Figure 3.92). This trend was mainly due to the reduction of fugitive CH_4 emissions from natural gas activities, which decreased by 23 % over that period.

In 2007, 76 % of all fugitive GHG emissions from oil and natural gas were emitted by four countries: the United Kingdom (27 %), Italy (18 %), Germany (17 %) and France (14 %). Between 1990 and 2007, emissions decreased in eight Member States and increased in seven Member States. The largest reductions (in absolute terms) were observed in the United Kingdom (mainly CH_4 emissions) and in Italy (both CH_4 and CO_2 emissions), while emissions increased most in Spain and in Portugal.

Table 3.911B2 Fugitive emissions from oil and natural gas: Member States' contributions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2007 (Gg CO_2 equivalents)
Austria	476	942	102	237	374	705
Belgium	610	500	85	91	525	409
Denmark	304	496	263	367	40	128
Finland	232	187	220	135	11	51
France	7,331	5,653	4,508	3,717	2,786	1,891
Germany	7,482	6,768	0	0	7,482	6,768
Greece	162	165	70	7	92	158
Ireland	131	60	IE,NE,NO	IE,NE,NO	131	60
Italy	10,640	7,164	3,341	2,176	7,298	4,987
Luxembourg	18	51	0	0	18	51
Netherlands	2,414	2,040	775	1,154	1,639	886
Portugal	206	1,590	155	888	51	702
Spain	2,391	3,043	1,760	2,482	631	560
Sweden	331	647	311	627	5	5
United Kingdom	16,107	10,576	5,760	5,092	10,304	5,445
EU-15	**48,836**	**39,880**	**17,352**	**16,973**	**31,387**	**22,805**

Ireland: CO_2 emissions from 1B2aiv Refing/Storage are negligible. CO_2 emissions from 1B2av Distribution of oil products and 1B2avi other: no activity data available.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.92 provides information on the methodologies used by EU-15 Member States.

Table 3.92 1B2 –Fugitive Emissions from Oil and Gas: Methodological Issues according to NIRs (submitted in 2009) of EU-15 Member States

	Methodology
Austria	**General:** Emissions from oil and from gas exploration and production were reported together under oil production (as oil and gas were extracted together at most sites) except CO_2 emissions from sour gas processing, which is reported separately under gas extraction. Regarding petroleum refining, all CO_2 emissions, thus including flaring, were reported in the Energy Sector, as these are emissions due to combustion. Fugitive CO_2 emissions were considered negligible. In category 1 B only CH_4 and NMVOC emissions, incl. venting, were considered. **Activity data:** national energy balance, Association of the Austrian Petroleum Industry, Austrian Natural Gas and District Heat Association. **Emission factor**: IPCC Reference Manual, IPCC GPG Table 2.16
Belgium	**General:** CO_2 of the refineries were allocated to the sectors 1A1a for the involved combined heat-power installations of the refineries, 1B2c for the flaring emissions and 1A1b for the total emissions excluding the emissions of the combined heat-power installations and excluding the emissions from flaring activities. **Activity data:** delivered by corresponding companies, SYNERGRID, the federation of the gridoperators of gas and electricity in Belgium **Emission factor:** plant specific, country specific, CITEPA
Denmark	**General:** The emissions from oil derived from offshore activities, service stations and refineries were included. Emissions from offshore activities included emissions from extraction, onshore oil tanks and onshore and offshore loading of ships. Emissions from gas storage were included n transmission. Emissions from flaring included both offshore flaring, flaring in gas storage and treatment plants and in refineries. In Denmark venting of gas was assumed to be negligible because controlled venting entered the gas flare system. **Activity data:** Danish gas transmission company DONG Energy, Danish Energy Authority **Emission factor:** EMEP/CORINAIR, country specific (Danish Gas Transmission Company), national studies, Danish EPA
Finland	**General:** There is no exploration or production of oil or natural gas in Finland.CO_2, CH_4 and N_2O emissions from flaring at oil refineries and in the petrochemical industry, fugitive methane emissions from oil refining and methane emissions from gas transmission and distribution were included.. **Activity data:** Energy statistics (quantity of oil refined) **Emission factor:** IPCC guidelines
France	**General:** Exploration, production, transport, refining were included. **Activity data:** national and plant statistics **Emission factor:** exploration Tier 1, refining Tier 2/3
Germany	**General:** The low implied emission factor of 1 B 2 a v in international comparison is due to the implementation of national legal regulations concerning the equipment. **Activity data:** Wirtschaftsverbandes Erdöl- und Erdgasgewinnung e.V. (WEG), Jahresbericht Mineralöl-Zahlen **Emission factor:** IPCC GPG default emission factors, country specific
Greece	**General:** Extraction, processing, storage, transmission/distribution were included. The introduction of natural gas in the Greek energy system started in 1996. **Activity data:** National Energy Balance, Public Gas Corporation **Emission factor:** IPCC Guidelines, IPCC Good Practice Guidancev
Ireland	**General:** Emissions reported under the OSPAR Convention were emissions due to combustion of natural gas on an off-shore platform and not fugitive emissions as previously reported. As theses emissions were already reported in sector 1A3e Other , Transport Pipeline compressors the emissions have now been excluded from

	Methodology
	1B2bii (Production Processing of Natural Gas) for all years 1990-2006 to avoid double counting. **Activity data:** energy balance **Emission factor:** country specific
Italy	**General**: Fugitive CO_2 emissions reported in 1B2 refered to fugitive emissions in refineries during petroleum production processes, e.g. fluid catalytic cracking and flaring, and emissions from the production of oil and natural gas. CH_4 emissions reported in 1B2 refered mainly to the production of oil and natural gas and to the transmission in pipelines and distribution of natural gas. **Activity Data:** National Energy Balance, specific industry data **Emission Factor**: IPCC GPG (2000), CORINAIR Guidebook
Luxembourg	**General:** no information provided
Netherlands	**General:** The fugitive emissions from category 1B2 comprised non fuel combustion emissions from flaring and venting, emissions from oil and gas production, emissions from gas transport (compressor stations) and gas distribution networks (pipelines for local transport) and oil refining. The fugitive CO_2 emissions from refineries were included in the combustion emissions reported in category 1A1b. In addition, the combustion emissions from exploration and production were reported under 1A1c. From the year 2007 submission onwards the Process emissions of CO_2 from a hydrogen plant of a refinery (about 0.9 Tg CO_2 per year) were reported in this category. Refinery data specifying these fugitive CO_2 emissions were available from 2002 onwards and reallocated from 1A1b to 1B2aiv for 2002 onwards. **Activity data:** country specific, the Process emissions of CO_2 from a hydrogen plant of a refinery are obtained from the environmental report. **Emission factor:** country specific Tier 3. Since 2004, the gas distribution sector annually records the number of leaks found per material, and any future possible trends in the emission factors will be derived from these data.
Portugal	**General:** Extraction and production of crude oil did never occur in the Portuguese territory. Therefore, fugitive emissions comprised only those resulting from refining, storage and transport of crude oil, other raw materials, intermediate products and final products. In 1990 there were three oil refining plants in Portugal. After 1993, the Lisbon unit was closed for all activity and only two units remained operating. **Activity data**: plant and country specific, GALP (the company operating all refineries in Portugal), PETROGAL, TRANSGAS, Directorate General of Geology and Energy **Emission factor:** IPCC, EMEP/CORINAIR, plant specific, US-EPA
Spain	**General:** main sources of CO_2 were processes in the oil refining industry, including fluid catalytic cracking and other processes to refine oil-derived products. Emissions from category 1B2 have been calculated by grouping the estimations for each potential emission source. **Activity Data:** national natural gas transmission company, Spanish Gas Association, SEDIGAS **Emission Factors:** CO_2 - country specific (questionnaires), CH_4 – EMEP/CORINAR Guidebook
Sweden	**General:** Due to some operational problems at the plant the total emissions of CO were high for 1997 and 1998 compared to other years. In submission 2009, emissions from combustion of petroleum coke in refineries earlier reported in CRF 1A1b were re-allocated to CRF 1B2Aiv to be in line with the IPCC guidelines. In Sweden, one facility for production of hydrogen was started in 2006, which resulted in a sharp increase in emissions from this sector during 2006 and later years. **Activity data:** plant specific, reports from the Swedish EPA, and Statistics Sweden, ARTEMIS model **Emission factor:** Tier 2, plant specific, national studies, Concawe
United Kingdom	**General:** Emissions occurred from oil and gas production facilities, gas and oil terminals, gas processing facilities, oil refineries, gas transmission networks, and storage and distribution of petrol. **Activity data:** Oil and Gas UK trade association (through their annual emissions reporting mechanism to the UK regulatory agency (the Department of Energy & Climate Change), called the Environmental Emissions Monitoring System (EEMS), for years prior to 1995 emission totals are based on an internal Oil and Gas UK summary report produced in 1998, UK Petroleum Industry Association, UK Energy Statistics **Emission factor:** plant specific and aggregated, calculated by UK Institute of Petroleum

CO_2 from Oil (1B2a)

Fugitive emissions from oil correspond to fugitive emissions from oil exploration, fugitive emissions from the production of crude oil, fugitive emissions resulting from the loading and unloading of crude oil from tankers, fugitive emissions from the refining of oil and from storage in tanks and emissions (primarily NMVOCs) from transport and handling of oil products. Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories)

CO_2 emissions from 1B2a ‘Fugitive CO_2 emissions from oil’ account for 0.2 % of total EU-15 GHG emissions in 2007 and for 20 % of all fugitive emissions in the EU-15. Between 1990 and 2007, CO_2 emissions from this source increased by 1 % in the EU-15 (Table 3.93). By contrast, during the same period 1990-2007, CH_4 emissions of this source category were reduced by 53 %.

France was the largest emitter (29.3%) of CO_2 from 1B2a in the EU-15, followed by Spain (19.8%) and Italy (19.5%) (Table 3.93). Toghether they accounted for 69 % of the EU-15 total. All three Member States used higher tier methods for the estimation of 1B2a. During the period 1990-2007, the largest decreases in CO_2 emissions (in absolute terms) were observed in Italy and the United Kingdom, while emissions increased most in the Netherlands, in Portugal and, in Spain.

Table 3.93 1B2a Fugitive CO_2 emissions from oil: Member States’ contributions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	43	140	142	1.4%	2	1%	99	230%	CS	AS	CS
Belgium	0	0	0	-	-	-	-	-	NA	NA	NA
Denmark	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Finland	1.0	1.3	1.4	0.0%	0.1	4%	0	42%	T1	NS	CS
France	3,428	3,347	2,923	29.3%	-424	-13%	-504	-15%	C	PS/ NS	CS
Germany	0	0	0	-	-	-	-	-	T1	NS	D
Greece	0	0.03	0.03	0.0%	-0.008	-24%	-0.24	-	T1	NS	D
Ireland	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NO	NO	NO
Italy	2,627	1,957	1,944	19.5%	-14	-1%	-684	-26%	T2	NS	CS
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NE	NA
Netherlands	IE,NA,NE	931	1,014	10.2%	83	9%	1,014	-	CS	PS	CS
Portugal	105	587	605	6.1%	18	3%	500	478%	M	AS,NS,PS	D,PS
Spain	1,581	2,018	1,974	19.8%	-44	-2%	393	25%	T2	PS	PS
Sweden	241	617	507	5.1%	-110	-18%	266	110%	T2	NS	CS
United Kingdom	1,840	967	850	8.5%	-117	-12%	-990	-54%	T2	NS	CS
EU-15	**9,866**	**10,566**	**9,961**	**100.0%**	**-605**	**-6%**	**95**	**1%**			

Emissions of Ireland were not estimated, because no activity data are available.

Emissions of the Netherlands 1990 were not estimated resp. included elswhere, as no data were available (negligible amounts).

Luxembourg: 1B2av: Distribution of oil products: The estimation was not yet carried out.

Abbreviations explained in the Chapter ‘Units and abbreviations’.

CH_4 from Natural gas (1B2b)

Fugitive emissions from natural gas correspond to emissions from the production of gas, gas gathering systems and gas separation plants, emissions from pipelines for long distance and local transport of methane, compressor stations and their maintenance facilities, and the release of gas at point of use, including residential, commercial, industrial and electricity generation users (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

CH_4 emissions from 1B2b ‘Fugitive CH_4 emissions from natural gas’ account for 0.5 % of total EU-15 GHG emissions in 2007 and for 40 % of all fugitive emissions in the EU-15. Between 1990 and 2007, CH_4 emissions from this source decreased by 23 % in the EU-15 (Table 3.94), with a 3 % decrease observed between 2006 and 2007.

In 2007, 77 % of the EU-15 CH_4 emissions from 1B2b were emitted by three Member States: Germany (32 %), the United Kingdom (22 %) and Italy (24 %) (Table 3.94). All three Member States used higher tier methods for the estimation of the emissions from 1B2b. The emission decreases observed in the United Kingdom (–45 %) and in Italy (-33 %) contributed most significantly to the overall reduction in the EU-15 between 1990 and 2007.

Various parameters (e.g. piplines length, PJ gas consumed, m^3 gas produced, see Table 3.96) were used as activity data for calculation of the sub categories of 1B2b by Member States and thus a meaningful implied emission factor could not be calculated for the EU-15.

Table 3.941B2b Fugitive CH_4 emissions from natural gas: Member States' contributions

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	273	578	582	2.9%	4	1%	309	113%	T1	AS	D
Belgium	519	403	406	2.0%	3	1%	-113	-22%	CS/M	AS	CS
Denmark	6	7	3	0.0%	-3	-47%	-2	-37%	CS	NS	CS
Finland	4	45	40	0.2%	-5	-10%	37	1034%	T1, T2	NS	CS, PS, D
France	2,683	1,850	1,861	9.2%	11	1%	-822	-31%	C	PS	CS
Germany	6,782	6,710	6,581	32.4%	-129	-2%	-200	-3%	CS	NS	CS
Greece	10	99	104	0.5%	5	5%	95	989%	T1	NS	D
Ireland	131	102	60	0.3%	-42	-41%	-71	-54%	CS	NS	CS
Italy	7,067	4,873	4,717	23.2%	-156	-3%	-2,350	-33%	T2	NS	CS
Luxembourg	18	52	51	0.2%	-1	-2%	32	176%	C	NS	C
Netherlands	373	401	399	2.0%	-1	0%	26	7%	T3	AS	CS
Portugal	NO	699	641	3.2%	-58	-8%	641	-	T1	AS,NS	C,OTH
Spain	466	488	499	2.5%	10	2%	32	7%	C, CS	NS, AS, Q	C, CS
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	7,955	4,573	4,371	21.5%	-203	-4%	-3,584	-45%	T3	NS,AS	CS
EU-15	**26,286**	**20,880**	**20,315**	**100.0%**	**-565**	**-3%**	**-5,971**	**-23%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 from Venting and Flaring (1B2c)

Fugitive emissions from venting and flaring correspond to the release and/or combustion of excess gas at facilities for the production of oil or gas and for the processing of gas (Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories).

Fugitive CO_2 emissions from 1B2c Venting and Flaring accounted for 0.2 % of total GHG emissions in 2007 and for 12 % of all fugitive emissions in the EU-15. The United Kingdom used a higher tier method for the estimation of emissions from 1B2c and was responsible for two thirds of the emissions from this source.

Between 1990 and 2007, CO_2 emissions from this source decreased by 4 % in the EU-15 (Table 3.95).

Austria, Germany and Ireland did not report such emissions in this source category:

Table 3.951B2c Fugitive CO_2 emissions from venting and flaring: Member States' contributions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	IE	IE	IE	-	-	-	-	-	IE	IE	IE
Belgium	84	130	89	1.4%	-41	-31%	6	7%	T3	PS	PS
Denmark	263	425	367	5.8%	-58	-14%	103	39%	C	NS/PS	CS
Finland	123	66	91	1.5%	25	39%	-32	-26%	T2	NS	CS
France	297	455	446	7.1%	-9	-2%	150	50%	C	PS	CS
Germany	NE	NE	NE	-	-	-	-	-	(IE,NE)	(IE,NE)	(IE,NE)
Greece	70	9	7	0.1%	-2	-24%	-63.03	-	T1	NS	D
Ireland	IE,NO	IE,NO	IE,NO	-	-	-	-	-	CS	NS	CS
Italy	681	211	214	3.4%	3	2%	-467	-69%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	774	137	139	2.2%	2	2%	-635	-82%	T2	PS	PS
Portugal	49	50	50	0.8%	0	1%	2	3%	D	AS,NS	D
Spain	179	261	508	8.1%	247	95%	329	183%	T1, T2, CS	PS	CS
Sweden	70	166	120	1.9%	-47	-28%	50	71%	T2	PS	CS, D
United Kingdom	3,920	3,916	4,242	67.6%	325	8%	322	8%	T3	NS	CS
EU-15	**6,510**	**5,826**	**6,274**	**100.0%**	**448**	**8%**	**-236**	**-4%**			

Austria included CO_2 emissions from 1B2c Flaring under 1A1b Petroleum Refining
Ireland included emissions from 1B2c Venting ii Gas under Production and Processing 1B2bii.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.96 1B2b Fugitive CH_4 emissions from natural gas: Information on activity data, emission factors by Member State

		1990					2007				
		Activity data					Activity data				
Member State	GHG source category	Description	Unit	Value	Implied emission factor (kg/unit)	CH4 emissions (Gg)	Description	Unit	Value	Implied emission factor (kg/unit)	CH4 emissions (Gg)
Austria	**Natural Gas**					**12.98**					**27.50**
	i. Exploration			1288	IE	IE			1819	IE	IE
	ii. Production (4) / Processing	Gas throughput (a)	10^6 m^3	1288	IE	IE	Gas throughput (a)	10^6 m^3	1819	IE	IE
	iii. Transmission	Pipelines length (km)	km	1032	2900.00	2.99	Pipelines length (km)	km	1548	2900.00	4.49
	iv. Distribution	Distribution network length	km	15200	657.43	9.99	Distribution network length	km	35350	651.04	23.01
	v. Other Leakage	(e.g. PJ gas consumed)	PJ	1500	NO	NO	(e.g. PJ gas consumed)	PJ	2962	NO	NO
	at industrial plants and power stations			NE	NO	NO			NE	NO	NO
	in residential and commercial sectors			NE	NO	NO			NE	NO	NO
Belgium	**Natural Gas**					**24.71**					**19.20**
	i. Exploration										
	ii. Production (4) / Processing								163	0.00	0.00
	iii. Transmission	(e.g. PJ gas consumed)	PJ	401	5079.35	2.04	(e.g. PJ gas consumed)	PJ	616	4538.36	2.80
	iv. Distribution	PJ gas consumed	PJ	401	56470.77	22.67	PJ gas consumed	PJ	453	36209.60	16.40
	v. Other Leakage										
	at industrial plants and power stations										
	in residential and commercial sectors										
Denmark	**Natural Gas**					**0.27**					**0.31**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	Gas produced	10^6 m^3	5137	IE	IE	Gas produced	10^6 m^3	10878	IE	IE
	iii. Transmission	Gas transmission	10^6 m^3	2739	88.62	0.24	Gas transmission	10^6 m^3	7600	28.68	0.22
	iv. Distribution	Gas distributed	10^6 m^3	1574	14.56	0.02	Gas distributed	10^6 m^3	3319	29.06	0.10
	v. Other Leakage	Incl. in transmission		IE	NO	NO	Incl. in transmission		IE	NO	NO
	at industrial plants and power stations			IE	NO	NO			IE	NO	NO
	in residential and commercial sectors			IE	NO	NO			IE	NO	NO
Finland	**Natural Gas**					**0.17**					**2.15**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	(e.g. PJ gas produced)		NO	NO	NO	(e.g. PJ gas produced)		NO	NO	NO
	iii. Transmission	PJ gas consumed	PJ	92	1855.49	0.17	PJ gas consumed	PJ	162	2787.05	0.45
	iv. Distribution	PJ gas distributed via local networks	PJ	5	NO	NO	PJ gas distributed via local networks	PJ	7	233516.48	1.70
	v. Other Leakage	t of natural gas released from pipelines		NO	NO	NO	t of natural gas released from pipelines		NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
France	**Natural Gas**					**127.77**					**88.09**
	i. Exploration			309	1614.89	0.50			133	980.99	0.13
	ii. Production (4) / Processing	PJ Production	PJ	1055	120586.04	127.27	PJ Production	PJ	1656	53126.10	87.96
	iii. Transmission	PJ Consumed	PJ	NA	NA	NA	PJ Consumed	PJ	NA	NA	NA
	iv. Distribution			NO	NO	NO			NO	NO	NO
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO

Germany	**Natural Gas**					**322.93**					**319.54**
	i. Exploration	numbers of wells drilled	TJ	IE	IE	IE	numbers of wells drilled	TJ	IE	IE	IE
	ii. Production (4) / Processing	production and processing	TJ	563382	101.94	57.43	production and processing	TJ	589884	89.00	52.50
	iii. Transmission	pipelines and containers	TJ	2292780	12.89	29.56	pipelines and containers	TJ	3224000	12.42	40.05
	iv. Distribution	distribution net	km	245852	811.74	199.57	distribution net	km	365094	438.37	160.05
	v. Other Leakage	gas consumed	TJ	893519	40.71	36.37	gas consumed	TJ	1594000	42.00	66.95
	at industrial plants and power stations		TJ	IE	IE	IE		TJ	IE	IE	IE
	in residential and commercial sectors	gas consumed	TJ	893519	40.71	36.37	gas consumed	TJ	1594000	42.00	66.95
Greece	**Natural Gas**					**0.46**					**4.74**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing	Natural gas production	10^6 m^3	123	3708.46	0.46	Natural gas production	10^6 m^3	23	311.52	0.01
	iii. Transmission	Length of transmission pipeline	km	NO	NO	NO	Length of transmission pipeline	km	960	2521.42	2.42
	iv. Distribution	Length of distribution mains	km	NO	NO	NO	Length of distribution mains	km	3756	615.00	2.31
	v. Other Leakage	(e.g. PJ gas consumed)		11567	IE	IE	(e.g. PJ gas consumed)		226800	IE	IE
	at industrial plants and power stations	NG consumption		5783	IE	IE	NG consumption		113400	IE	IE
	in residential and commercial sectors	NG Consumption		5783	IE	IE	NG Consumption		113400	IE	IE
Ireland	**Natural Gas**					**6.24**					**4.85**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing	PJ of Gas produced	PJ	79	14330.75	1.13	PJ of Gas produced	PJ	17	153184.74	2.63
	iii. Transmission	(e.g. PJ gas consumed)		IE	IE	IE	(e.g. PJ gas consumed)		IE	IE	IE
	iv. Distribution	PJ of gas consumed	PJ	24	214519.35	5.12	PJ of gas consumed	PJ	66	33887.41	2.22
	v. Other Leakage	(e.g. PJ gas consumed)	PJ	NO	NO	NO	(e.g. PJ gas consumed)	PJ	NO	NO	NO
	at industrial plants and power stations		PJ	NO	NO	NO		PJ	NO	NO	NO
	in residential and commercial sectors		PJ	NO	NO	NO		PJ	NO	NO	NO
Italy	**Natural Gas**					**336.52**					**232.04**
	i. Exploration	not available		NA	IE	IE	not available		NA	IE	IE
	ii. Production (4) / Processing	(Mm3 gas produced)	10^6 m^3	17296	2910.93	50.35	(Mm3 gas produced)	10^6 m^3	10837	1611.00	17.46
	iii. Transmission	(Mm3 gas transported)	10^6 m^3	45684	822.12	37.56	(Mm3 gas transported)	10^6 m^3	87990	414.68	36.49
	iv. Distribution	(Mm3 gas transported)	10^6 m^3	20632	12049.80	248.61	(Mm3 gas transported)	10^6 m^3	34656	5138.88	178.09
	v. Other Leakage			NA	IE	IE			NA	IE	IE
	at industrial plants and power stations			NA	IE	IE			NA	IE	IE
	in residential and commercial sectors			NA	IE	IE			NA	IE	IE
Luxembourg	**Natural Gas**					**0.87**					**2.46**
	i. Exploration	gas exploration		NO	NO	NO	gas exploration		NO	NO	NO
	ii. Production (4) / Processing	gas produced		NO	NO	NO	gas produced		NO	NO	NO
	iii. Transmission	gas consumed	PJ	20	43888.89	0.87	gas consumed	PJ	57	42893.31	2.46
	iv. Distribution	gas consumed		IE	IE	IE	gas consumed		IE	IE	IE
	v. Other Leakage	(specify)		IE	IE	IE	(specify)		IE	IE	IE
	at industrial plants and power stations	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE
	in residential and commercial sectors	gas leakage		IE	IE	IE	gas leakage		IE	IE	IE

Netherlands	**Natural Gas**					**17.79**					**19.09**
	i. Exploration	number of wells drilled/tested	number	79	IE	IE	number of wells drilled/tested	number	39	IE	IE
	ii. Production (4) / Processing	gas produced	PJ	2292	IE	IE	gas produced	PJ	2238	IE	IE
	iii. Transmission	gas transported	PJ	2292	2468.91	5.66	gas transported	PJ	3051	1984.56	6.06
	iv. Distribution	natural gas distribution network	10^3 km	100	121283.21	12.13	natural gas distribution network	10^3 km	122	107058.82	13.03
	v. Other Leakage			IE	IE	IE			IE	IE	IE
	at industrial plants and power stations			IE	IE	IE			IE	IE	IE
	in residential and commercial sectors			IE	IE	IE			IE	IE	IE
Portugal	**Natural Gas**					**NO**					**33.27**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	gas consumed	Gg	NO	NO	NO	gas consumed	Gg	4650	7153.41	33.27
	iv. Distribution	gas consumed	Gg	NO	NO	NO	gas consumed	Gg	IE	IE	IE
	v. Other Leakage			NO	NO	NO			IE	IE	IE
	at industrial plants and power stations	gas consumed	10^3 m^3	NO	NO	NO	gas consumed	10^3 m^3	IE	IE	IE
	in residential and commercial sectors	gas consumed	10^3 m^3	NO	NO	NO	gas consumed	10^3 m^3	IE	IE	IE
Spain	**Natural Gas**					**22.20**					**23.25**
	i. Exploration			NE	NE	NE			NE	NE	NE
	ii. Production (4) / Processing	PJ gas produced (NCV)	PJ	51	70889.00	3.63	PJ gas produced (NCV)	PJ	3	70889.00	0.19
	iii. Transmission	PJ gas (NCV)	PJ	218	759.33	0.17	PJ gas (NCV)	PJ	1312	562.07	0.74
	iv. Distribution	PJ gas consumed (NCV)	PJ	226	81503.15	18.40	PJ gas consumed (NCV)	PJ	1323	16875.16	22.32
	v. Other Leakage	(e.g. PJ gas consumed)	0	NE	NE	NE	(e.g. PJ gas consumed)		NE	NE	NE
	at industrial plants and power stations			NE	NE	NE			NE	NE	NE
	in residential and commercial sectors			NE	NE	NE			NE	NE	NE
Sweden	**Natural Gas**					**NO**					**NO**
	i. Exploration			NO	NO	NO			NO	NO	NO
	ii. Production (4) / Processing			NO	NO	NO			NO	NO	NO
	iii. Transmission	Pressure levelling losses	TJ	NO	NO	NO	Pressure levelling losses	TJ	NO	NO	NO
	iv. Distribution	(e.g. PJ gas consumed)	0	NO	NO	NO	(e.g. PJ gas consumed)		NO	NO	NO
	v. Other Leakage			NO	NO	NO			NO	NO	NO
	at industrial plants and power stations			NO	NO	NO			NO	NO	NO
	in residential and commercial sectors			NO	NO	NO			NO	NO	NO
United Kingdom	**Natural Gas**					**378.80**					**217.77**
	i. Exploration			IE	IE	IE			IE	IE	IE
	ii. Production (4) / Processing			IE	IE	IE			IE	IE	IE
	iii. Transmission			IE	IE	IE			IE	IE	IE
	iv. Distribution	gas consumed	PJ	1573	240742.27	378.80	gas consumed	PJ	3188	68319.23	217.77
	v. Other Leakage			NE	NE	NE			NE	NE	NE
	at industrial plants and power stations			NE	NE	NE			NE	NE	NE
	in residential and commercial sectors			NE	NE	NE			NE	NE	NE

Tables 3.97 and 3.98 provide information on the contribution of Member States to EU-15 recalculations in CO_2 and CH_4 from 1B2 'Oil and natural gas' for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 3.97 1B2 Fugitive CO_2 emissions from Oil and natural gas: Contribution of MS to EC recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	-0.2	-0.2	0.0	0.0	
Denmark	0.0	0.0	10.1	2.4	
Finland	-6.0	-2.6	0.7	0.6	
France	0.0	0.0	0.0	0.0	
Germany	0.1	0.0	0.1	0.0	
Greece	70.2	-	-0.2	-	
Ireland	-138.9	-100.0	-60.3	-100.0	Emissions reported under the OSPAR Convention were emissions due to combustion of natural gas on an off-shore platform and not fugitive emissions as previously reported. As theses emissions were already reported in sector 1A3e Other , Transport Pipeline compressors the emissions have now been excluded from 1B2bii (Production Processing of Natural Gas) for all years 1990-2006 to avoid double counting.
Italy	0.0	0.0	0.0	0.0	
Luxembourg	-	0.0	-	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	40.0	34.8	43.3	5.8	
Spain	16.6	1.0	11.7	0.5	
Sweden	218.6	235.8	616.8	370.6	Reallocation: Use of petroleum coke in refineries are in this submission moved from CRF 1A1b to CRF 1B2A4. Also, emissions from hydrogen production 2006 (and 2007) is included in this submission; Acticity data: Updated activity data from the ARTEMIS
UK	0.0	0.0	74.7	1.6	
EU-15	**200.5**	**1.2**	**697.0**	**4.3**	

Table 3.98 1B2 Fugitive CH_4 emissions from Oil and natural gas: Contribution of MS to EU-15 recalculations in CH_4 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006	
	Gg	Percent	Gg	Percent
Austria	0.0	0.0	0.0	0.0
Belgium	0.0	0.0	0.7	0.2
Denmark	0.0	0.0	31.8	32.6
Finland	0.0	0.0	0.0	0.0
France	0.0	0.0	-0.5	0.0
Germany	473.8	6.8	62.6	0.9
Greece	2.9	3.3	12.7	8.9
Ireland	0.0	0.0	-0.1	-0.1
Italy	0.0	0.0	-40.1	-0.8
Luxembourg	-9.2	-33.4	-7.7	-13.0
Netherlands	0.0	0.0	12.4	1.8
Portugal	16.0	45.5	19.8	2.7
Spain	0.0	0.0	-5.3	-0.8
Sweden	0.1	2.0	0.1	2.6
UK	0.0	0.0	165.0	3.1
EU-15	**483.6**	**1.6**	**251.5**	**1.1**

3.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 1 an overview of the Member States' contributions to the key source in terms of level and trend, and information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 3.99 shows the total EU-15 uncertainty estimates for the sector 'Energy' excluding 1A3 'Transport' and the uncertainty estimates for the relevant gases for each source category. For those emissions for which no split by source category was available, uncertainty estimates were made for stationary combustion as a whole. The highest level uncertainty was estimated for N_2O from 1A2 (gaseous fuels) and the lowest for CO_2 from 1A1a (liquid fuels). With regard to trend CH_4 from 1A5 (gaseous fuels) shows the highest uncertainty estimates, CO_2 from 1A1a (solid fuels) the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 3.99 Sector 1 Energy (excl. 1A3b and 1B): Uncertainty estimates for EU-15

Source category	Fuel	Gas	Emissions 1990	Emissions 2007	Emission trends 1990-2007	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.1.a Public electricity and heat production	Gaseous	CO_2	60 437	259 984	330%	0.6%	0.8
1.A.1.a Public electricity and heat production	Liquid	CO_2	124 579	52 360	-58%	1.4%	0.7
1.A.1.a Public electricity and heat production	Other	CO_2	13 334	32 759	146%	5.1%	6.0
1.A.1.a Public electricity and heat production	Solid	CO_2	750 835	683 450	-9%	2.6%	0.2
1.A.1.b Petroleum refining	Gaseous	CO_2	3 846	8 947	133%	1.5%	3.4
1.A.1.b Petroleum refining	Liquid	CO_2	98 388	111 336	13%	2.9%	0.5
1.A.1.c Manufacture of solid fuels	Gaseous	CO_2	16 872	21 590	28%	14.4%	4.7
1.A.1.c Manufacture of solid fuels	Liquid	CO_2	3 401	1 778	-48%	3.1%	2.4
1.A.1.c Manufacture of solid fuels	Solid	CO_2	72 520	30 900	-57%	8.4%	0.0
1.A.2 Manufacturing industries and construction	Gaseous	CO_2	175 187	232 474	33%	2.4%	1.3
1.A.2 Manufacturing industries and construction	Liquid	CO_2	193 232	152 832	-21%	4.0%	1.6
1.A.2 Manufacturing industries and construction	Other	CO_2	8 063	17 714	120%	10.9%	15.6
1.A.2 Manufacturing industries and construction	Solid	CO_2	236 279	114 224	-52%	2.9%	1.6
1.A.4.a Commercial/institutional	Gaseous	CO_2	59 112	92 033	56%	7.7%	4.3
1.A.4.a Commercial/institutional	Liquid	CO_2	73 998	44 760	-40%	7.9%	4.3
1.A.4.a Commercial/institutional	Other	CO_2	1 048	3 052	191%	1.0%	2.2
1.A.4.a Commercial/institutional	Solid	CO_2	27 618	2 180	-92%	5.4%	4.9
1.A.4.b Residential	Gaseous	CO_2	161 897	221 887	37%	2.3%	1.3
1.A.4.b Residential	Liquid	CO_2	169 554	121 788	-28%	10.7%	1.8
1.A.4.b Residential	Other	CO_2	154	165	8%	10.2%	1.3
1.A.4.b Residential	Solid	CO_2	74 504	9 842	-87%	7.7%	4.1
1.A.4.c Agriculture/Forestry/Fisheries	Gaseous	CO_2	9 720	9 476	-3%	8.9%	2.0
1.A.4.c Agriculture/Forestry/Fisheries	Liquid	CO_2	56 086	47 587	-15%	8.2%	3.2
1.A.4.c Agriculture/Forestry/Fisheries	Other	CO_2	40	56	38%	10.2%	1.3
1.A.4.c Agriculture/Forestry/Fisheries	Solid	CO_2	4 066	751	-82%	8.4%	6.2
1.A.5 Other	Gaseous	CO_3	565	675	20%	9.5%	2.0
1.A.5 Other	Liquid	CO_2	15 971	6 992	-56%	6.5%	3.0
1.A.5 Other	Solid	CO_2	4 667	7	-100%	7.6%	7.6
1.A.1 Energy Industries	Biomass	CH_4	79	247	215%	49.7%	64.0
1.A.1 Energy Industries	Gaseous	CH_4	183	508	178%	25.8%	26.6
1.A.1 Energy Industries	Liquid	CH_4	162	106	-34%	47.7%	8.9
1.A.1 Energy Industries	Other	CH_4	31	60	94%	40.2%	30.4
1.A.1 Energy Industries	Solid	CH_4	412	264	-36%	43.1%	22.7
1.A.2 Manufacturing industries and construction	Biomass	CH_4	139	166	20%	99.3%	32.3
1.A.2 Manufacturing industries and construction	Gaseous	CH_4	211	358	70%	32.1%	35.7
1.A.2 Manufacturing industries and construction	Liquid	CH_4	186	154	-17%	34.8%	10.3
1.A.2 Manufacturing industries and construction	Other	CH_4	13	16	23%	24.9%	13.8
1.A.2 Manufacturing industries and construction	Solid	CH_4	745	498	-33%	22.7%	12.8
1.A.4 Other Sectors	Biomass	CH_4	6 262	4 816	-23%	72.0%	43.4
1.A.4 Other Sectors	Gaseous	CH_4	638	1 383	117%	65.2%	76.4
1.A.4 Other Sectors	Liquid	CH_4	388	284	-27%	77.5%	12.4
1.A.4 Other Sectors	Other	CH_4	19	23	24%	75.1%	123.3
1.A.4 Other Sectors	Solid	CH_4	4 005	464	-88%	43.8%	28.3
1.A.5 Other	Gaseous	CH_4	0.1	0.3	377%	60.3%	227.2
1.A.5 Other	Liquid	CH_4	38	11	-71%	36.6%	35.7
1.A.5 Other	Solid	CH_4	210	0	-100%	72.1%	74.4
1.A.1 Energy Industries	Biomass	N_2O	182	701	286%	31.9%	16.0
1.A.1 Energy Industries	Gaseous	N_2O	411	1 146	179%	193.0%	362.5
1.A.1 Energy Industries	Liquid	N_2O	1 240	1 124	-9%	117.0%	33.6
1.A.1 Energy Industries	Other	N_2O	196	565	189%	81.8%	75.1
1.A.1 Energy Industries	Solid	N_2O	7 417	6 337	-15%	73.5%	7.0
1.A.2 Manufacturing industries and construction	Biomass	N_2O	453	686	51%	163.4%	44.7
1.A.2 Manufacturing industries and construction	Gaseous	N_2O	840	1 308	56%	42.3%	18.0
1.A.2 Manufacturing industries and construction	Liquid	N_2O	3 285	3 343	2%	95.5%	25.8
1.A.2 Manufacturing industries and construction	Other	N_2O	62	156	149%	74.5%	140.1
1.A.2 Manufacturing industries and construction	Solid	N_2O	2 328	1 023	-56%	30.1%	11.5
1.A.4 Other Sectors	Biomass	N_2O	1 088	1 443	33%	139.9%	19.2
1.A.4 Other Sectors	Gaseous	N_2O	798	1 235	55%	27.6%	12.0
1.A.4 Other Sectors	Liquid	N_2O	3 702	3 104	-16%	280.7%	12.5
1.A.4 Other Sectors	Other	N_2O	24	89	275%	348.5%	311.6
1.A.4 Other Sectors	Solid	N_2O	1 161	235	-80%	36.1%	26.7
1.A.5 Other	Gaseous	N_2O	1	2	97%	62.4%	68.2
1.A.5 Other	Liquid	N_2O	222	132	-40%	123.1%	74.3
1.A.5 Other	Other	N_2O	439	272	-38%	61.8%	23.6
1.A.5 Other	Solid	N_2O	15	0	-99%	35.9%	48.2
Total		**all**	**2 460 749**	**2 318 619**	**-6%**	**1.3%**	**0.4**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories; uncertainty estimates include for Spain 2006 data.

Table 3.100 shows the total EU-15 uncertainty estimates for the sector 1.B 'Fugitive emissions' and the uncertainty estimates for the relevant gases for each source category. The highest level and trend uncertainties were estimated for CH_4 from 1B1 and the lowest for CH_4 from 1B2.

Table 3.100 1B Fugitive Emissions: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2007	Emission trends 1990-2007	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.B.1 Solid fuels	CO_2	2 074	1397	-33%	28.5%	8.1
1.B.2 Oil and natural gas	CO_2	17 352	16 973	-2%	33.9%	10
1.B.1 Solid fuels	CH_4	46 333	9 156	-80%	82.3%	49
1.B.2 Oil and natural gas	CH_4	31387	22 805	-27%	21.9%	4
1.B.1 Solid fuels	N_2O	4	3	-40%	50.9%	31
1.B.2 Oil and natural gas	N_2O	98	102	4%	77.2%	5
Total	**all**	**97 247**	**50 436**	**-48%**	**21.6%**	**22**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories; uncertainty estimates include for Spain 2006 data.

Table 3.101 shows the total EU-15 uncertainty estimates for the sector 1A3 'Transport' and the uncertainty estimates for the relevant gases for each source category. The highest uncertainty was estimated for N_2O from 1A3a and the lowest for CO_2 from 1A3e. With regard to trend N_2O from 1A3a shows the highest uncertainty estimates, CO_2 from 1A3e the lowest.

Table 3.101 1A3 Transport: Uncertainty estimates for EU-15

Source category	Gas	Emissions 1990	Emissions 2007	Emission trends 1990-2007	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
1.A.3.a Civil aviation	CO_2	16 561	21 871	32%	36.5%	12
1.A.3.b Road transport	CO_2	637 514	794 384	25%	2.4%	1
1.A.3.c Railways	CO_2	8 100	5 819	-28%	62.4%	14
1.A.3.d Navigation	CO_2	19 493	21 646	11%	14.8%	4
1.A.3.e Other	CO_2	6 502	7 172	10%	1.9%	0
1.A.3.a Civil aviation	CH_4	11	8	-22%	39.9%	15
1.A.3.b Road transport	CH_4	4 252	1 355	-68%	13.3%	12
1.A.3.c Railways	CH_4	12	8	-30%	46.8%	15
1.A.3.d Navigation	CH_4	55	58	7%	19.3%	7
1.A.3.e Other	CH_4	16	17	3%	43.7%	57
1.A.3.a Civil aviation	N_2O	165	233	41%	309.3%	110
1.A.3.b Road transport	N_2O	5 379	10 737	100%	5.3%	2
1.A.3.c Railways	N_2O	365	371	2%	136.7%	45
1.A.3.d Navigation	N_2O	176	180	2%	249.6%	53
1.A.3.e Other	N_2O	90	121	36%	35.8%	33
Total	**all**	**698 690**	**863 981**	**24%**	**2.3%**	**1**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories; uncertainty estimates include for Spain 2006 data.

3.4 Sector-specific quality assurance and quality control (EU-15)

There are several activities for improving the quality of GHG emissions from energy: Before and during the compilation of the EC GHG inventory, several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency. In the second half of the year, the EC internal review is carried out for selected source categories. In 2006 the following source categories have been reviewed by Member States experts: 1A1 'Energy industries', 1A2a 'Iron and steel production' and 1.B 'Fugitive emissions from fuels'. In 2005, the EC internal review was carried out for the first time. In this pilot exercise two Member States experts reviewed the source categories 1A2 'Manufacturing industries' and 1A3 'Transport'. In 2008, N_2O from road transport were subject to the EC internal review.

Since the inventory 2005 plant-specific data is available from the EU Emission Trading Scheme (EU ETS). This information has been used by EC Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see Section 1.4.2).

After the annual compilation of the GHG inventory Eurostat checks with Member States remaining differences found when comparing the Member States’ reference approach with the Eurostat reference approach. This crosscheck between the the European energy reporting system and the EC GHG inventory system is an important QA/QC element of the EC GHG inventrory compilation.

The quality of the EC GHG inventory is directly affected by the quality of Member States and EC energy statistics systems. Currently EC energy statistics are collected on the basis of gentlemen's' agreement. The Joint Eurostat/IEA/UNECE energy questionnaires are used for gathering nationally collected data. Since its creation in the early fifties, when the European energy statistics were essentially a collection of the main national aggregated data, the system has followed the development of energy policies and markets and adapted to meet new demands. Recent developments have been:

- a new questionnaire (in 2000) covering Renewable Energy Sources; intensive efforts at national level and EC financial support since the early 1990's lead to the successful adoption of this questionnaire alongside the already established existing four joint questionnaires
- expanded electricity questionnaire (in 2004) to allow coherence with the UNFCCC CO_2 emissions reporting system
- development of CHP (2004) statistics, following pilot projects over a decade

In 2007 the Commission presented the energy statistics regulation as part of the energy package. This regulation aims at collecting detailed statistical data on energy flows by energy commodity at annual and monthly level. It ensures harmonised and coherent reporting of national energy data, which is indispensable for the assessment of EC energy policies and targets. The content and structure of this regulation reflects the essence of the existing European statistical system, a system that is part of the international energy statistical system, and is in direct link with the national statistical structures (classifications) and methodologies. It also has concrete links to other statistical domains, such as economic, environment, trade and business statistics. These links provide an additional dimension in safeguarding data quality assurance. The energy statistics regulation was adopted by the European Parliament and Council in 2008 and will be in force from 2009 onwards.

The European energy statistics system and the quality of the EC inventory will be directly affected by this regulation that will:

- ensure a stable and institutional basis for energy statistics in the EU,
- guarantee long-term availability of energy data for EC policies,
- reinforce available resources for the production of the basic energy statistics at national level

The energy statistics regulation will help improving the QA/QC of the EC inventory as it will:

- make available more detailed energy statistics by fuel,
- allow the estimation of CO_2 emissions from energy with the reference and sectoral approach
- assure the quality of the underlying energy statistics
- improve timeliness of energy statistics

- provide a formal legal framework assuring consistency between national and Eurostat data

Moreover, Article 6, paragraph 2 stipulates that:

'Every reasonable effort shall be undertaken to ensure coherence between energy data declared in the energy statistics regulation, and data declared in accordance with Commission Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol'.

It also foresees the further development of the energy statistics system setting a time frame for the production of more detailed data on renewable energy and final energy consumption, stating:

'With a view to improving the quality of energy statistics, the Commission (Eurostat), in collaboration with the Member States, shall make sure that these statistics are comparable, transparent, detailed and flexible by:

(a) reviewing the methodology used to generate renewable energy statistics in order to make available additional, pertinent, detailed statistics on each renewable energy source, annually and in a cost effective manner. The Commission (Eurostat) shall present and disseminate the statistics generated from 2010 (reference year) onwards

(b) reviewing and determining the methodology used at national and Community level to generate final energy consumption statistics (sources, variables, quality, costs) based on the current state of play, existing studies and feasibility pilot-studies, as well as cost-benefit analysis yet to be conducted; and evaluating the findings of the pilot studies and cost benefit analysis with the view to establishing breakdown keys for final energies by sector and main energy uses and gradually integrating the resulting elements in the statistics from 2012 (reference year) onwards.'

The first annual statistics based will be submitted to Eurostat on the basis of Energy Statistics Regulation in November 2010.

3.5 Sector-specific recalculations (EU-15)

Table 3.102 shows that in the energy sector the largest recalculations in absolute terms in 1990 and 2006 were made for CO_2. In relative terms the recalculations of N_2O emissions in 1990 were -3.3 % and in 2006, they were at - 16.6 %.

Table 3.102 Sector 1 Energy: Recalculations of total GHG emissions and recalculations of GHG emissions for the years 1990 and 2006 by gas in Gg (CO_2-eq.) and percentage

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	52,613	1.7%	-3,524	-0.8%	-12,777	-3.2%	11	0.0%	-680	-3.9%	0	0.0%
Energy	1,148	0.0%	813	0.9%	-1,022	-3.3%	NO	NO	NO	NO	NO	NO
2006												
Total emissions and removals	48,924	1.6%	293	0.1%	-16,310	-5.2%	58	0.1%	-299	-6.9%	165	1.9%
Energy	-19,188	-0.6%	532	1.2%	-7,135	-16.9%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 3.103 provides an overview of Member States' contributions to EU-15 recalculations. In absolute terms, Germany and the UK had the most influence on CO_2 recalculations in the EU-15 in 2006. The German recalculation s are mainly due to revision of activity data from 2003 onwards, changed split factor used for separating national and international aviation, and the newly reported use of bio-ethanol which is reported under biomass. The main reasons for recalcualtions in the UK are revisions to activity data presented in UK National Statistics (DUKES). N_2O recalculations were mainly influenced by Italy and the UK due to the switch from COPERT III to COPERT IV. Further explanations for the largest recalculations by Member State are provided in Section 10.1.

Table 3.103 **Sector 1 Energy: Contribution of Member States to EU-15 recalculations for 1990 and 2006 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)**

	1990						2006					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	-3	-130	NO	NO	NO	172	57	-23	NO	NO	NO
Belgium	-186	0	-6	NO	NO	NO	13	9	19	NO	NO	NO
Denmark	0	0	0	NO	NO	NO	490	38	1	NO	NO	NO
Finland	-39	0	0	NO	NO	NO	-366	-1	0	NO	NO	NO
France	2,460	12	-41	NO	NO	NO	2,656	-14	-52	NO	NO	NO
Germany	74	474	-302	NO	NO	NO	-15,333	-71	-212	NO	NO	NO
Greece	913	4	-153	NO	NO	NO	-359	-69	-218	NO	NO	NO
Ireland	-145	2	1	NO	NO	NO	-78	2	8	NO	NO	NO
Italy	-18	125	-607	NO	NO	NO	-1,411	-129	-2,555	NO	NO	NO
Luxembourg	-89	-5	7	NO	NO	NO	95	-15	-152	NO	NO	NO
Netherlands	0	64	0	NO	NO	NO	335	457	-3	NO	NO	NO
Portugal	139	17	4	NO	NO	NO	444	22	25	NO	NO	NO
Spain	-52	2	-48	NO	NO	NO	-1,125	12	2	NO	NO	NO
Sweden	-44	-5	-36	NO	NO	NO	698	18	-108	NO	NO	NO
UK	-1,866	128	289	NO	NO	NO	-5,420	217	-3,867	NO	NO	NO
EU-15	**1,148**	**813**	**-1,022**	**NO**	**NO**	**NO**	**-19,188**	**532**	**-7,135**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.6 Comparison between the sectoral approach and the reference approach (EU-15)

The IPCC reference approach for CO_2 from fossil fuels for the EU-15 is based on Eurostat energy data (NewCronos database, March 2009 version). This submission includes the reference approach tables for 1990–2007.

Energy statistics are submitted to Eurostat by Member States on an annual basis with the five joint Eurostat/IEA/UNECE questionnaires on solid fuels, oil, natural gas, electricity and heat, and renewables and wastes. On the basis of this information Eurostat compiles the annual energy balances which are used for the estimation of CO_2 emissions from fossil fuels by Member State and for the EU-15 as a whole.

The Eurostat data for the EU-15 IPCC reference approach includes activity data, net calorific values and carbon emission factors as available in the Eurostat NewCronos database. In the CRF Table 1.A(b) some fuel categories are grouped and average net calorific values are used: 'Orimulsion' is included in 'Residual fuel oil'. 'Natural gas liquids' is included in 'Crude oil'. 'Other kerosene' is included in 'Total kerosene'. 'Anthracite', 'Coking coal' and 'Other bituminous coal' are referred to in the Eurostat NewCronos database as 'Hard coal' and are included in CRF Table 1.A(b) under 'Other bituminous coal'. 'Solid biomass', 'Liquid biomass' and 'Gas biomass' is included in 'Total biomass'. For international bunkers, only fuel consumption for international navigation is available in the NewCronos database; data on international aviation is taken from the EU-15 sectoral approach. For the calculation of CO_2 emissions, the IPCC default carbon emission factors are used in the Eurostat database.

The IPCC reference approach method at EU-15 level is a four-step process.

Step 1: For each Member State, annual data on energy production, imports, exports, international bunkers (except international aviation) and stock changes are available in the Eurostat database in fuel specific units (i.e. kt (= 1 000 tonnes)) for solid fuels and petroleum products, TJ for natural gas). The apparent consumption in TJ is calculated for each Member State by using country-specific average net calorific values. These net calorific values are updated annually for solid fuels together with the energy data in the NewCronos database; for petroleum products the net calorific values are kept constant. For groups of fuels average weighted net calorific values are used, which is the case for 'Other bituminous coal' and 'Lignite'.

Step 2: The EU-15 CRF Table 1.A(b) are calculated by adding the relevant Member State activity and emission data, as calculated under Step 1. The net calorific values provided for the EU-15 in CRF

Table 1.A(b) are calculated from dividing apparent consumption in TJ by apparent consumption in fuel-specific units for each fuel. Therefore, these net calorific values are 'implied calorific values'; there are no fuel-specific net calorific values at EU-15 level.

Step 3: Fuel consumption from international aviation is included in Tables 1.A(b) from the Table 1.C from the EU-15 sectoral approach.

Step 4: For the calculations of carbon stored in Tables 1.A(d), Eurostat data on non-energy use of fuels are used, as reported by Member States in the joint questionnaire. For the fraction of carbon stored and carbon emission factors IPCC default values are taken (IPCC, 1997).

Table 3.104 shows the apparent energy consumption from fossil fuel combustion from 1990 to 2006 as provided in Tables 1.A(b). Total fossil fuel energy consumption increased by 10 % between 1990 and 2006. Large increases had gas consumption (+69 %), whereas solid fuel combustion declined by 27 %.

Table 3.105 compares EU-15 CO_2 emissions calculated with the IPCC reference approach based on Eurostat data and the sectoral approach available from Member States. The reference approach and the sectoral approach, increased by 0.8 % and 1.5 % respectively between 1990 and 2007; the percentage differences between the two data sets are below 1.2 % for all years.

Table 3.104 Reference Approach: Apparent EU-15 energy consumption (in PJ) (Eurostat data)

Fuel types	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Liquid Fuels	22.143	23.309	23.702	23.641	24.128	23.849	23.380	23.946	23.662	23.827	23.711	23.535	23.189	22.407
Solid Fuels	12.555	9.829	9.739	9.286	9.281	8.616	9.010	9.074	9.070	9.331	9.380	9.028	9.107	9.333
Gaseous Fuels	9.355	11.519	12.791	12.675	13.215	13.787	14.204	14.543	14.655	15.335	15.761	16.150	15.836	15.702
Total	**44.053**	**44.657**	**46.231**	**45.602**	**46.625**	**46.252**	**46.595**	**47.563**	**47.388**	**48.493**	**48.852**	**48.714**	**48.133**	**47.442**

Table 3.105 IPCC Reference approach (Eurostat data) and sectoral approach (Member State data) for EU-15 (in Tg)

CO2 emissions	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sectoral approach	3.111	3.044	3.130	3.067	3.115	3.093	3.111	3.185	3.172	3.236	3.241	3.212	3.203	3.137
Reference approach	3.128	3.052	3.149	3.082	3.142	3.094	3.114	3.186	3.189	3.260	3.279	3.244	3.218	3.175
Percentage difference	-0,5%	-0,3%	-0,6%	-0,5%	-0,9%	0,0%	-0,1%	-0,1%	-0,5%	-0,7%	-1,1%	-1,0%	-0,5%	-1,2%

Table 3.106 provides an overview by Member State on differences between the Eurostat and national reference approach for 1990 and 2006/2007. The differences can occur due to differences in the basic energy data or due to differences when calculating CO_2 emissions from the basic energy data. The main reasons for diverging energy data are:

- the use of different calorific values (CV) mainly for oil products, BKB (lignite briquettes) and patent fuels. For BKB and patent fuels, Eurostat is using the same CV for all countries which differs from the calorific values used by the Member States;
- small differences in the basic energy balance data reported by Member States to Eurostat (in the joint questionnaires) and to the Commission and the UNFCCC (in the CRF tables).

The main reasons for diverging CO_2 emissions are:

- differences in the treatment of non-energy use of fossil fuels and carbon stored;
- the use of country-specific emission factors. The Eurostat reference approach uses the IPCC default emission factors.

To explain and resolve these differences Eurostat launched a project for harmonisation of the two (joint questionnaires and CRF) reporting systems of energy data and for revision of reported energy data back to 1990. Recently Eurostat has revised the CVs for liquid fuels which led to improved consistency with MS energy balance data which is also reflected in the comparisons below.

Table 3.105 shows the comparison between Eurostat and national reference approach for apparent consumption and CO_2 from fuel combustion for the EU-15 MS. For the EU-15 as a whole there is a difference of 0.6 % between the two approaches for apparent consumption in 2007. Most MS are within 2 % (Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, Netherlands, Spain and the UK). No differences of more than 5 % can be observed.

The differences of CO_2 emissions for 2007 range from +5 % (Ireland) to -21 % (Sweden). The reasons for these large differences have to be further analysed. For the EU-15 as a whole the difference for

CO_2 emissions is -0.7 % in 2007.

A comparison of these tables with the tables provided in the 2008 submission shows that for 1990 13 EU-15 Member States have now a better fit for apparent consumption than in 2007; however for 2006 only six Member States have a better fit. For CO_2 emissions of 1990 ten Member States show a better fit in 2008 than in 2007 whereas for 2006 again six Member States have a better fit.

Table 3.106 Comparison between Eurostat and national reference approach for CO_2 from fuel combustion for EU-15 (CRF 1.A) ([26])

EU-15

1990	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)
Liquid fossil fuels	22,143,202	1,424,335	22,316,517	1,441,201	0.8%	1.2%
Solid fossil fuels	12,555,030	1,190,066	12,588,218	1,161,278	0.3%	-2.4%
Gaseous fossil fuels	9,355,246	513,439	9,392,679	510,049	0.4%	-0.7%
Total	**44,053,478**	**3,127,840**	**44,297,414**	**3,112,528**	**0.6%**	**-0.5%**
2006	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)
Liquid fossil fuels	23,189,321	1,480,145	23,828,063	1,501,987	2.8%	1.5%
Solid fossil fuels	9,107,016	861,192	9,251,668	853,745	1.6%	-0.9%
Gaseous fossil fuels	15,836,425	876,591	15,803,346	875,762	-0.2%	-0.1%
Total	**48,132,762**	**3,217,928**	**48,883,078**	**3,231,494**	**1.6%**	**0.4%**
2007	Eurostat reference approach		National reference approach		Percentage difference	
	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)	Apparent consumption (TJ)	CO2 emissions (Gg)
Liquid fossil fuels	22,407,361	1,422,328	22,858,093	1,431,678	2.0%	0.7%
Solid fossil fuels	9,332,662	883,151	9,238,135	856,736	-1.0%	-3.0%
Gaseous fossil fuels	15,702,357	869,057	15,609,694	864,896	-0.6%	-0.5%
Total	**47,442,380**	**3,174,536**	**47,705,922**	**3,153,310**	**0.6%**	**-0.7%**

Apparent consumption

2007	Liquid fuels			Solid fuels			Gaseous fuels			Total fuels		
	National	Eurostat	Difference	National	Eurostat	Difference	National	Eurostat	Difference	National	Eurostat	Difference
	PJ	PJ	%	PJ	PJ	%	PJ	PJ	%	PJ	PJ	%
AT	561	551	2%	159	163	-2%	295	292	1%	1.015	1.006	1%
BE	924	889	4%	193	193	0%	627	625	0%	1.744	1.707	2%
DK	314	311	1%	204	195	5%	170	170	0%	688	675	2%
FI	409	425	-4%	304	302	1%	156	156	0%	869	883	-2%
FR	3.636	3.560	2%	553	549	1%	1.608	1.611	0%	5.797	5.720	1%
DE	4.408	4.280	3%	3.605	3.641	-1%	3.100	3.209	-3%	11.113	11.130	0%
GR	724	683	6%	372	454	-18%	135	140	-4%	1.230	1.277	-4%
IE	344	323	7%	96	96	1%	180	179	0%	621	599	4%
IT	3.319	3.181	4%	703	703	0%	2.930	2.911	1%	6.952	6.795	2%
LU	101	103	-2%	5	3	49%	50	50	0%	156	157	-1%
NL	1.352	1.375	-2%	357	348	3%	1.395	1.395	0%	3.104	3.118	0%
PT	575	553	4%	121	121	0%	160	159	0%	856	833	3%
ES	2.805	2.821	-1%	851	844	1%	1.335	1.334	0%	4.991	4.999	0%
SE	532	554	-4%	107	111	-3%	34	38	-10%	674	703	-4%
GB	2.853	2.800	2%	1.608	1.610	0%	3.434	3.432	0%	7.895	7.841	1%
EU15	22.858	22.407	2%	9.238	9.333	-1%	15.610	15.702	-1%	47.706	47.442	1%

([26]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

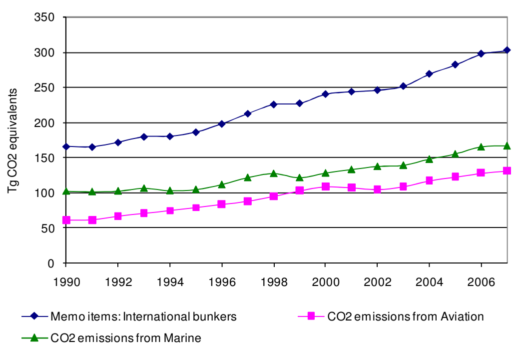
CO_2 emissions

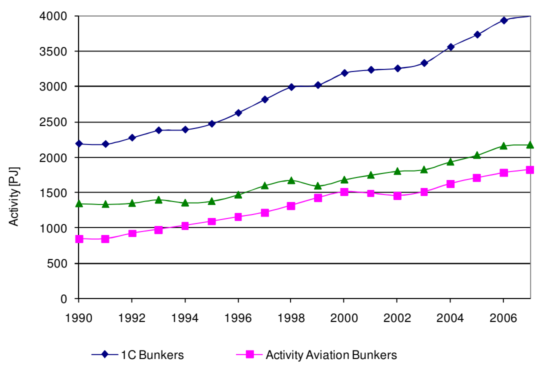
2007	Liquid fuels			Solid fuels			Gaseous fuels			Total fuels		
	National	Eurostat	Difference	National	Eurostat	Difference	National	Eurostat	Difference	National	Eurostat	Difference
	Tg	Tg	%	Tg	Tg	%	Tg	Tg	%	Tg	Tg	%
AT	37	36	2%	15	16	-4%	16	16	2%	68	68	1%
BE	51	50	3%	18	18	0%	34	34	0%	104	102	1%
DK	22	22	2%	19	18	6%	10	9	1%	51	50	3%
FI	25	28	-10%	28	29	-3%	8	9	-4%	62	66	-6%
FR	226	226	0%	51	51	0%	88	89	0%	366	365	0%
DE	277	248	12%	315	350	-10%	169	178	-5%	762	776	-2%
GR	52	48	7%	45	45	0%	8	8	-3%	104	101	3%
IE	25	23	7%	10	9	3%	10	10	3%	45	42	5%
IT	211	209	1%	66	65	1%	161	162	0%	438	437	0%
LU	7	7	-2%	0	0	22%	3	3	1%	10	11	-1%
NL	58	78	-25%	33	32	3%	77	76	1%	169	186	-10%
PT	37	35	3%	11	11	-3%	9	9	0%	56	56	2%
ES	185	190	-3%	81	78	3%	74	74	0%	340	342	-1%
SE	30	34	-12%	7	11	-36%	2	2	-9%	38	46	-17%
GB	188	186	1%	158	150	6%	194	191	2%	540	527	3%
EU15	1.432	1.422	1%	857	883	-3%	865	869	0%	3.153	3.175	-1%

3.7 International bunker fuels (EU-15)

International bunker emissions include emissions from Aviation bunkers and Marine bunkers. The emissions of the EC inventory are the sum of the international bunker emissions of the Member States ([27]). Between 1990 and 2007, greenhouse gas emissions from international bunker fuels increased by 82 % in the EU-15. CO_2 emissions from “Marine bunkers” account for 55 % of total greenhouse gas emissions from international bunkers in 2007, CO_2 from “Aviation bunkers” accounts for 45 % (Figure 3.93).

Figure 3.93 International bunker fuels: GHG emission trend and activity data





3.7.1 Aviation bunkers (EU-15)

This source category includes emissions from flights that depart in one country and arrive in a different country (include take-offs and landings for these flight stages)

([27]) The definitions in Tables 2.8 and 2.9 of the IPCC good practice guidance are based on activities within ‘one country”. This means domestic aviation is defined for individual countries. The decision tree in Figure 2.8 of the IPCC good practice guidance considers ‘national fuel statistics’ for domestic aviation. As the EC is neither a country nor a nation, the EC’s interpretation of the good practice guidance is that the emission estimate at EC level has to be the sum of Member States estimates for domestic air or marine transport as they are the countries or nations addressed in the definition and decision trees of the IPCC good practice guidance.

CO_2 emissions from Aviation Bunkers account for 3.2 % of total GHG emissions in 2007 but are not included in the national total GHG emissions. Between 1990 and 2007, CO_2 emissions from Aviation bunkers increased by 102 % in the EU-15 (Table 3.107).

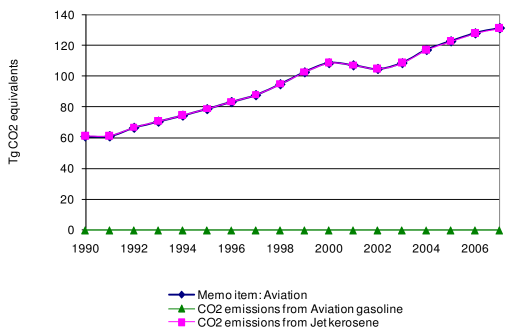
The Member States France, the Netherlands, Germany and the United Kingdom contributed the most to the emissions from this source (115 %). All Member States increased emissions from Aviation bunkers between 1990 and 2007. The Member States with the highest increases in absolute terms were the United Kingdom, Germany and France. The countries with the lowest increase in absolute terms were Greece, Finland and Belgium.

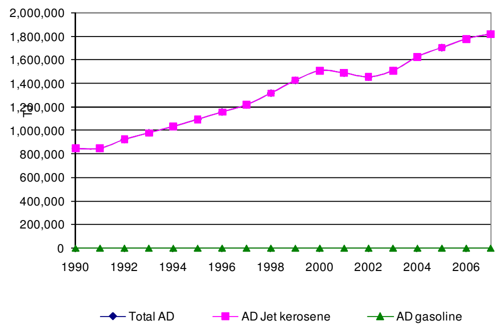
Table 3.107 Aviation bunkers: Member States' contributions to CO_2

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 1990-2007		Change 2006-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	886	2,049	2,176	1.7%	1,290	146%	127	6%
Belgium	3,096	3,684	3,787	2.9%	691	22%	103	3%
Denmark	1,736	2,583	2,701	2.1%	965	56%	118	4%
Finland	1,012	1,440	1,662	1.3%	651	64%	222	13%
France	8,549	16,419	17,119	13.0%	8,570	100%	699	4%
Germany	11,412	24,351	25,273	19.2%	13,861	121%	922	4%
Greece	2,448	2,863	2,923	2.2%	476	19%	60	2%
Ireland	1,061	2,843	3,000	2.3%	1,939	183%	157	5%
Italy	4,161	9,833	10,430	7.9%	6,270	151%	597	6%
Luxembourg	402	1,237	1,328	1.0%	926	230%	91	7%
Netherlands	4,540	10,975	11,097	8.4%	6,556	144%	122	1%
Portugal	1,454	2,368	2,500	1.9%	1,046	72%	132	5%
Spain	3,441	9,907	10,420	7.9%	6,979	203%	513	5%
Sweden	1,335	2,006	2,195	1.7%	859	64%	188	9%
United Kingdom	15,697	35,642	34,963	26.6%	19,266	123%	-679	-2%
EU-15	**61,228**	**128,201**	**131,574**	**100.0%**	**70,346**	**115%**	**3,373**	**3%**

CO_2 emissions from Jet kerosene account for 99,7 % of total emissions from "Aviation bunkers" in 2007 (Figure 3.94). All Member States increased emissions from Jet kerosene between 1990 and 2007. Member States with the highest increase in percent were Luxembourg, Spain and Ireland. The country with the lowest increase was Belgium.

Figure 3.94 Aviation bunkers: Trend of CO_2Emissions and Activity Data

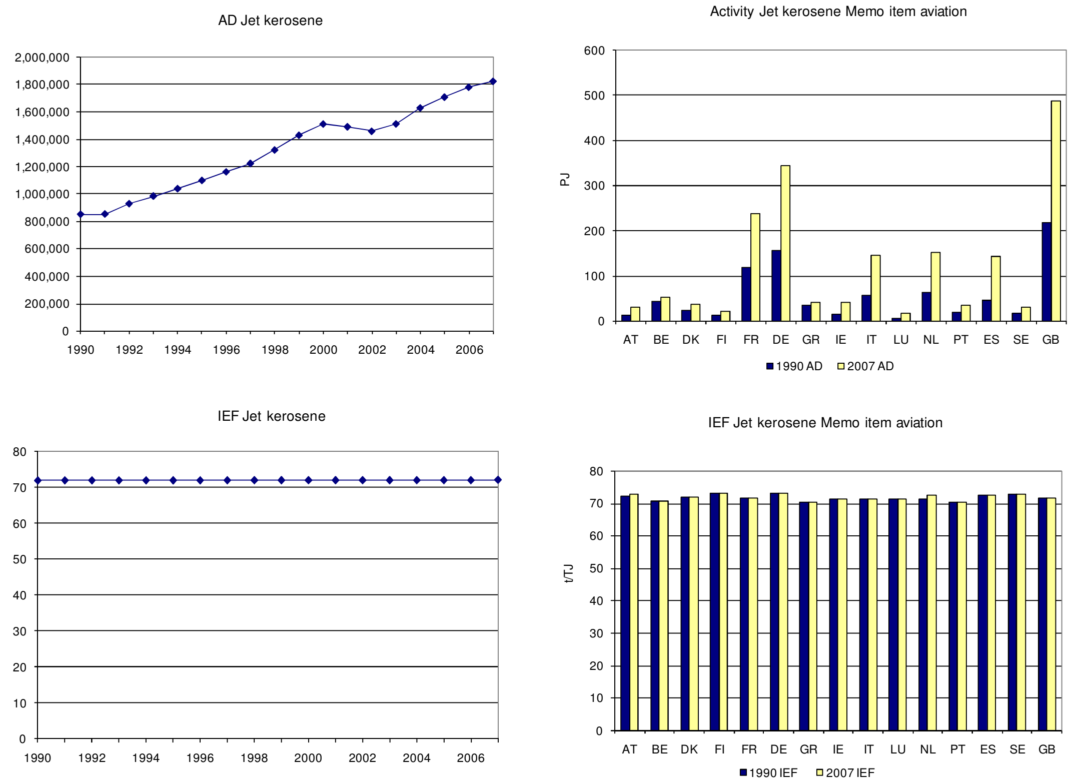




Aviation Bunkers – Jet Kerosene (CO_2)

Figure 3.95 provides an overview of activity data and emission factors for EU-15 and those Member States contributing most to EU-15 emissions. Fuel combustion of EU-15 increased by 115 % between 1990 and 2007. The EU-15 implied emission factor was at 72.1 t/TJ in 2007.

Figure 3.95 Aviation bunkers, Jet kersoene: Activity Data and Implied Emission Factors for CO_2



3.7.2 Marine bunkers (EU-15)

This source category includes emissions from fuels used by vessels of all flags that are engaged in international water-borne navigation. The international navigation may take place at sea, on inland lakes and waterways and in coastal waters. Marine bunkers include emissions from journeys that depart in one country and arrive in a different country. Marine bunkers exclude consumption by fishing vessels (see Other Sector - Fishing).

CO_2 emissions from “Marine bunkers” account for 4.1 % of total GHG emissions in 2007 and are also not included in the national total GHG emissions. Between 1990 and 2007, CO_2 emissions from Marine bunkers increased by 63 % in the EU-15 (Table 3.108).

The Member States Spain, the Netherlands and Belgium contributed most to the emissions from this source (65 %). All Member States except for Finland increased emissions from Marine bunkers between 1990 and 2007. The Member States with the highest increase in absolute terms again were Spain, the Netherlands and Belgium. Austria and Luxembourg reported emission estimates as ‘Not Applicable’.

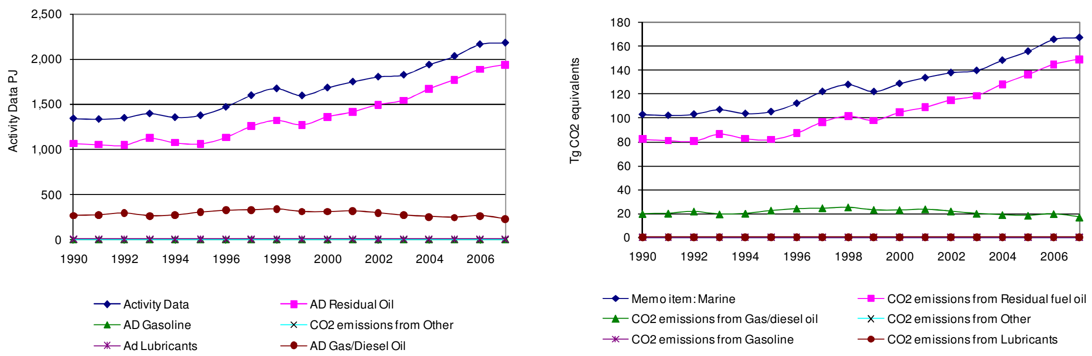
Table 3.108 Marine bunkers:Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 1990-2007		Change 2006-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	13,303	27,285	30,427	18.2%	17,124	129%	3,143	10%
Denmark	3,087	3,433	3,559	2.1%	472	15%	126	4%
Finland	1,845	1,816	1,490	0.9%	-354	-19%	-326	-22%
France	7,955	9,100	9,338	5.6%	1,384	17%	238	3%
Germany	7,980	8,320	9,923	5.9%	1,943	24%	1,603	16%
Greece	8,028	9,800	10,012	6.0%	1,984	25%	211	2%
Ireland	57	404	357	0.2%	300	529%	-47	-13%
Italy	4,389	7,442	7,756	4.6%	3,366	77%	314	4%
Luxembourg	0	0	0	-	-	-	-	-
Netherlands	34,357	56,224	51,385	30.7%	17,028	50%	-4,839	-9%
Portugal	1,383	1,674	1,760	1.1%	377	27%	86	5%
Spain	11,528	26,244	26,850	16.1%	15,322	133%	606	2%
Sweden	2,228	7,140	7,418	4.4%	5,190	233%	278	4%
United Kingdom	6,680	6,807	6,912	4.1%	231	3%	104	2%
EU-15	**102,819**	**165,689**	**167,186**	**100.0%**	**64,366**	**63%**	**1,496**	**1%**

CO_2 emissions from Residual fuel oil account for 90 % of total emissions from "Marine bunkers" in 2007 (Figure 3.96). Between 1990 and 2007, CO_2 emissions from Residual fuel oil increased by 82 % in the EU-15. All Member States except for Finland increased emissions from Residual oil between 1990 and 2007. Member States with the highest increase in percent were Ireland and Sweden. The countries with the lowest increase were Austria, Belgium, France and the UK.

CO_2 emissions from Gas/Diesel oil account for 10 % of total emissions from "Marine bunkers" in 2007. Between 1990 and 2007, CO_2 emissions from Gas/Diesel oil decreased by 15 % in the EU-15.

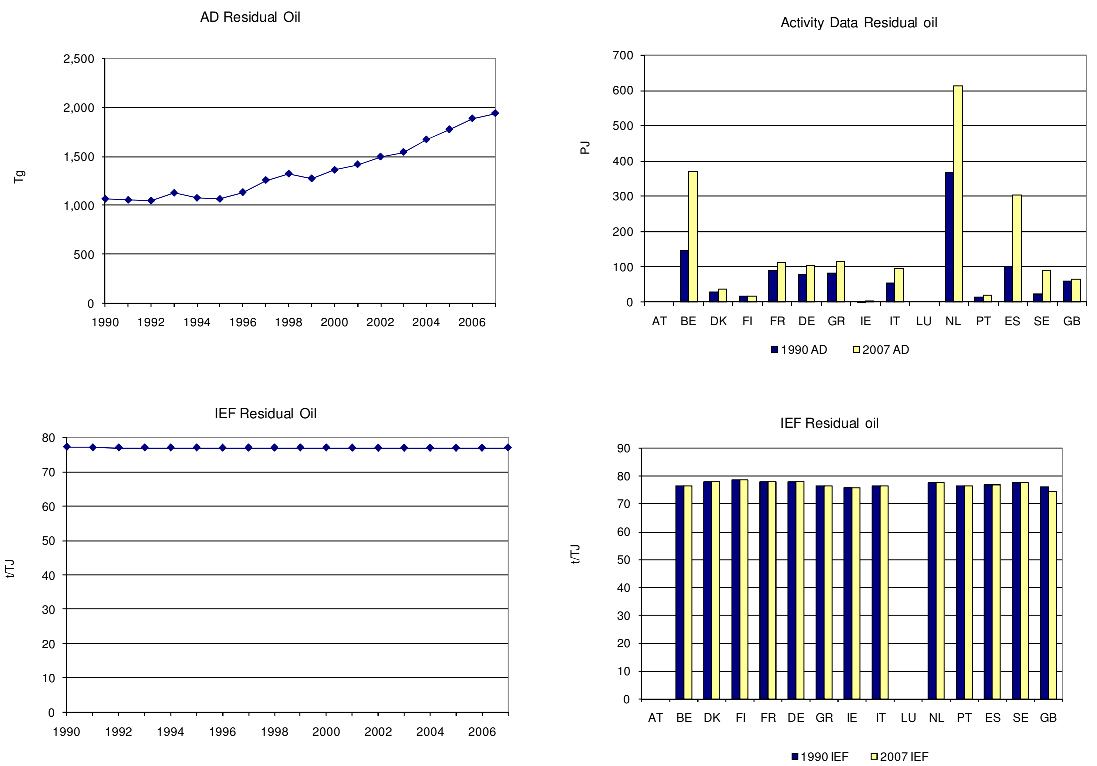
Figure 3.96 Marine bunkers: Trend of CO_2 Emissions and Activity Data



Marine Bunkers – Residual Oil (CO_2)

Figure 3.97 provides an overview of activity data and emission factors for EU-15 and those Member States contributing most to EU-15 emissions. Fuel combustion of EU-15 increased by 82 % between 1990 and 2007. The EU-15 implied emission factor was at 77.1 t/TJ in 2007.

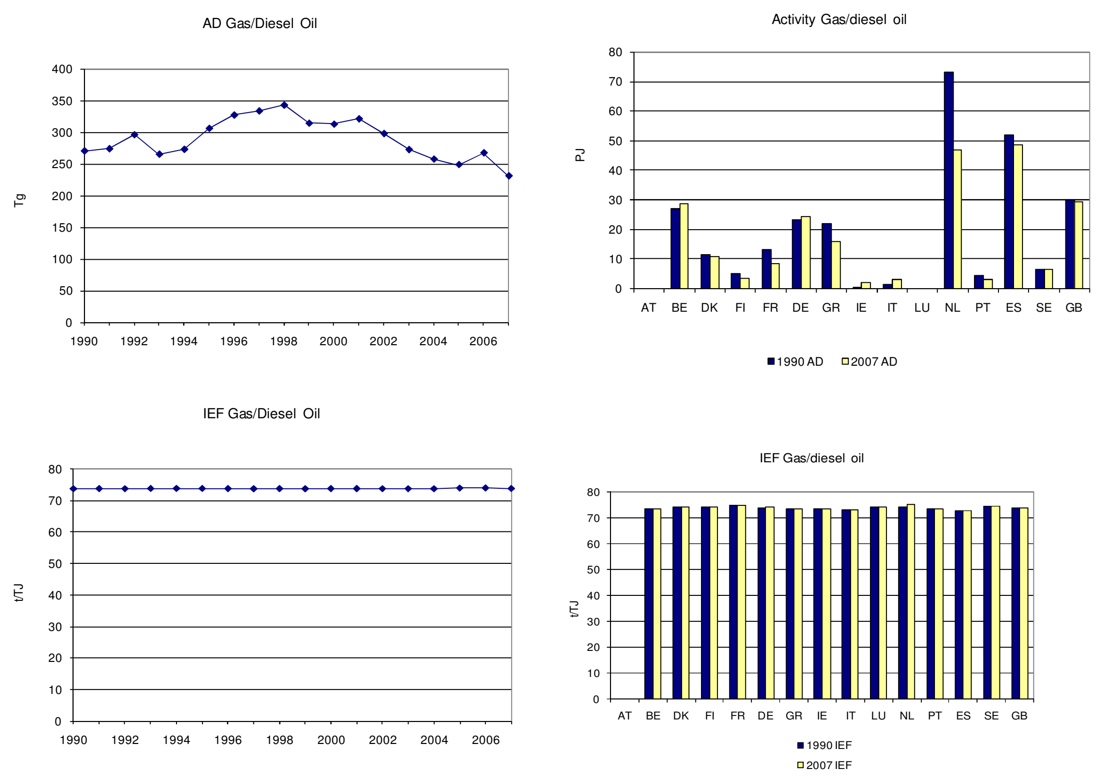
Figure 3.97 Marine bunkers' – Residual Oil:Activity Data and Implied Emission Factors for CO_2



Marine Bunkers – Gas/Diesel Oil (CO_2)

Figure 3.98 provides an overview of activity data and emission factors for EU-15 and those Member States contributing most to EU-15 emissions. Fuel combustion of EU-15 decreased by 15 % between 1990 and 2007. The EU-15 implied emission factor was at 73.79 t/TJ in 2007.

Figure 3.98 Marine bunkers, Gas/Diesel Oil: Activity Data and Implied Emission Factors for CO_2



QA/QC activities

The European Topic Centre on Air and Climate Change conducted a study in 2007 based on aviation emission estimates from Member States and calculations by the European Organisation for the Safety of Air Navigation (Eurocontrol). The purpose of the study was to compare emissions reported by Member States with modelling results provided by Eurocontrol to assess the quality of the emissions estimates and help identify areas in need for improvement. The calculations by Eurocontrol are based on flight movement data using an independent data set whereas most Member States use fuel sale statistics. The study assessed three questions: (i) how consistent are estimates for total fuel consumption between the two data sets; (ii) how consistent are estimates for the share of domestic aviation between the two data sets; (iii) does the consistency between the two estimates depend on the type of methodology applied by Member States. The main conclusions of the study were:

(1) Comparing country estimates for fuel burn, CO_2 emissions and NOx with Eurocontrol calculations is a genuine quality assurance exercise which can help both sides in improving their data. Despite significant uncertainties in the estimates the comparison was able to identify countries for which the differences could not be easily explained and where countries as well as Eurocontrol might need to do further analysis. Especially for the share of domestic aviation Eurocontrol data might be of use to several countries in the future.

(2) The analysis showed that although in theory CO_2 estimates from aviation do not depend on the tier chosen, in practice countries applying higher tiers also had more consistent carbon dioxide emission estimates. One of the reasons might be that the application of higher tiers requires detailed statistics in the aviation sector which might also be reflected in the fuel sale estimates.

(3) The use of bottom-up data for the determination of the split between domestic and international aviation could improve the accuracy of inventory estimates. The small country approach is a good and very easy methodology for countries without domestic IFR/GAT aviation; research projects can produce good estimates for the share of domestic emissions. Out of the 29 countries assessed those applying expert judgement or top-down data had the highest discrepancies compared to Eurocontrol.

(4) In general, the European countries tend to overestimate domestic emissions. This is a conservative approach as it increases the emissions included in the emission reduction commitment under the Kyoto Protocol. For the same reason it would be in the interest of the concerned countries to improve their estimates: greenhouse gas emissions from aviation have increased substantially since 1990 and overestimating the domestic share will exacerbate the efforts for reaching the national targets. Applying the share of domestic aviation as calculated by Eurocontrol to total fuel consumption in the EU-15 leads to an overestimation of domestic emissions from aviation by 6.2 Mt CO_2 in 2005.

(5) In theory, Eurocontrol data could be used to compile national inventory reports for its Member States. The data has several advantages, most importantly the timely preparation and estimation of emissions using a Tier 3 methodology without additional resource requirements for inventory agencies. However, several issues need to be solved before Eurocontrol data can be used:

- Consistent time series: Eurocontrol has no data for the years 1990 – 1995 and only limited information for 1996 – 2002. Additional information will be necessary to compile a consistent time series.
- Consistency with national statistics: National statistics could be used to complement the modelled data to ensure consistency and completeness with the reference approach. In addition, energy statistics often have a lower uncertainty than the fuel consumption data calculated with ANCAT 3.
- Completeness: Eurocontrol only covers certain geographic areas and certain types of flights. Inventory agencies will need to ensure that all emissions are covered in the national inventory report independent of the coverage of Eurocontrol.

3.8 Feedstocks and non-energy use of fuels

Following a recommendation of the expert review team the EC GHG inventory team analysed in more detail the fractions of carbon stored as used by the EC and its Member States. The recommendation of the ERT was to use weighted average fractions in order to potentially reduce the differences for apparent consumption between the reference approach and the sectoral approach. During this exercise the EC inventory team found an error in Table 1.A(c) which was mainly responsible for the relatively large differences in the previous years. Apart from removing this error the EC inventory team also revised the fractions of carbon stored for those fuels where the IPCC default values (used by the EC up to 2008) are far from the weighted averages of the EC Member States (i.e for natural gas and lubricants). Table 3.109 provides an overview of the fraction of carbon stored by fuel as used in the EC GHG inventory 2009. These values are compared with the IPCC default values and the weighted average values of the EU-15 MS.

Table 3.109 **Fraction of carbon stored from Table 1A(c) used by the EU-15 Member States compared with IPCC default values and the values used in the EC GHG inventory 2009**

2007	Weighted average based on EU-15 MS GHG inventories 2009	IPCC default (used by the EC before 2009)	Values used in the EC GHG inventory 2009
Naphtha	0,76	0,75	0,75
Lubricants	0,74	0,50	0,75
Bitumen	1,00	1,00	1,00
Coal Oils and Tars	0,78	0,75	0,75
Natural Gas	0,53	0,33	0,50
Gas/Diesel Oil	0,60	0,50	0,50
LPG	0,75	0,80	0,80
Ethane	0,70	0,80	0,80

Table 3.110 provides an overview on how Member States treat emissions from feedstocks and non-energy use of fuels.

Table 3.110: Information related to feedstocks and non-energy use from Member States' NIRs

MS	Information on feedstocks and non-energy use of fuels	Source
Austria	Non-energy use of fuels is considered in the national energy balance. Below explanations for the reported non-energy use is provided together with information on where CO_2 emissions due to the manufacture, use and disposal of carbon containing products are considered. For fraction of carbon stored the IPCC default values are applied for all fuels except for coke oven coke, of which the amount carbon stored in steel was calculated. **Lubricants** **manufacture:** emissions are assumed to be included in total emissions from category 1 A 1 b petroleum refinery. **use:** emissions from the use of motor oil are included in CO_2 emissions from transport. VOC emissions from lubricants used in rolling mills are considered in category 2 C 1. It is assumed that other uses of lubricants do not result in VOC or CO_2 emissions due to the low vapour pressure of lubricants. **disposal:** emissions from incineration of lubricants (waste oil) are either included in categories 1 A 1 a and 1 A 2 if waste oil is used as fuels or in category 6 C respectively if energy is not recovered. **Bitumen** **manufacture:** emissions from the production of bitumen are assumed to be included in total emissions of category 1 A 1 b petroleum refinery. **use:** indirect CO_2 emissions from the use of bitumen for road paving and roofing that should be reported in categories 2 A 5 and 2 A 6 are included in sector 3 solvent and other product use. **disposal:** CO_2 emissions from the disposal from bitumen are assumed to be negligible. Recycling is not considered. **Natural Gas** **manufacture:** emissions from the use of natural gas as a feedstock in ammonia production are accounted for in the industrial processes sector (category 2 B 1). **use/disposal:** not applicable, no CO_2 emissions result from the use or disposal of ammonia. **Coke oven coke** **manufacture:** emissions from the production of coke are considered in category 1 A 2 a. **use:** CO_2 emissions from coke used in iron and steel industry are reported under 2 C. **disposal:** not applicable. **Other bituminous coal** In (IEA JQ 2008) non energy use is reported for the manufacture of electrodes. **manufacture:** No information about emissions from manufacture of electrodes is currently available. Therefore it is not clear if emissions are not estimated or not applicable. **use:** Emissions from the use of electrodes are considered in category 2 B 4 carbide production and 2 C metal production. **disposal:** not applicable. **Other oil products** **manufacture:** emissions from the production of ethylene and propylene are included in total emissions of category 1 A 1 b petroleum refinery. CO_2 emissions from solvent use are considered in sector 3 solvent and other product use. **use:** CO_2 emissions from solvent use are considered in sector 3. **disposal:** emissions from the disposal of plastics in landfills are considered in 6 A and from the use of plastic waste as a fuel in 1 A 2; emissions from the incineration of plastic in waste without energy recovery is included in 6 C; emissions from incineration of plastics in waste with energy recovery are considered in 1 A 1 a.	Austria's National Inventory Report 2009, march 2009, pp.138-139

MS	Information on feedstocks and non-energy use of fuels	Source
Belgium	The emissions of non-energy use of fuels and related emissions (emissions from recovered fuels from processes) are reported under categories 1A2, 2B1 and 2B5. As a result of the in-country review performed by the expert review team of UNFCCC in June 2007, the emissions reported in category 2G during the previous submissions are no longer included in the Belgian emission inventory. In this category 2G the emissions from the non-energy use of fuel were reported, estimated by using the IPCC default emission factors of carbon stored during the use of lubricants and solvents. Following the advise of the expert review team, these emissions of CO_2 from the use of solvents and lubricants will only arise when they are burned or destroyed. As a consequence these emissions are excluded out of the Belgian emission inventory during this submission. In Flanders, a recalculation of the non-energy use and related CO_2 emissions was performed during the 2005 submission, based on the results of a study conducted in 2003. The default % of carbon stored in the IPCC Guidelines were considered to be inaccurate in the Flemish situation. The default % of carbon stored are not well defined in the 1996 IPCC guidelines: it is not clear what is included or excluded in these default %. Belgium participated in an European network on the CO_2-emissions from non-energy use and one of the conclusions of this network is that the new IPCC guidelines need to give more information on this subject. Since the petrochemical industry is important in Flanders and Belgium and the emissions from the feed stocks are a key source in the Belgian inventory, the study mentioned above was conducted to get more detailed, country-specific information. A distinction was made between: 1. The use of recovered fuels from cracking units or other processes where a fuel is used as a raw material and where part of this fuel (or transformed product) is recovered for energy purposes. These emissions are reported under category 1A2c 'other fuels'. This is the largest source of CO_2 emissions. The involved industry is reporting the CO_2 emissions and PJ for these recovered fuels. 2. CO_2 emissions occurring during chemical processes, for example the production of ammonia based on natural gas or the production ethylene oxide where CO_2 is formed in a side reaction (reported respectively under 2B1 and 2B5 other). The industry involved is reporting these CO_2 emissions directly for these processes. 3. Waste treatment of final products is not included in the study. This is practically impossible due to import/export of plastic products, etc (it is also not clear if the waste phase is included in the default IPCC carbon stored % or not). The emissions of waste incineration are therefore calculated separately and are reported under the sector of waste (category 6C) or under the sector of energy (category 1A1a), whether or not energy recuperation takes place during the process. The result of the study made a recalculation possible for all years. The effect of the recalculation was greater in the more recent years because the petrochemical industry has expanded its activities in the beginning of the nineties (that's one of the reasons this sector is a key source). The resulting emissions are reported under different sections. The first and largest part (recovered fuels) of the resulting emissions is reported under 1A2c, under 'other fuels'. This includes other fuels in the chemical sector, a result of recovered fuels in the steam cracking units in petrochemical industry (approx. 2/3) and other recovered fuels from the chemical industry (approx. 1/3). These recovered fuels are reported directly in the yearly surveys carried out by the chemical federation in cooperation with the Vito to establish a yearly Flemish energy balance. The choice was made to allocate these fuels under 'other fuels' and not 'liquid fuels' or 'gaseous fuels', for transparency reasons. Another part of the emissions surveyed in the study, are considered to be process emissions and are reported under 2B. These include the CO_2-emission during the production of ammonia (2B1) and other process CO_2 emissions (2B5) reported by the chemical industry in Flanders (for example production of ethylene oxide, production of acrylic acid from propene, production of cyclohexanone from cyclohexane, production of paraxylene/meta-xylene, etc). These CO_2 emissions result from the same surveys in the chemical sector in Flanders as those reported under 1A2c. In the survey, more sources of emissions from chemical processes are reported than are described in the IPCC 1996 guidelines.	Belgium´s Greenhouse Gas Inventory 1990-2007, March 2009, pp.69-70
Denmark	Non-energy use of fuels is included in the reference approach for Climate Convention reporting. The Danish energy statistics include three fuels used for non-energy purposes: bitumen, white spirit and lube oil. The fuels used for non-energy purposes add up to about 2% of the total fuel consumption in Denmark.	Denmark's National Inventory Report 2009, April 2009, p. 84
Finland	Emissions from subcategories 1.A 4 and 1.A 5 are calculated with the ILMARI system. The ILMARI system includes point source (bottom-up) data on feedstock combustion in the petrochemical industry as well as recycled waste oil combustion in different branches of industry, and they are reported in corresponding subcategories of 1.A 2. These known energy uses of feedstock and lubricants are subtracted from the corresponding total amounts. For the rest of the feedstock 100% (previously 90%) of carbon is estimated to be stored in products (mainly plastics). For the rest of lubricants, 33% of carbon is estimated to be stored in products (recycled lubricants) and 67% of carbon released as CO_2 either in burning of lubricants in motors or illegal combustion of waste oil in small boilers. Emissions from natural gas used as feedstock are calculated and reported in sector 2.B 5. These non-specified emissions from burning of feedstocks (which are not included in 1.A 2 or 2.B 5) are included in category 1.A 5.	Greenhouse Gas emissions in Finland 1990-2007, March 2009, p. 104

MS	Information on feedstocks and non-energy use of fuels	Source
Germany	Germany uses the results of the research project "Estimating CO_2 Emissions from the Non- Energy Use of Fossil Fuels in Germany" in order to improve the inventory of non-energy use of fuels. In this research project non-energy use of fossil fuels is calculated with the NEAT-Model (Non-energy Use Emission Accounting Tables) that was developed at Utrecht University (Netherlands). NEAT calculates the non-energy use of fossil fules and the resulting emissons with a mass-balance and a material-flow analysis. These calculations are almost independent from data from the official energy balance but require data from production and external trade and detailed knowledge of the structure of the of the chemical industry. The emissions from the ammonia production are considerably higher with the NEAT model than with the IPCC sectoral approach. This is mainly due to the assumption of rather efficient plants in the NEAT model. The emissions from aluminium production are considerably higher with the NEAT model than with the IPCC sectoral approach. The main reason for this difference is the lower emission factor used in the IPCC sectoral approach. Based on the results of the research project Germany plans further improvements.	National Inventory Report – 2007, May 2007, p. 465-472
Greece	Non-energy use of fuels in Greece refers to the consumption of: • naphtha, natural gas, and lignite (for the period 1990 – 1991) in chemical industry, • petroleum coke in the production of non-ferrous metals, • lubricants in transport (including off-road transportation), • bitumen in construction and • other petroleum products in the industrial and residential sectors Data on the non-energy consumption of fuels derive from the national energy balance. However, the availability of more detailed data regarding non-energy consumption of fuels and industrial activity in Greece should be examined, as current data do not provide adequate information. • The non-energy use for ammonia production is included in the non-energy consumption of the chemical industry but the available information does not allow for the allocation of the total figure to individual industrial sub-sectors. Thus, CO_2 emissions from ammonia production are reported under the energy sector instead of the industrial processes sector. Non-energy use of lignite (for 1990 and 1991) refers only to ammonia production (in one installation) and as a result the fraction of carbon stored is equal to 0. The operation of this installation ended at 1998 while it did not produce ammonia for the period 1992 – 1998. • No data regarding non-energy use in the iron and steel industry are reported in the national energy balance and, as a result, CO_2 emissions from the use of fuels as reduction agents, are only reported under the industrial processes sector. • Solid fuels consumption in the ferroalloys production industry is included (in the national energy balance) in the solid fuels consumption of the non-ferrous metals sector. However, the available information does not allow for the allocation of the total figure to individual industrial sub-sectors and, as a result, CO_2 emissions from ferroalloys production are reported under the energy sector instead of the industrial processes sector. • The non-energy use of petroleum coke (see Table 3.28) refers exclusively to the primary aluminium production. Given that the relevant emissions are reported under the industrial processes sector, petroleum coke consumption is not taken into account in the energy sector. On the basis of the above-mentioned clarifications, the possibility to double-count or underestimate CO_2 emissions from the non-energy use of fuels is minor.	Annual Inventory submission under the convention and the Kyoto Protocol for Greenhouse and other Gases for years 1990-2007, Mar 2009, pp.109-110
Ireland	Naphtha was previously the only petroleum product to be considered in relation to non-energy fuel-use, where the carbon is not fully released as in combustion. The IPCC default value of 0.50, 0.75 and 1.0 are used for the proportion of carbon stored in lubricants, naphtha and bitumen respectively. Ireland's only oil refinery is a small hydroskimming refinery where there is no production of other petroleum products normally used for nonenergy purposes, such as bitumen, lubricants, plastics and asphalt. The expanded SEI energy balance sheets now record the import of some of these products, thereby allowing improved completeness in the Reference Approach estimation of CO_2 emissions and carbon storage. A significant amount of natural gas feedstock was traditionally used in ammonia production in Ireland but the company closed in 2003 and there is consequently no feedstock use of natural gas since then.	Ireland National Inventory Report 2009, March 2009, p. 45-46

MS	Information on feedstocks and non-energy use of fuels	Source
Italy	Data on petrochemical and other non-energy use of fuels are based on a rather detailed yearly report available by the Ministry of Economic Development (MSE). The report summarizes answers from a detailed questionnaire that all operators in Italy prepare monthly. The data are more detailed than those normally available by international statistics and refer to: - input to plants (gross input); - quantities of fuels returned to the marked (with possibility to estimate the net input); - fuels used internally for combustion; - quantities stored in products. In the energy balances only the input and output quantities from the petrochemical plants are reported, so it may be that the output quantity is greater than the input quantity, due to internal transformation. Therefore it is possible to have negative values for some products mainly gasoline, refinery gas, fuel oil. With these data it is possible to estimate the quantities of fuels stored in product in percentage on net and gross petrochemical input. There is a sizeable difference of the estimated quantities of fuel stored in product if reference is made to "net" or "gross" input. Moreover the estimation of quantities stored in product are quite different from those reported in the Revised 1996 IPCC Guidelines for National GHG Inventories, Reference Manual. An attempt was made to estimate the quantities stored in products using IPCC percentage values and the fuels reported as "petrochemical input. The resulting estimate of about 6,880 kt of products for the year 2006, is more than 50% bigger than the quantities reported, 4,570. At national level this methodology seems the most precise according to the available data. The European Project "Non Energy use-CO_2 emissions" ENV4-CT98-0776 has analysed the Italian methodology performing a mass balance between input fuels and output products in a sample year. The results of the project confirm the reliability of the reported data.	Italian Greenhouse Gas Inventory 1990-2006 National Inventory Report 2008, April 2008, pp.69-70

MS	Information on feedstocks and non-energy use of fuels	Source
Netherlands	At the present time the following emissions are accounted for as feedstocks and other non-energy use: • CO_2 emissions from the use of feedstock and other non-energy uses of fuels: feedstocks from natural gas and oil products in the chemical industry (IPCC categories 2B1 and 2B5) and coke and coal inputs in blast furnaces in the iron and steel industry (part of 2C1); • CO_2 emissions from other non-energy uses of fuels for their physical properties in other industrial sectors: coke for soda ash production (part of 2A4), coke (2D2), lubricants and waxes (2G4); • Indirect CO_2 emissions from solvents and other product use (3); • CO_2 emissions from 'Waste Incineration' (6C, in the Netherlands reported under 1A1a); • CO_2 emissions from the combustion of by-products produced in the Industry sector (e.g. blast furnace gas, chemical waste gas and refinery gas), reported as combustion emissions in the Energy sector under 1A1a 'Electricity and Heat Production' and 1A1c 'Manufacturing Industry and Construction'. **Key sources** The major CO_2 sources reported under 'Industrial Processes' are identified as key sources: 'Ammonia Production' (2B1). 'Other Chemical Product Manufacture' (2B5) and 'Carbon Inputs in Blast Furnaces' (2C1). However, it should be noted that the Netherlands accounts for most of the use of chemical waste gas and of blast furnace gas separately as combustion in the source categories 1A1a, 1A2a and 1A2c. As the former may be included in feedstock emissions by other countries, with significant levels of CO_2 emissions, they would then become key sources when assessed separately. **Overview of shares and trends in emissions** The share of total feedstock - related emissions, including the combustion of chemical waste gas and waste combustion i n national total CO_2 emissions (excluding LULUCF) is about 12%. The largest part of these emissions, 64% in 1990 and about 80% in 2007, is reported under 'Fuel Combustion' (1A). About 50% of these emissions are from blast furnace gas , which is largely used for power generation, and the other 50% stems from chemical waste gas, which is predominantly used in the chemical industry. **Methodological issues** Clearly, not all CO_2 emissions from the use of feedstock and other non-energy uses of fuels are allocated under sector 2. This is mainly because the Netherlands allocates a large part of the chemical waste gas produced in the industry sector into the energy sector. In addition, significant parts of chemical waste gas and blast furnace gas are combusted in a sector (i.e. public power generation) other than the one in which they were produced, making it logical to allocate these combustion emissions to sector 1 Energy rather than to sector 2 Industrial Processes. This allocation applies to the chemical waste gases from the production of silicon carbide, carbon black, ethylene and methanol. In addition, the Netherlands reports waste combustion emissions under fuel combustion by the Energy sector (1A1a) since most of these facilities also produce commercial energy (heat and/or electricity). Country-specific methodologies are used for the emissions from feedstock use and feedstock product use with country-specific or default IPCC emission factors (see Annex 2). Only indirect CO_2 emissions from domestic uses of petrochemical products are reported here. A full description of the methodology is provided in the monitoring protocol 8101: CO_2 , CH_4 and N_2O emissions from the stationary combustion of fossil fuels and protocol 8102: CO_2 , CH_4 and N_2O process emissions from fossil fuel use. In the Sectoral Approach, the Netherlands uses the following data sources to estimate these emissions: • Sectoral energy consumption statistics by fuel type on feedstock and other non-energy uses of fuels as part of Total sectoral energy consumption, based on information provided by the companies, including chemical waste gas produced from feedstock uses of fuels; • Plant-specific fuel consumption data to identify a particular industrial process – for example, soda ash production; • Production data for estimating the net oxidation fractions – for example, urea production; • NMVOC emissions from solvents and other products; • Emissions from waste: the amount (and composition in order to calculate the fraction and amount of fossil carbon) of waste incinerated. This approach in which all statistics on feedstock and other non-energy uses of fuels are considered as activity data for sources of CO_2 complemented with industrial production data necessary for a more accurate estimation of these emissions, each with a specific allocation to CRF subcategories, guarantees completeness of reporting of these sources.	Greenhouse Gas Emissions in the Netherlands National Inventory report 2009 1990-2007 pp.86-89
Portugal	Emissions of greenhouse gas emissions from feedstock use are only clearly accounted in the inventory in the following situations: • emission of CO_2 resulting from use of feedstock sub-products as energy sources. That is the case for emissions from consumption of fuel gas in refinery and petrochemical industry; • emission of CO_2 liberated as sub-product in production processes such as ammonia production; • emission of NMVOC from fossil fuel origin, and occurring from solvent use and evaporation. Although in this case it is not possible to establish which part results from feedstock consumption in Portugal in the energy balance. However, some potential emissions are not estimated or are only partly estimated. Those that are estimated in the reference approach but not in sectoral approach are: • emissions from mineral oil use as lubricants; • emissions from wear of bitumen in roads. It is evident that more efforts should be made to estimate other emissions from feedstock use, although it is expected that reporting guidelines should give more clear guidance in the future.	Portuguese National Inventory Report on Greenhouse Gases 1990-2007, March 2009 p.182

MS	Information on feedstocks and non-energy use of fuels	Source
Spain	The consumption of fuel for non-energy use is accounted for in the energy balance. The quantities of each fuel type are included in the reference approach. For each fuel type a split into two parts is given: a) the part that stays in the product and b) the part that is set free and causes the corresponding CO_2 emissions.	Inventario de emissiones de gases de efecto invernadero de Espana años 1990-2006, March 2008,p. 1.23
Sweden	Activity data on feedstocks and non-energy use of fuels is collected from the quarterly fuel statistics. In the survey form for the quarterly fuel statistics, respondents are among many other things asked to specify whether fuels are used as raw materials or for energy purposes. This facilitates the use of data for CRF table 1Ad, non-energy use of fuels. Data on carbon from coke, bound in produced ferroalloys is collected directly from the only ferroalloy producer and is added to the remaining data on carbon from coke. Estimates of carbon stored are derived by multiplying given energy amount with emission factors for CO_2multiplied by 12/44 (the weight of one atom of carbon is by definition 12/44 the weight of one molecule of CO_2). For submission 2008 CO_2 emissions derived from non-energy use of fuels and reported under CRF 1B and CRF 2 (e.g. flaring of gases and iron and steel process emissions) are added under CRF 1Ad and linked to the CRF 1Ab as carbon stored	Sweden's National Inventory Report 2008, April 2008, p. 108

MS	Information on feedstocks and non-energy use of fuels	Source
United Kingdom	The UK reports emissions from the combustion of fuels only with emissions from the non-energy use of fuels assumed to be zero (i.e. the carbon is assumed to be sequestered as products), except for the following cases where emissions could be identified and included in the inventory: • Catalytic crackers – regeneration of catalysts • Ammonia production • Aluminium production – consumption of anodes • Benzoles and tars – produced in coke ovens and emissions assigned to the waste sector • Combustion of waste lubricants and waste solvents • Incineration of fossil carbon in products disposed of as waste. Estimates of the quantities of lubricants burnt are based on data from Recycling Advisory Unit, 1999; Oakdene Hollins Ltd, 2001 & BLF/UKPIA/CORA, 1994.Separate estimates are produced for power stations, cement kilns, and other industry. In addition, an estimate is made of lubricants burnt in vehicle engines. Carbon emissions from these sources are calculated using a carbon factor derived from analysis of eight samples of waste oil (Passant, 2004). In 2005, the combustion of lubricating oils within engines was reviewed.Analysis by UK experts in transport emissions and oil combustion have lead to a revision to the assumptions regarding re-use or combustion of lubricating oils from vehicle and industrial machinery. The fate of the unrecovered oil has now been allocated across several IPCC source sectors including road, rail, marine, off-road and air transport.Some of the unrecovered oil is now allocated to non-oxidising fates such as coating on products, leaks and disposal to landfill. Fossil carbon destroyed in MSW incinerators and clinical waste incinerators is included in the GHG inventory, as is carbon emitted by chemical waste incinerators. As part of our review of the base year GHG inventory estimates, the UK has reviewed the treatment of stored carbon in the UK GHG inventory and the fate of carbon from the non-energy use (NEU) of products and the breakdown of those products.This appraisal included a review of the National Inventory Reports (NIRs) of other countries.The US NIR contained a detailed methodology of the approach used in the US inventory to estimate emissions of stored carbon, and the US NIR presents 'storage factors' for a range of products.Some of these factors have been used in the new UK method. The UK Inventory Agency has conducted a series of calculations to estimate the fate of carbon contained in those petroleum products shown in the NEU line of the UK commodity balance tables.The analysis indicates that most of the carbon is stored, although a significant quantity does appear to be emitted. Some of the emitted carbon has been included in previous versions of the GHG inventory, e.g. carbon from chemical waste incinerators; most has not.A summary of the estimates of emitted/stored carbon has been produced and these have been presented in a separate technical report . The study also provides subjective, qualitative commentary regarding the quality of the estimates. The analysis also includes an assessment of the fate of carbon from the use of coal tars and benzoles.Benzoles and coal tars are shown as an energy use in the DBERR DUKES and up until the 2002 version of the GHG inventory, the carbon was included in the coke ovens carbon balance as an emission of carbon from the coke ovens. When the carbon balance methodology was improved for the 2003 GHG inventory, the UK inventory treated the carbon in these benzoles and coal tars as a non-emissive output from the coke ovens.However, we were not sure what the ultimate fate of the carbon was but were unable to research this in time for the 2003 GHG inventory.It was therefore treated as an emission from the waste disposal sector - thus ensuring that total UK carbon emissions were not altered until we had sufficient new information to judge what the fate of the carbon was. New information from Corus UK Ltd (the sole UK operator of coke ovens) indicates that the benzoles & coal tars are recovered and sold on for other industrial uses, the emissions from which are already covered elsewhere within the inventory. Hence the carbon content from these coke oven by-products is now considered as stored and the carbon emissions included in previous inventories has been removed from the new version of the GHG inventory. The analysis estimates emissions from the energy uses of coal tars and benzoles, and NEU of petroleum products. Since emissions of carbon are estimated, carbon which is not emitted (i.e. stored) can be calculated from the DBERR DUKES consumption data by difference. The analysis divides the various fossil fuels into six categories: (1) coal tars & benzoles, (2) lubricants, (3) petroleum coke, (4) petroleum waxes, (5) bitumen, (6) chemical feedstocks (ethane, propane, butane, other gases, naphtha, industrial spirit, white spirit, middle distillate feedstock). After considering the magnitude of the source in relation to the national totals, the uncertainty associated with emissions, and the likely forthcoming IPCC reporting requirements in the 2006 Guidelines, emissions of carbon from the following additional sources have been included in the 2004 GHG inventory (2006 NIR) and subsequent NIRs: (1) Petroleum waxes, (2) Carbon emitted during energy recovery - chemical industry, (3) Carbon in products - soaps, shampoos, detergents etc., (4) Carbon in products – pesticides.	UK Greenhouse Gas Inventory, 1990 to 2006, April 2008, Annex 3, pp. 351-353

3.9 Energy for EU-27

3.9.1 Overview of sector (EU-27)

Figure 3.99: **CRF Sector 1 Energy: EU-27 GHG emissions in CO_2 equivalents (Tg)for 1990–2007**

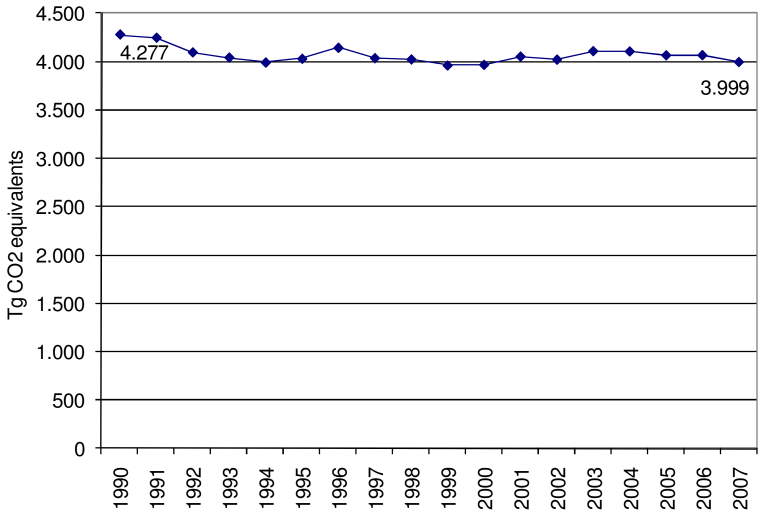
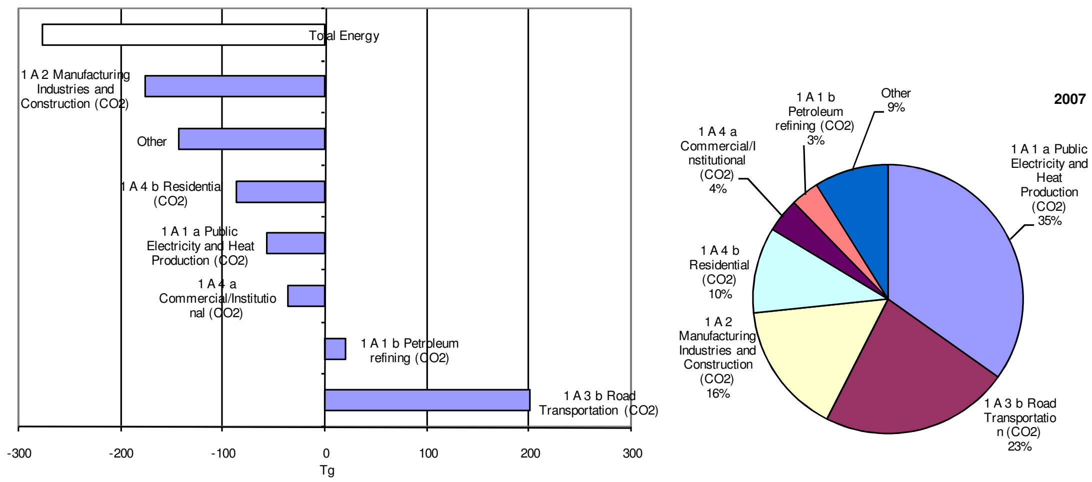


Figure 3.100: **CRF Sector 1 Energy: Absolute change of GHG emissions in CO_2 equivalents (Tg) by large key source categories for 1990–2007 and share of largest key source categories in 2007**



3.9.2 Source categories (EU-27)

3.9.2.1 Public Electricity and Heat Production (1A1a) (EU-27)

Table 3.111: 1A1a Public Electriciy and Heat Production, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	124.579	66.355	52.360	79,0%	-13.995	-21%	-72.219	-58%			
Bulgaria	9.835	149	211	0,3%	62	42%	-9.624	-98%	T2	NS	CS
Cyprus	1.708	3.653	3.802	5,7%	148	4%	2.094	123%	C	NS	D
Czech Republic	819	443	320	0,5%	-123	-28%	-498	-61%	T1	NS	D
Estonia	4.825	409	410	0,6%	1	0%	-4.415	-92%	T1,T2	NS,PS	D, CS
Hungary	1.830	452	452	0,7%	0	0%	-1.378	-75%	T2	PS, NS	D
Latvia	3.051	96	87	0,1%	-9	-10%	-2.964	-97%	T1	CS	CS
Lithuania	6.058	672	425	0,6%	-246	-37%	-5.633	-93%	T2	NS	CS
Malta	738	1.976	2.017	3,0%	41	2%	1.279	173%	D,T1	PS	D
Poland	5.115	697	616	0,9%	-82	-12%	-4.500	-88%	T2	NS	D
Romania	22.727	6.407	5.510	8,3%	-897	-14%	-17.217	-76%	T1	NS	D
Slovakia	1.033	26	17	0,0%	-10	-37%	-1.017	-98%	T2	PS	CS
Slovenia	277	43	32	0,0%	-11	-26%	-245	-89%	T1	NS	D
EU-27	**182.596**	**81.379**	**66.258**	**100,0%**	**-15.121**	**-19%**	**-116.338**	**-64%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.112: 1A1a Public Electriciy and Heat Production, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	750.835	679.527	683.450	68,5%	3.923	1%	-67.385	-9%			
Bulgaria	21.740	25.447	28.981	2,9%	3.534	14%	7.241	33%	T2	NS	CS
Cyprus	NA	NA	NA	-	-	-	-	-	C	NS	D, CS
Czech Republic	51.658	53.844	56.982	5,7%	3.137	6%	5.323	10%	T1	NS	CS
Estonia	21.494	9.064	11.328	1,1%	2.264	25%	-10.166	-47%	T1,T2	NS,PS	D, CS
Hungary	12.725	8.758	8.891	0,9%	133	2%	-3.835	-30%	T3	PS, NS	CS,PS
Latvia	355	12	31	0,0%	19	164%	-324	-91%	T1	CS	CS
Lithuania	185	42	73	0,0%	31	73%	-112	-60%	T2	NS	CS
Malta	611	NA	NA	-	-	-	-611	-100%	NO	NO	NO
Poland	214.586	168.604	165.487	16,6%	-3.116	-2%	-49.099	-23%	T2	NS	CS/D
Romania	36.266	30.501	31.419	3,1%	918	3%	-4.848	-13%	T1	NS	D
Slovakia	11.542	5.815	5.206	0,5%	-609	-10%	-6.336	-55%	T2	PS	CS
Slovenia	5.600	6.050	6.269	0,6%	219	4%	669	12%	T1	PS	PS
EU-27	**1.127.599**	**987.664**	**998.117**	**100,0%**	**10.453**	**1%**	**-129.482**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.113: 1A1a Electricity and heat production, solid fuels: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	6.663	6.004	6.051	79,7%	47	1%	-612	-9%			
Bulgaria	230	248	283	3,7%	35	14%	53	23%	T2	NS	D
Cyprus	NA	NA	NA	-	-	-	-	-	C	NS	C
Czech Republic	229	242	256	3,4%	14	6%	27	12%	T1	NS	D
Estonia	4	2	3	0,0%	1	22%	-1	-29%	T1,T2	NS,PS	D, CS
Hungary	59	38	40	0,5%	2	5%	-19	-32%	T1	PS, NS	D
Latvia	3	0	0	0,0%	0	129%	-3	-94%	T1	CS	D
Lithuania	2	0	1	0,0%	0	85%	-1	-54%	T2	NS	CS
Malta	3	NA	NA	-	-	-	-3	-100%	NO	NO	NO
Poland	982	789	770	-	-	-	-212,4	-22%	T2	NS	D
Romania	142	134	137	1,8%	4	3%	-4	-3%	T1	NS	D
Slovakia	52	26	22	0,3%	-4	-14%	-30	-57%	T1	PS	D
Slovenia	24	26	26	0,3%	1	2%	3	13%	T1	PS	D
EU-27	**8.393**	**7.509**	**7.590**	**100,0%**	**81**	**1%**	**-803**	**-10%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.114 1A1a Electricity and heat production, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	60.437	241.387	259.984	88,0%	18.597	8%	199.547	330%			
Bulgaria	6.364	1.906	1.911	0,6%	4	0%	-4.453	-70%	T2	NS	CS
Cyprus	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	1.541	1.845	1.692	0,6%	-153	-8%	151	10%	T1	NS	D
Estonia	2.548	1.973	1.812	0,6%	-161	-8%	-736	-29%	T1,T2	NS,PS	D, CS
Hungary	5.825	8.266	8.827	3,0%	562	7%	3.003	52%	T3	PS, NS	D
Latvia	2.691	1.911	1.792	0,6%	-119	-6%	-899	-	T1	CS	CS
Lithuania	5.982	3.055	2.849	1,0%	-207	-7%	-3.133	-52%	T2	NS	CS/C
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	1.208	2.908	2.712	0,9%	-196	-7%	1.504	125%	T2	NS	D
Romania	38.778	11.880	11.509	3,9%	-371	-3%	-27.269	-70%	T1	NS	D
Slovakia	2.089	2.345	1.947	0,7%	-398	-17%	-142	-	T2	PS	CS
Slovenia	112	247	264	0,1%	17	7%	152	136%	T1	NS	CS
EU-27	**127.574**	**277.725**	**295.299**	**100,0%**	**17.574**	**6%**	**167.725**	**131%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.115: 1A1a Public Electriciy and Heat Production, other fuels:CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	13.334	30.608	32.759	99,8%	2.152	7%	19.425	146%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	T1	NS,PS	D, CS
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	NA	NA	NA	-	-	-	-	-	T2	NS	D
Romania	NE	NE	NE	-	-	-	-	-	T1	NS	D
Slovakia	154	89	63	0,2%	-26	-29%	-91	-59%	T1a	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**13.488**	**30.696**	**32.822**	**100,0%**	**2.126**	**7%**	**19.335**	**143%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.2 Petroleum Refining (1A1b) (EU-27)

Table 3.116 1A1b Petroleum Refining, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	98.388	111.602	111.336	92,8%	-267	0%	12.947	13%			
Bulgaria	286	NO	NO	-	-	-	-286	-100%	NO	NO	NO
Cyprus	74	NO	NO	-	-	-	-74	-100%	NO	NO	NO
Czech Republic	923	964	715	0,6%	-249	-26%	-209	-23%	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	928	982	968	0,8%	-15	-1%	39	4%	T1	NS	D
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	1.580	1.624	1.524	1,3%	-100	-6%	-56	-4%	T2	NS	CS/C
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	1.373	4.706	4.465	3,7%	-241	-5%	3.092	225%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	507	947	990	0,8%	43	5%	483	95%	T2	PS	CS
Slovenia	43	1	0	0,0%	0	-55%	-42	-99%	T1	NS	D
EU-27	**104.103**	**120.826**	**119.997**	**100,0%**	**-828**	**-1%**	**15.894**	**15%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.117 1A1b Petroleum Refining, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	3.581	510	1.340	55,0%	829	162%	-2.241	-63%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	T1	NS	CS
Estonia	582	1.034	909	37,3%	-125	-12%	327	56%	T2	NS,PS	CS
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	736	32	2	0,1%	-30	-94%	-734	-100%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	NO	155	184	7,6%	30	19%	184	-	T2	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**4.898**	**1.731**	**2.435**	**100,0%**	**704**	**41%**	**-2.463**	**-50%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.118 1A1b Petroleum Refining, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	3.846	8.725	8.947	73,7%	222	3%	5.101	133%			
Bulgaria	69	51	59	0,5%	8	17%	-10	-15%	T2	NS	CS
Cyprus	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	324	292	255	2,1%	-37	-13%	-70	-22%	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	689	482	827	6,8%	344	71%	137	20%	T1	NS	D
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	0	0,3	0,002%	0	0%	-	-	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	93	1.383	1.682	13,8%	299	22%	1.588	1703%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	755	358	373	3,1%	16	-	-382	-	T2	PS	CS
Slovenia	126	8	NO	-	-8	-	-126	-	T1	NS	CS
EU-27	**5.905**	**11.299**	**12.143**	100,0%	844	7%	6.238	-			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.3 Manufacture of Solid Fuels and Other Energy Industries (1A1c) (EU-27)

Table 3.119 1A1c Manufacture of Solid Fuels and Other Energy Industries, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	16.872	20.693	21.590	84,2%	897	4%	4.718	28%			
Bulgaria	71	698	778	3,0%	80	12%	707	991%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	218	0,8%	218	-	218	-	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	IE	3	3	0,0%	0	-	3	-	T1	NS	D
Latvia	45	52	32	0,1%	-21	-39%	-14	-30%	T1	CS	CS
Lithuania	NO	5	5	0,02%	-0,1	-1%	5	-	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	691	1.482	1.565	6,1%	83	6%	875	127%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	NO	1.456	1.460	5,7%	3	0%	1.460	-	T2	PS	CS
Slovenia	42	NO	NO	-	0	-	-42	-100%	NO	NO	NO
EU-27	**17.721**	**24.389**	**25.651**	**100,0%**	**1.261**	**5%**	**7.930**	**45%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.120 1A1c Manufacture of Solid Fuels and Other Energy Industries, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	72.520	30.729	30.900	80,5%	171	1%	-41.620	-57%			
Bulgaria	382	161	149	0,4%	-12	-7%	-233	-61%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	2.393	1.654	1.107	2,9%	-547	-33%	-1.286	-54%	T1	NS	CS
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	IE	155	166	0,4%	11	-	166	-	T2	NS	D
Latvia	164	1	3	0,0%	2	232%	-160	-98%	T1	CS	CS
Lithuania	35	24	20	0,1%	-3	-14%	-14	-41%	`	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	4.060	3.373	6.052	15,8%	2.679	79%	1.992	49%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE1	NA
Slovakia	10	NO	NO	-	0	-	-10	-100%	NO	NO	NO
Slovenia	36	NO	NO	-	-	-	-36	-100%	NO	NO	NO
EU-27	**79.600**	**36.096**	**38.396**	**100,0%**	**2.301**	**6%**	**-41.204**	**-52%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.4 Iron and Steel (1A2a) (EU-27)

Table 3.121 1A2a Iron and Steel, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	7.635	4.142	3.969	93,1%	-173	-4%	-3.667	-48%			
Bulgaria	22	0	0,4	0,01%	0	22%	-22	-98%	T2	NS	CS
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	101	161	3,8%	60	60%	161	-	T1	NS	D
Estonia	NO	0	NA	-	-0,1	-	0,0	-	NO	NO	NO
Hungary	803	8	10	0,2%	2	23%	-793	-99%	T2	PS, NS	D
Latvia	154	64	64	1,5%	0	0%	-90	-58%	T1	CS	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	56	38	43	1,0%	5	14%	-13	-23%	NO	NO	NO
Poland	855	9	6	0,1%	-3	-34%	-849	-99%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	164	1	0	0,0%	-1	-79%	-164	-100%	T2	PS	CS
Slovenia	54	18	7	0,2%	-11	-59%	-46	-86%	T1	NS	D
EU-27	**9.744**	**4.382**	**4.261**	**100,0%**	**-120**	**-3%**	**-5.482**	**-56%**			

Table 3.122 1A2a Iron and Steel, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	95.632	70.909	67.611	76,9%	-3.298	-5%	-28.020	-29%			
Bulgaria	2.378	2.039	1.942	2,2%	-98	-5%	-436	-18%	T2	NS	CS
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	4.970	2.901	3,3%	-2.069	-42%	2.901	-	T1	NS	CS
Estonia	3	1	1	0,0%	0	-11%	-2	-62%	T1,T2	NS	D, CS
Hungary	3.327	2.346	2.501	2,8%	155	7%	-826	-25%	T2	PS, NS	D
Latvia	5	12	9	0,01%	-2	-20%	5	103%	T1	CS	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	11.493	5.672	7.014	8,0%	1.342	24%	-4.479	-39%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	7.672	6.350	5.886	6,7%	-464	-7%	-1.786	-23%	T2	PS	CS
Slovenia	56	35	29	0,0%	-7	-19%	-27	-49%	T1	NS	D
EU-27	**120.565**	**92.335**	**87.894**	**100,0%**	**-4.441**	**-5%**	**-32.671**	**-27%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.123 1A2a Iron and Steel, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	16.561	20.127	19.418	82,8%	-709	-4%	2.857	17%			
Bulgaria	1.049	622	624	2,7%	1	0%	-425	-41%	T2	NS	CS
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	727	662	2,8%	-66	-9%	662	-	T1	NS	D
Estonia	NO	1	0	0,0%	-1	-74%	0	-	T1	NS	D
Hungary	1.448	546	496	2,1%	-50	-9%	-951	-66%	T2	PS, NS	D
Latvia	239	228	230	1,0%	2	1%	-8	-3%	T1	CS	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	4	7	8	0,03%	1	9%	4	104%	NO	NO	NO
Poland	2.894	1.100	1.158	4,9%	58	5%	-1.735	-60%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	1.301	921	679	2,9%	-242	-26%	-623	-48%	T2	PS	CS
Slovenia	308	172	167	0,7%	-4	-3%	-141	-46%	T1	NS	CS
EU-27	**23.803**	**24.452**	**23.442**	**100,0%**	**-1.010**	**-4%**	**-361**	**-2%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.5 Non Ferrous Metals (1A2b) (EU-27)

Table 3.124 1A2b Non ferrous Metals, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	4.129	1.384	1.562	50,9%	178	13%	-2.567	-62%			
Bulgaria	223	146	166	5,4%	20	14%	-57	-26%	T2	NS	CS
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	2	10	0,3%	8	488%	10	-	T1	NS	CS
Estonia	NO	NO	2	0,1%	2	-	2	-	T1	NS	D
Hungary	397	468	431	14,1%	-37	-8%	34	9%	T2	NS	CS,D
Latvia	NO	NO	NO	-	-	-	-	-	T1	CS	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	727	773	817	26,6%	44	6%	90	12%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	798	94	79	2,6%	-14	-15%	-719	-90%	T2	PS	CS
Slovenia	152	NO	NO	-	0	-	-152	-100%	NO	NO	NO
EU-27	**6.428**	**2.867**	**3.067**	**100,0%**	**201**	**7%**	**-3.360**	**-52%**			

Table 3.125 1A2b Non ferrous Metals, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	2.413	5.167	5.304	80,6%	136	3%	2.891	120%			
Bulgaria	24	39	38	0,6%	-1	-4%	14	60%	T2	NS	CS
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	147	136	2,1%	-11	-7%	136	-	T1	NS	D
Estonia	NO	1	4	0,1%	3	288%	4	-	T1	NS	D
Hungary	1.645	591	572	8,7%	-19	-3%	-1.073	-65%	T2	NS	D
Latvia	NO	11	11	0,2%	0	-1%	11	-	T1	CS	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	257	384	376	5,7%	-8	-2%	120	47%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	435	79	80	1,2%	1	2%	-355	-82%	T2	PS	CS
Slovenia	163	47	62	0,9%	15	33%	-101	-62%	T1	NS	CS
EU-27	**4.935**	**6.466**	**6.583**	**100,0%**	**117**	**2%**	**1.648**	**33%**			

3.9.2.6 Chemicals (1A2c) (EU-27)

Table 3.126 1A2c Chemicals, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	30.690	22.921	23.945	79,1%	1.025	4%	-6.745	-22%			
Bulgaria	458	472	578	1,9%	106	22%	120	26%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	C	NS	D
Czech Republic	IE	3.027	1.425	4,7%	-1.602	-53%	1.425	-	T1	NS	D
Estonia	13	6	6	0,0%	1	11%	-6	-49%	T1	NS	D
Hungary	812	1.146	1.106	3,7%	-39	-3%	294	36%	T2	NS	D
Latvia	277	NO	NO	-	-	-	-277	-100%	T1	CS	CS
Lithuania	72	2	1	0,0%	-1	-41%	-71	-98%	T2	NS	CS
Malta	IE	IE	IE	-	-	-	-	-	NO	NO	NO
Poland	306	2.159	2.187	7,2%	29	1%	1.881	614%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	1.363	1.049	993	3,3%	-56	-5%	-370	-27%	T2	PS	CS
Slovenia	31	40	40	0,1%	0	-1%	8	26%	T1	NS	D
EU-27	**34.021**	**30.821**	**30.281**	**100,0%**	**-539**	**-2%**	**-3.740**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.127 1A2c Chemicals, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	8.017	4.651	4.697	39,9%	46	1%	-3.320	-41%			
Bulgaria	436	616	630	5,4%	14	2%	194	44%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	505	2.254	19,2%	1.749	346%	2.254	-	T1	NS	CS
Estonia	7	NO	NO	-	-	-	-7	-100%	NO	NO	NO
Hungary	61	NO	NO	-	-	-	-61	-100%	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	T1	CS	CS
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	IE	IE	IE	-	-	-	-	-	NO	NO	NO
Poland	3.350	4.006	3.935	33,4%	-71	-2%	584	17%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	1.584	278	252	2,1%	-26	-9%	-1.331	-84%	T2	PS	CS
Slovenia	1	NO	NO	-	-	-	-1	-100%	NO	NO	NO
EU-27	**13.457**	**10.056**	**11.768**	**100,0%**	**1.712**	**17%**	**-1.689**	**-13%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.128 1A2c Chemicals, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	28.121	30.935	29.976	89,3%	-959	-3%	1.855	7%			
Bulgaria	2.593	1.178	1.131	3,4%	-47	-4%	-1.462	-56%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	722	644	1,9%	-78	-11%	644	-	T1	NS	D
Estonia	327	1	0	0,0%	-1	-92%	-327	-100%	T1,T2	NS	D, CS
Hungary	515	515	504	1,5%	-11	-2%	-11	-2%	T2	NS	D
Latvia	24	27	21	0,1%	-5	-20%	-3	-11%	T1	CS	CS
Lithuania	341	195	136	0,4%	-58	-30%	-205	-60%	T2	NS	CS
Malta	IE	IE	IE	-	-	-	-	-	NO	NO	NO
Poland	295	510	486	1,4%	-25	-5%	190	65%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	1.753	128	538	1,6%	410	319%	-1.215	-69%	T2	PS	CS
Slovenia	175	124	133	0,4%	9	8%	-42	-24%	T1	NS	CS
EU-27	**34.144**	**34.336**	**33.570**	**100,0%**	**-766**	**-2%**	**-574**	**-2%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.129 1A2c Chemicals, other fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	3.363	6.801	6.708	100,0%	-93	-1%	3.345	99%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	T1	NS	D
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Malta	IE	IE	IE	-	-	-	-	-	NO	NO	NO
Poland	NA	NA	NA	-	-	-	-	-	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	0,5	NO	0,4	-	-	-	-0,2	-29%	NO	NO	NO
EU-27	**3.364**	**6.801**	**6.709**	**100,0%**	**-92**	**-1%**	**3.345**	**99%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.7 Pulp, Paper and Print (1A2d) (EU-27)

Table 3.130 1A2d Pulp, Paper and Print, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9.500	5.790	5.305	93,9%	-485	-8%	-4.195	-44%			
Bulgaria	59	64	74	1,3%	10	15%	16	27%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	34	54	1,0%	20	60%	54	-	T1	NS	CS
Estonia	NO	1	1	0,02%	0	51%	1	-	T1	NS	D
Hungary	86	20	28	-	8	42%	-59	-68%	T2	NS	D
Latvia	16	NO	NO	-	-	-	-16	-100%	T1	CS	CS
Lithuania	69	1	1	0,01%	0	-17%	-68	-99%	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	104	158	175	3,1%	17	11%	71	68%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	985	26	5	0,1%	-21	-81%	-980	-99%	T2	PS	CS
Slovenia	97	44	7	0,1%	-36	-83%	-90	-93%	T1	NS	D
EU-27	**10.916**	**6.137**	**5.651**	**100,0%**	**-486**	**-8%**	**-5.264**	**-48%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.131 1A2d Pulp, Paper and Print, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	3.536	1.495	1.202	40,9%	-292	-20%	-2.333	-66%
Bulgaria	3	0	1	0,0%	0	443%	-2	-79%
Cyprus	NO	NO	NO	-	-	-	-	-
Czech Republic	IE	277	309	10,5%	31	11%	309	-
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	24	0,3	0,1	0,00%	0	-67%	-24	-100%
Latvia	3	2	NO	-	-2	-100%	-3	-100%
Lithuania	NO	NO	NO	-	-	-	0	-
Malta	NO	NO	NO	-	-	-	-	-
Poland	173	1.073	884	30,1%	-189	-18%	711	411%
Romania	IE	IE	IE	-	-	-	-	-
Slovakia	1.142	397	380	12,9%	-17	-4%	-761	-67%
Slovenia	169	170	162	5,5%	-8	-5%	-6	-4%
EU-27	**5.049**	**3.416**	**2.939**	**100,0%**	**-478**	**-14%**	**-2.110**	**-42%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.132 1A2d Pulp, Paper and Print, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	10.636	18.516	18.912	93,9%	396	2%	8.276	78%			
Bulgaria	NO	128	124	0,6%	-4	-3%	124	-	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	229	211	1,0%	-18	-8%	211	-	T1	NS	D
Estonia	NO	5	4	0,0%	-1	-13%	4	-	T1	NS	D
Hungary	51	189	167	0,8%	-22	-12%	116	227%	T2	NS	D
Latvia	152	13	11	0,1%	-2	-14%	-141	-93%	T1	CS	CS
Lithuania	193	2	3	0,0%	0	-	-190	-	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	6	162	247	1,2%	85	52%	241	4283%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	152	209	186	0,9%	-23	-11%	34	-	T2	PS	CS
Slovenia	109	257	283	1,4%	26	10%	174	160%	T1	NS	CS
EU-27	**11.298**	**19.709**	**20.148**	**100,0%**	**438**	**2%**	**8.850**	**78%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.8 Food Processing, Beverages and Tobacco (1A2e) (EU-27)

Table 3.133 1A2e Food Processing, Beverages and Tobacco, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	14.886	10.123	9.492	88,7%	-631	-6%	-5.394	-36%			
Bulgaria	180	201	214	2,0%	13	7%	34	19%	T2	NS	CS
Cyprus	47	168	138	1,3%	-30	-18%	91	194%	NO	NO	NO
Czech Republic	IE	69	76	0,7%	7	10%	76	-	T1	NS	D
Estonia	439	3	5	0,0%	2	59%	-434	-99%	T1	NS	D
Hungary	817	73	41	0,4%	-32	-44%	-776	-95%	T2	NS	D
Latvia	798	76	60	0,6%	-15	-20%	-738	-92%	T1	CS	CS
Lithuania	241	53	55	0,5%	3	5%	-186	-77%	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NE	NE	NE
Poland	228	626	566	5,3%	-60	-10%	338	148%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	359	45	2	0,0%	-43	-95%	-357	-99%	T2	PS	CS
Slovenia	144	112	55	0,5%	-57	-51%	-89	-62%	T1	NS	D
EU-27	**18.139**	**11.549**	**10.705**	**100,0%**	**-844**	**-7%**	**-7.434**	**-41%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.134 1A2e Food Processing, Beverages and Tobacco, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	5.186	2.109	2.253	40,6%	144	7%	-2.933	-57%			
Bulgaria	36	94	50	0,9%	-44	-46%	14	40%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	81	176	3,2%	95	117%	176	-	T1	NS	CS
Estonia	5	0,2	NA	-	-0,2	-	-5	-100%	NO	NO	NO
Hungary	194	15	13	0,2%	-3	-17%	-181	-93%	T2	NS	CS
Latvia	98	10	7	0,1%	-2	-24%	-90	-93%	T1	CS	CS
Lithuania	33	10	10	0,2%	-1	-	-24	-71%	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NE	NE	NE
Poland	3.374	2.937	3.004	54,1%	67	-	-370	-11%	T2	NS	CS/D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	312	32	40	0,7%	7	-	-272	-87%	T2	PS	CS
Slovenia	9	4	NO	-	-4,0	-	-9	-100%	T1	NS	D
EU-27	**9.247**	**5.294**	**5.553**	**100,0%**	**260**	**5%**	**-3.694**	**-40%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.135 1A2e Food Processing, Beverages and Tobacco, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	12.744	23.516	23.926	86,9%	410	2%	11.182	88%			
Bulgaria	12	204	221	0,8%	17	8%	209	1814%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	IE	961	860	3,1%	-100	-10%	860	-	T1	NS	D
Estonia	15	6	7	0,0%	0	7%	-8	-56%	T1	NS	D
Hungary	804	697	584	2,1%	-113	-16%	-220	-27%	T2	NS	D
Latvia	177	181	150	0,5%	-31	-17%	-27	-15%	T1	CS	CS
Lithuania	484	220	240	0,9%	20	9%	-244	-50%	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NE	NE	NE
Poland	110	1.028	1.140	4,1%	111	11%	1.030	936%	T2	NS	D
Romania	IE	IE	IE	-	-	-	-	-	NA	IE2	NA
Slovakia	470	347	327	1,2%	-20	-6%	-143	-30%	T2	PS	CS
Slovenia	65	86	76	0,3%	-10	-12%	11	17%	T1	NS	CS
EU-27	**14.880**	**27.247**	**27.530**	**100,0%**	**283**	**1%**	**12.650**	**85%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.9 Other (1A2f) (EU-27)

Table 3.136 1A2f Other, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	125.832	110.796	105.855	88,4%	-4.941	-4%	-19.978	-16%			
Bulgaria	1.238	2.110	2.245	1,9%	135	6%	1.007	81%	T2	NS	CS
Cyprus	520	801	788	0,7%	-13	-2%	267	51%	C	NS	D
Czech Republic	9.110	1.196	1.833	1,5%	638	53%	-7.277	-80%	T1	NS	D
Estonia	324	121	148	0,1%	27	22%	-176	-54%	T1,T2	NS	D, CS
Hungary	636	114	97	0,1%	-17	-15%	-539	-85%	T1	NS	D
Latvia	945	172	171	0,1%	-1	0%	-774	-82%	T1	CS	CS
Lithuania	3.515	212	192	0,2%	-20	-10%	-3.323	-95%	T2	NS	CS/C
Malta	NA	NA	NA	-	-	-	-	-	D,T1	NS	D
Poland	2.199	2.496	1.774	1,5%	-722	-29%	-426	-19%	T2	NS	D
Romania	8.958	4.960	5.969	5,0%	1.009	20%	-2.989	-33%	T1	NS	D
Slovakia	1.286	176	193	0,2%	18	10%	-1.092	-85%	T2	PS	CS
Slovenia	696	613	457	0,4%	-155	-25%	-239	-34%	T1	NS	D
EU-27	**155.259**	**123.766**	**119.721**	**100,0%**	**-4.044**	**-3%**	**-35.538**	**-23%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.137 1A2f Other, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	119.778	35.470	36.898	58,4%	1.429	4%	-82.880	-69%			
Bulgaria	11.201	1.115	1.563	2,5%	448	40%	-9.637	-86%	T2	NS	CS
Cyprus	113	149	117	0,2%	-32	-	5	4%	NO	NO	NO
Czech Republic	31.522	7.009	9.308	14,7%	2.299	33%	-22.214	-70%	T1	NS	D
Estonia	793	287	705	1,1%	418	146%	-88	-11%	T1,T2	NS	D, CS
Hungary	550	20	8	0,0%	-11	-58%	-542	-99%	T1	NS	D
Latvia	41	114	179	0,3%	65	57%	138	337%	T1	CS	CS
Lithuania	156	527	547	0,9%	20	4%	391	251%	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	13.752	6.006	7.208	11,4%	1.202	20%	-6.544	-48%	T2	NS	CS/D
Romania	6.552	6.043	5.698	9,0%	-346	-6%	-854	-13%	T1	NS	D
Slovakia	2.897	829	793	1,3%	-36	-4%	-2.104	-73%	T2	PS	CS
Slovenia	199	158	196	0,3%	38	24%	-3	-1%	T1	NS	D
EU-27	**187.552**	**57.727**	**63.220**	**100,0%**	**5.493**	**10%**	**-124.332**	**-66%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.138 1A2f Other, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	104.712	140.439	134.938	86,8%	-5.501	-4%	30.226	29%			
Bulgaria	1.793	1.097	1.093	0,7%	-4	0%	-700	-39%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	5.984	4.342	3.862	2,5%	-480	-11%	-2.122	-35%	T1	NS	D
Estonia	101	106	112	0,1%	6	6%	11	11%	T1	NS	D
Hungary	2.072	584	553	0,4%	-31	-5%	-1.519	-73%	T1	NS	D
Latvia	850	278	295	0,2%	17	6%	-555	-65%	T1	CS	CS
Lithuania	1.093	389	396	0,3%	7	2%	-697	-64%	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	D,T1	NS	D
Poland	2.245	3.553	3.640	2,3%	87	2%	1.395	62%	T2	NS	D
Romania	16.449	8.300	7.864	5,1%	-436	-5%	-8.584	-52%	T1	NS	D
Slovakia	1.613	2.377	2.033	1,3%	-345	-15%	419	-	T2	PS	CS
Slovenia	530	619	587	0,4%	-33	-5%	57	11%	T1	NS	CS
EU-27	**137.442**	**162.084**	**155.373**	**100,0%**	**-6.712**	**-4%**	**17.931**	**13%**			

3.9.2.10 Civil Aviation (1A3a) (EU-27)

Table 3.139 1A3a Civil Aviation, jet kerosine: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	16.231	21.328	21.695	98,7%	367	2%	5.464	34%			
Bulgaria	314	121	132	0,6%	11	9%	-182	-58%	T1	NS	D
Cyprus	NA	NA	NA	-	-	-	-	-	T2a	NS, AS	T2a
Czech Republic	82	10	26	0,12%	16,1	167%	-57	-69%	T1	NS	D
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	0	3	1	0,01%	-1,6	-54%	1	2428%	T1	AS	CS
Lithuania	NE	1	3	0,013%	1,6	138%	3	-	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	D,T2	NS	C
Poland	30	65	68	0,3%	3	4%	38	126%	T1	NS	D
Romania	25	12	53	0,24%	42	354%	29	117%	T1	AS	D
Slovakia	7	11	13	0,06%	2	16%	6	86%	T2	NS	D
Slovenia	NO	NO	NO	-	-	-	-	-	T1	NS	D
EU-27	**16.689**	**21.551**	**21.992**	100,0%	440	2%	5.302	32%			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.11 Road Transportation (1A3b) (EU-27)

Table 3.140 1A3b Road Transport, diesel oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	266.758	499.946	512.279	88,9%	12.334	2%	245.521	92%			
Bulgaria	3.124	4.504	4.262	0,7%	-242	-5%	1.138	36%	T2	NS	CS
Cyprus	642	1.068	1.120	0,2%	52	5%	478	74%	COPERT III	NS	D
Czech Republic	2.817	10.573	11.158	1,9%	585	6%	8.341	296%	T1	NS	D
Estonia	675	1.174	1.254	0,2%	80	7%	579	86%	T1	NS	D
Hungary	2.485	7.321	7.599	1,3%	277	4%	5.113	206%	T1	NS	CS
Latvia	615	1.883	2.200	0,4%	317	17%	1.585	258%	COPERT IV	NS	CS
Lithuania	2.166	2.352	2.877	0,5%	525	22%	710	33%	T2	NS	CS
Malta	150	268	268	0,0%	0	0%	118	79%	D,T1	NS	D
Poland	11.161	18.189	18.376	3,2%	186	1%	7.215	65%	T2	Q	CS
Romania	3.388	7.534	7.609	1,3%	75	1%	4.220	125%	T1	NS	D
Slovakia	3.108	3.542	4.222	0,7%	681	19%	1.114	36%	COPERT III	NS	D
Slovenia	900	2.550	3.190	0,6%	640	25%	2.289	254%	COPERT 3	NS	C
EU-27	**297.989**	**560.904**	**576.413**	**100,0%**	**15.509**	**2,8%**	**278.423**	**93%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.141 1A3b Road Transport, gasoline: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	362.575	285.695	275.078	87,7%	-10.617	-4%	-87.496	-24%			
Bulgaria	4.462	1.920	1.893	0,6%	-27	-1%	-2.569	-58%	T2	NS	CS
Cyprus	119	985	1.073	0,3%	88	9%	954	803%	COPERT III	NS	D
Czech Republic	3.179	6.363	6.637	2,1%	274	4%	3.458	109%	T1	NS	D
Estonia	1.462	925	971	0,3%	46	5%	-491	-34%	T1	NS	D
Hungary	4.985	4.672	4.545	1,4%	-127	-3%	-440	-9%	T1	NS	CS
Latvia	1.660	1.119	1.225	0,4%	106	9%	-435	-26%	COPERT IV	NS	CS
Lithuania	3.054	1.099	1.312	0,4%	213	19%	-1.743	-57%	T2	NS	CS
Malta	183	229	238	0,1%	10	4%	55	30%	D,T1	NS	D
Poland	10.130	12.831	12.632	4,0%	-198	-2%	2.502	25%	T2	Q	CS
Romania	3.073	4.290	4.208	1,3%	-82	-2%	1.135	37%	T1	NS	D
Slovakia	1.393	1.971	2.059	0,7%	88	4%	667	48%	COPERT III	NS	D
Slovenia	1.711	2.017	1.959	0,6%	-59	-3%	248	14%	COPERT 3	NS	C
EU-27	**397.986**	**324.116**	**313.830**	**100,0%**	**-10.286**	**-3,2%**	**-84.156**	**-21%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.142 1A3b Road Transport, LPG: Member CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	7.296	5.478	5.353	41,3%	-125	-2%	-1.943	-27%			
Bulgaria	0	1.195	1.143	8,8%	-52	-4%	1.143	2011834%	T2	NS	D
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	218	233	1,8%	15	7%	233	-	T1	NS	D
Estonia	9	0,2	0,1	0,001%	-0,1	-46%	-9	-99%	T1	NS	D
Hungary	NA	72	84	0,7%	13	-	84	-	T1	NS	D
Latvia	38	83	71	0,5%	-12	-14%	33	85%	T1	NS	CS
Lithuania	60	638	631	4,9%	-7	-1%	571	955%	T2	NS	CS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	NO	5.206	5.267	40,6%	61	1%	5.267	-	T2	Q	CS
Romania	NA	48	95	0,7%	48	100%	95	-	T1	NS	D
Slovakia	NO	91	79	0,6%	-12	-13%	79	-	COPERT III	NS	D
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**7.403**	**13.027**	**12.956**	**100,0%**	**-71**	**-1%**	**5.553**	**75%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.143 1A3b Road Transport, diesel oil: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	2.138	5.949	6.297	87,0%	348	6%	4.159	195%			
Bulgaria	24	35	33	0,5%	-2	-5%	9	36%	T2	NS	CS
Cyprus	10	17	18	0,3%	1	5%	8	74%	COPERT III	NS	D
Czech Republic	36	198	211	2,9%	12	6%	175	491%	T2	NS	CS
Estonia	12	28	30	0,4%	2	7%	18	152%	T3	NS	D, CS
Hungary	63	122	126	1,7%	5	4%	63	100%	T2	NS	D
Latvia	10	16	18	0,2%	2	16%	8	77%	COPERT IV	NS	CS
Lithuania	36	39	48	0,7%	9	22%	12	33%	T2	NS	CS
Malta	0	1	1	0,0%	0	0%	0	80%	D,T1	NS	D
Poland	151	249	266	3,7%	17	7%	115	76%	T2	Q	D
Romania	9	19	19	0,3%	0	1%	11	125%	T1	NS	D
Slovakia	61	69	81	1,1%	12	18%	20	32%	COPERT III	NS	D
Slovenia	20	72	89	1,2%	17	24%	69	336%	COPERT 3	NS	C
EU-27	**2.571**	**6.814**	**7.238**	**100,0%**	**424**	**6%**	**4.667**	**182%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.144 1A3b Road Transport, gasoline: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	3.191	4.610	4.213	68,3%	-397	-9%	1.022	32%			
Bulgaria	23	9	9	0,2%	0	-1%	-13	-59%	T2	NS	CS
Cyprus	7	35	38	0,6%	3	8%	31	441%	COPERT III	NS	D
Czech Republic	35	493	512	8,3%	19	4%	476	1361%	T2	NS	CS
Estonia	10	39	39	0,6%	0	1%	29	299%	T3	NS	D, CS
Hungary	338	261	253	4,1%	-9	-3%	-85	-25%	T2	NS	D
Latvia	6	24	24	0,4%	0	1%	19	324%	COPERT IV	NS	CS
Lithuania	26	9	11	0,2%	2	19%	-15	-57%	T2	NS	CS
Malta	0	1	1	0,0%	0	4%	0	30%	D,T1	NS	D
Poland	75	829	862	14,0%	33	4%	787	1053%	T2	Q	D
Romania	8	12	11	0,2%	0	-2%	3	37%	T1	NS	D
Slovakia	11	90	99	1,6%	9	10%	88	835%	COPERT III	NS	D
Slovenia	13	94	94	1,5%	0	0%	81	604%	COPERT 3	NS	C
EU-27	**3.742**	**6.506**	**6.166**	**100,0%**	**-341**	**-5%**	**2.423**	**65%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.12 Railways (1A3c) (EU-27)

Table 3.145 1A3c Railways, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	8.037	5.892	5.818	70,8%	-74	-1%	-2.219	-28%			
Bulgaria	334	93	79	1,0%	-14	-16%	-255	-76%	T2	NS	CS
Cyprus	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	647	301	298	3,6%	-3	-1%	-349	-54%	T1	NS	D
Estonia	143	136	112	1,4%	-24	-18%	-31	-22%	T1	NS	D
Hungary	513	185	185	2,3%	0	0%	-328	-64%	T1	NS	D
Latvia	526	224	243	3,0%	19	8%	-283	-54%	T1	NS	CS
Lithuania	355	221	229	2,8%	9	4%	-126	-35%	T2	NS	CS
Malta	NO	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	1.770	463	537	6,5%	73	16%	-1.233	-70%	T1	NS	D
Romania	904	223	566	6,9%	343	154%	-337	-37%	T1	NS	D
Slovakia	377	113	109	1,3%	-5	-4%	-268	-71%	T1	AS	D
Slovenia	64	37	37	0,5%	0	0%	-27	-42%	T1	NS	D
EU-27	**13.669**	**7.890**	**8.213**	**100,0%**	**324**	**4%**	**-5.456**	**-40%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.13 Navigation (1A3d) (EU-27)

Table 3.146 1A3d Navigation, residual oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	5.729	7.607	7.996	99,8%	389	5%	2.267	40%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	T1	NS	D
Estonia	473	NO	NO	-	-	-	-473	-100%	T1	NS	D
Hungary	2	NO	NO	-	-	-	-2	-100%	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	T1	NS	CS
Lithuania	NO	1,1	1	0,01%	0	-36%	1	-	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	58	3	3	0,04%	0	1%	-55	-94%	T1	NS	D
Romania	146	1	13	0,16%	11	988%	-133	-91%	T1	NS	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**6.406**	**7.612**	**8.012**	**100,0%**	**400**	**5%**	**1.606**	**25%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.147 1A3d Navigation, gas/diesel oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	12.525	13.010	12.116	98,4%	-894	-7%	-410	-3%	#NV	#NV	#NV
Bulgaria	58	NO	NO	-	-	-	-58	-100%	NO	NO	NO
Cyprus	NO	NO	NO	-	-	-	-	-	C	NS	D
Czech Republic	56	19	16	0,1%	-3	-16%	-40	-72%	T1	NS	D
Estonia	106	34	54	0,4%	20	59%	-51	-49%	T1	NS	D
Hungary	28	4	3	0,0%	-1	-14%	-25	-89%	T1	NS	D
Latvia	16	44	3	0,0%	-40	-93%	-13	-80%	T1	NS	CS
Lithuania	16	18	17	0,1%	-1	-5%	2	11%	T2	NS	CS
Malta	8	17	19	0,2%	2	10%	10	125%	D,T1	NS	D
Poland	145	11	7	0,1%	-3	-30%	-138	-95%	T1	NS	D
Romania	39	38	75	0,6%	37	96%	35	90%	T1	NS	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	IE	IE	IE	-	-	-	-	-	IE	IE	IE
EU-27	**12.997**	**13.194**	**12.310**	**100,0%**	**-884**	**-7%**	**-687**	**-5%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.14 Other (1A3e) (EU-27)

Table 3.148 1A3e Other: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	6.502	7.619	7.172	82,0%	-446	-6%	670	10%
Bulgaria	2.569	788	687	7,9%	-101	-13%	-1.882	-73%
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	494	158	76	0,9%	-82	-52%	-418	-85%
Estonia	451	135	144	1,7%	10	7%	-307	-68%
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NA	NA	NA	-	-	-	-	-
Poland	1.299	607	616	7,0%	9	1%	-683	-53%
Romania	7	54	45	0,5%	-9	-17%	38	522%
Slovakia	7	2	2	0,0%	1	29%	-5	-66%
Slovenia	NO	NO	NO	-	-	-	-	-
EU-27	**11.330**	**9.362**	**8.744**	**100,0%**	**-619**	**-7%**	**-2.587**	**-23%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.15 Commercial/Institutional (1A4a) (EU-27)

Table 3.149 1A4a Commercial/Institutional, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	73.998	56.820	44.760	91,0%	-12.060	-21%	-29.238	-40%			
Bulgaria	102	205	151	0,3%	-54	-26%	50	49%	T2	NS	CS
Cyprus	27	106	85	0,2%	-22	-20%	57	211%	C	NS	D
Czech Republic	1.786	101	48	0,1%	-54	-53%	-1.738	-97%	T1	NS	D
Estonia	62	41	45	0,1%	4	9%	-17	-27%	T1,T2	NS	D, CS
Hungary	1.296	103	275	0,6%	172	168%	-1.021	-79%	T1	NS	D
Latvia	1.131	183	140	0,3%	-43	-24%	-991	-88%	T1	CS	CS
Lithuania	1.174	17	16	0,0%	0	-2%	-1.158	-99%	T2	NS	CS
Malta	56	36	39	0,1%	3	8%	-16	-30%	D,T1	NS	D
Poland	NO	1.034	1.639	3,3%	604	58%	1.639	-	T2	NS	D
Romania	926	877	1.536	3,1%	659	75%	610	66%	T1	NS	D
Slovakia	384	25	4	0,0%	-20	-83%	-379	-99%	T2	PS	CS
Slovenia	267	597	448	0,9%	-149	-25%	180	67%	T1	NS	D
EU-27	**81.210**	**60.146**	**49.186**	**100,0%**	**-10.960**	**-18%**	**-32.024**	**-39%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.150 1A4a Commercial/Institutional, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	27.618	1.852	2.180	38,6%	328	18%	-25.439	-92%			
Bulgaria	31	31	14	0,2%	-17	-55%	-17	-56%	T2	NS	CS
Cyprus	NA	NA	NA	-	-	-	-	-	C	NS	D
Czech Republic	6.274	593	196	3,5%	-398	-67%	-6.078	-97%	T1	NS	CS
Estonia	6	1	2	0,0%	1	128%	-4	-62%	T1	NS	D
Hungary	650	19	15	0,3%	-4	-23%	-635	-98%	T1	NS	D
Latvia	1.440	106	101	1,8%	-5	-5%	-1.340	-93%	T1	CS	CS
Lithuania	1.186	299	222	3,9%	-77	-26%	-964	-81%	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	11.635	3.048	2.876	50,9%	-172	-6%	-8.759	-75%	T2	NS	CS/D
Romania	400	15	7	0,1%	-8	-53%	-393	-98%	T1	NS	D
Slovakia	1.729	60	40	0,7%	-21	-34%	-1.689	-98%	T2	PS	CS
Slovenia	200	NO	NO	-	0	-	-200	-100%	NO	NO	NO
EU-27	**51.170**	**6.025**	**5.652**	**100,0%**	**-373**	**-6%**	**-45.518**	**-89%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.151 1A4a Commercial/Institutional, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	59.112	97.842	92.033	86,8%	-5.809	-6%	32.921	56%			
Bulgaria	39	147	158	0,1%	10	7%	118	300%	T2	NS	CS
Cyprus	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	1.428	2.879	2.899	2,7%	20	1%	1.471	103%	T1	NS	D
Estonia	19	34	66	0,1%	32	96%	47	253%	T1	NS	D
Hungary	1.928	5.048	3.560	3,4%	-1.488	-29%	1.633	85%	T1	NS	D
Latvia	343	279	318	0,3%	39	14%	-25	-7%	T1	CS	CS
Lithuania	730	128	172	0,2%	44	34%	-558	-76%	T2	NS	CS/C
Malta	7	12	13	0,0%	2	13%	6	93%	D,T1	NS	D
Poland	770	3.513	3.620	3,4%	107	3%	2.850	370%	T2	NS	D
Romania	313	3.768	2.551	2,4%	-1.217	-32%	2.238	715%	T1	NS	D
Slovakia	1.215	759	653	0,6%	-107	-14%	-563	-	T2	PS	CS
Slovenia	29	32	27	0,0%	-6	-18%	-2	-8%	T1	NS	CS
EU-27	**65.933**	**114.442**	**106.069**	**100,0%**	**-8.373**	**-7%**	**40.136**	**61%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.16 Residential (1A4b) (EU-27)

Table 3.152 1A4b Residential, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	169.554	153.515	121.788	95,2%	-31.728	-21%	-47.766	-28%			
Bulgaria	1.577	74	69	0,1%	-5	-7%	-1.508	-96%	T2	NS	CS
Cyprus	222	237	208	0,2%	-30	-13%	-15	-7%	C	NS	D
Czech Republic	490	111	90	0,1%	-21	-19%	-400	-82%	T1	NS	D
Estonia	547	29	24	0,0%	-5	-18%	-523	-96%	T1,T2	NS	D, CS
Hungary	3.423	430	246	0,2%	-184	-43%	-3.177	-93%	T1	NS	D
Latvia	330	104	93	0,1%	-11	-11%	-237	-72%	T1	CS	CS
Lithuania	396	152	105	0,1%	-47	-31%	-292	-74%	T2	NS	CS
Malta	3	0	0	0,0%	0	-25%	-2	-89%	D,T1	NS	D
Poland	106	2.230	2.789	2,2%	559	25%	2.682	2524%	T2	NS	D
Romania	867	1.211	1.697	1,3%	486	40%	830	96%	T1	NS	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	434	1.125	860	0,7%	-265	-24%	425	98%	T1	NS	D
EU-27	**177.950**	**159.219**	**127.968**	**100,0%**	**-31.251**	**-20%**	**-49.982**	**-28%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.153 1A4b Residential, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	74.504	10.332	9.842	28,4%	-490	-5%	-64.661	-87%			
Bulgaria	3.209	1.164	947	2,7%	-217	-19%	-2.263	-70%	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	C	NS	D
Czech Republic	17.373	3.464	2.017	5,8%	-1.447	-42%	-15.356	-88%	T1	NS	CS
Estonia	700	75	44	0,1%	-31	-41%	-656	-94%	T1,T2	NS	D, CS
Hungary	7.981	956	540	1,6%	-416	-44%	-7.441	-93%	T1	NS	D
Latvia	632	75	75	0,2%	0	0%	-557	-88%	T1	CS	CS
Lithuania	1.458	206	206	0,6%	-1	0%	-1.252	-86%	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	26.227	22.791	20.616	59,6%	-2.175	-10%	-5.611	-21%	T2	NS	CS/D
Romania	2.040	40	42	0,1%	3	7%	-1.997	-98%	T1	NS	D
Slovakia	5.949	578	289	0,8%	-289	-50%	-5.660	-95%	T2	PS	CS
Slovenia	338	NO	NO	-	0	#WERT!	-338	-100%	NO	NO	NO
EU-27	**140.409**	**39.681**	**34.618**	**100,0%**	**-5.063**	**-13%**	**-105.791**	**-75%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.154 1A4b Residential, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	161.897	236.916	221.887	88,6%	-15.029	-6%	59.990	37%			
Bulgaria	NO	57	77	0,0%	19	34%	77	-	T2	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	2.746	5.301	5.025	2,0%	-275	-5%	2.279	83%	T1	NS	D
Estonia	118	106	114	0,0%	7	7%	-5	-4%	T1	NS	D
Hungary	3.937	8.516	7.506	3,0%	-1.010	-12%	3.569	91%	T1	NS	D
Latvia	223	241	257	0,1%	15	6%	33	15%	T1	CS	CS
Lithuania	526	334	351	0,1%	17	5%	-175	-33%	T2	NS	CS
Malta	32	41	39	0,0%	-2	-5%	7	23%	D,T1	NS	D
Poland	6.821	7.741	7.403	3,0%	-338	-4%	582	9%	T2	NS	D
Romania	2.785	6.014	4.880	1,9%	-1.134	-19%	2.095	75%	T1	NS	D
Slovakia	1.586	2.975	2.565	1,0%	-410	-14%	979	-	T2	PS	CS
Slovenia	25	219	196	0,1%	-22	-10%	171	687%	T1	NS	CS
EU-27	**180.696**	**268.461**	**250.299**	**100,0%**	**-18.162**	**-7%**	**69.603**	**39%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.155 1A4b Residential, biomass: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	6.099	4.613	4.523	64,5%	-90	-2%	-1.576	-26%
Bulgaria	18	117	112	1,6%	-5	-4%	94	526%
Cyprus	1	0	1	0,0%	1	5381%	0	-14%
Czech Republic	37	213	294	4,2%	81	38%	257	692%
Estonia	34	76	100	1,4%	24	31%	66	197%
Hungary	73	240	108	1,5%	-132	-55%	35	49%
Latvia	126	197	192	2,7%	-5	-2%	66	52%
Lithuania	76	152	141	2,0%	-11	-7%	65	86%
Malta	NA	NA	NA	-	-	-	-	-
Poland	216	658	599	8,5%	-60	-9%	382	177%
Romania	139	678	707	10,1%	29	4%	568	407%
Slovakia	NO	NO	155	2,2%	155	-	155	-
Slovenia	86	86	86	1,2%	0	0%	0	0%
EU-27	**6.905**	**7.030**	**7.017**	**100,0%**	**-13**	**0%**	**112**	**2%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.17 Agriculture/Forestry/Fisheries (1A4c) (EU-27)

Table 3.156 1A4c Agriculture/Forestry/Fisheries, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	56.086	49.765	47.587	87,2%	-2.178	-4%	-8.499	-15%			
Bulgaria	245	117	88	0,2%	-29	-25%	-156	-64%	T2	NS	CS
Cyprus	32	64	59	0,1%	-5	-8%	27	84%	C	NS	D
Czech Republic	342	61	22	0,0%	-39	-64%	-320	-94%	T1	NS	D
Estonia	47	50	49	0,1%	0	-1%	2	5%	T1,T2	NS	D, CS
Hungary	2.134	819	723	1,3%	-95	-12%	-1.411	-66%	T1	NS	D
Latvia	695	336	336	0,6%	0	0%	-358	-52%	T1	CS	CS
Lithuania	1.188	130	137	0,3%	7	5%	-1.051	-88%	T2	NS	CS
Malta	NE	NA	NA	-	-	-	-	-	NE	NE	NE
Poland	3.620	6.990	4.956	9,1%	-2.034	-29%	1.336	37%	T2	NS	D
Romania	3.558	487	388	0,7%	-99	-20%	-3.170	-89%	T1	NS	D
Slovakia	3	15	3	0,0%	-12	-80%	0	2%	T2	PS	CS
Slovenia	330	231	229	0,4%	-2	-1%	-101	-31%	T1	NS	D
EU-27	**68.280**	**59.067**	**54.579**	**100,0%**	**-4.488**	**-8%**	**-13.701**	**-20%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.157 1A4c Agriculture/Forestry/Fisheries, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	4.066	747	751	15,9%	4	1%	-3.315	-82%			
Bulgaria	177	27	35	0,7%	8	30%	-142	-80%	T2	NS	CS
Cyprus	NA	NA	NA	-	-	-	-	-	C	NS	D
Czech Republic	1.493	89	53	1,1%	-36	-41%	-1.440	-96%	T1	NS	CS
Estonia	16	0	3	0,1%	2	1852%	-14	-84%	T1,T2	NS	D, CS
Hungary	212	12	11	0,2%	-1	-5%	-200	-95%	T1	NS	D
Latvia	103	5	5	0,1%	0	0%	-98	-95%	T1	CS	CS
Lithuania	148	6	3	0,1%	-2	-44%	-145	-98%	T2	NS	CS
Malta	NE	NA	NA	-	-	-	-	-	NE	NE	NE
Poland	2.850	4.369	3.870	81,7%	-499	-11%	1.020	36%	T2	NS	CS/D
Romania	69	1	0	0,01%	-1	-76%	-68	-100%	T1	NS	D
Slovakia	1	5	3	0,1%	-1	-31%	2	132%	T2	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**9.135**	**5.261**	**4.735**	**100,0%**	**-526**	**-10%**	**-4.400**	**-48%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.158 1A4c Agriculture/Forestry/Fisheries, gaseous fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9.720	9.319	9.476	90,7%	157	2%	-244	-3%			
Bulgaria	0	75	76	0,7%	1	1%	76	36324%	T2	NS	CS
Cyprus	NA	NA	NA	-	-	-	-	-	C	NS	D
Czech Republic	415	152	154	1,5%	2	1%	-261	-63%	T1	NS	D
Estonia	4	0	1	0,0%	0	240%	-3	-82%	T1	NS	D
Hungary	627	453	355	3,4%	-98	-22%	-272	-43%	T1	NS	D
Latvia	792	45	43	0,4%	-2	-5%	-750	-95%	T1	CS	CS
Lithuania	168	90	94	0,9%	4	5%	-74	-44%	T2	NS	CS/C
Malta	NE	NA	NA	-	-	-	-	-	NE	NE	NE
Poland	25	83	103	1,0%	19	23%	78	310%	T2	NS	D
Romania	73	70	59	0,6%	-11	-15%	-13	-18%	T1	NS	D
Slovakia	41	90	84	0,8%	-6	-6%	43	-	T2	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**11.864**	**10.376**	**10.444**	**100,0%**	**67**	**1%**	**-1.421**	**-12%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.18 Stationary (1A5a) (EU-27)

Table 3.159 1A5a Stationary, solid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	4.667	18	7	48,7%	-11	-60%	-4.659	-100%			
Bulgaria	37	NO	NO	-	-	-	-37	-100%	NO	NO	NO
Cyprus	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	0,0	0,0	0,0
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Lithuania	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NO	NO	NO
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	IE	IE	IE	-	-	-	-	-	IE	IE	IE
Romania	NE	NE	NE	-	-	-	-	-	NA	NA4	NA
Slovakia	198	10	8	51,3%	-2	-21%	-190	-96%	T2	PS	CS
Slovenia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
EU-27	**4.902**	**28**	**15**	**100,0%**	**-13**	**-47%**	**-4.887**	**-100%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.19 Mobile (1A5b) (EU-27)

Table 3.160 1A5b Mobile, liquid fuels: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	13.757	5.676	6.217	84,7%	541	10%	-7.540	-55%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	17	28	29	0,4%	1	4%	12	70%	NO	NO	NO
Czech Republic	1.601	1.066	1.078	14,7%	12	1%	-523	-33%	T1	NS	D
Estonia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NA	3	3	0,0%	0	0%	3	-	T1	CS	CS
Lithuania	NE,NO	12	16	0,2%	4	33%	16	-	NO	NO	NO
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	NO	NO	NO	-	-	-	-	-	IE	IE	IE
Romania	NA	NA	NA	-	-	-	-	-	NA	NA4	NA
Slovakia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Slovenia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
EU-27	**15.375**	**6.785**	**7.343**	**100,0%**	**558**	**8%**	**-8.032**	**-52%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.20 Fugitive emissions from Solid Fuels (1B1) (EU-27)

Table 3.161 1B1a Coal Mining: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	44.285	10.893	8.928	33,6%	-1.965	-18%	-35.357	-80%			
Bulgaria	1.592	1.187	1.306	4,9%	119	10%	-286	-18%	T1	NS	D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	NS	D
Czech Republic	7.600	4.960	4.567	17,2%	-393	-8%	-3.033	-40%	T2,T1	NS	CS, D
Estonia	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Hungary	659	23	23	0,1%	0	-1%	-637	-97%	D,T2	NS,PS	CS
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	T2	NS	CS
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	14.717	9.193	8.518	32,1%	-675	-7%	-6.199	-42%	CS	NS	CS
Romania	3.661	2.598	2.679	10,1%	80	3%	-982	-27%	NA	NA4	NA
Slovakia	571	308	284	1,1%	-24	-8%	-287	-50%	T2	PS	CS
Slovenia	303	254	254	1,0%	0	0%	-48	-16%	CS	NS	CS
EU-27	**73.389**	**29.417**	**26.560**	**100,0%**	**-2.858**	**-10%**	**-46.829**	**-64%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.2.21 Fugitive emissions from oil and natural gas (1B2) (EU-27)

Table 3.162 1B2a Fugitive CO_2 emissions from oil: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9.866	10.566	9.961	98,1%	-605	-6%	95	1%			
Bulgaria	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NE	NE	NE
Cyprus	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-	T1	NS	D
Czech Republic	,NA,NE,NO	,NA,NE,NO	,NA,NE,NO	-	-	-	-	-	0,0	0,0	0,0
Estonia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Hungary	IE,NO	IE,NO	IE,NO	-	-	-	-	-	---	---	---
Latvia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Lithuania	0,1	0,1	0,1	0,001%	0	-39%	0	52%	T2	NS	D
Malta	NA,NE	NA,NE	NA,NE	-	-	-	-	-	NO	NO	NO
Poland	43	214	192	1,9%	-22	-10%	149	351%	0,0	0,0	0,0
Romania	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NO	NA5
Slovakia	0,0012	0,0007	0,0006	0,0%	0	-23%	0	-51%	T1	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**9.909**	**10.780**	**10.153**	**100,0%**	**-627**	**-6%**	**244**	**2%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.163 1B2b Fugitive CH_4 emissions from natural gas: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	26.286	20.880	20.315	54,6%	-565	-3%	-5.971	-23%			
Bulgaria	606	583	611	1,6%	28	5%	5	1%	T1	NS	D
Cyprus	NO	NO	NO	-	-	-	-	-	T1	NS	D
Czech Republic	878	682	684	1,8%	2	0%	-194	-22%	T2	NS	CS
Estonia	787	519	516	1,4%	-3	-1%	-271	-34%	T1	NS	D
Hungary	908	1.501	1.506	4,0%	5	0%	598	66%	D	NS, PS	OTH
Latvia	236	97	99	0,3%	2	2%	-137	-58%	CS	PS	PS
Lithuania	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	-	T2	NS	CS
Malta	NA,NE	NA,NE	NA,NE	-	-	-	-	-	NO	NO	NO
Poland	3.076	4.298	4.783	12,9%	485	11%	1.706	55%	T1	IS	CS
Romania	19.027	8.609	7.990	21,5%	-620	-7%	-11.038	-58%	NA	NA4	NA
Slovakia	448	612	681	1,8%	69	11%	233	-	T1	PS	CS
Slovenia	58	32	31	0,1%	-1	-3%	-27	-47%	T2	NS, AS	CS, D
EU-27	**52.310**	**37.813**	**37.214**	**100,0%**	**-599**	**-2%**	**-15.096**	**-29%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 3.164 1B2c Fugitive CO_2 emissions from venting and flaring: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	6.510	5.826	6.274	98,6%	448	8%	-236	-4%			
Bulgaria	NE	NE	NE	-	-	-	-	-	NE	NE	NE
Cyprus	NO	NO	NO	-	-	-	-	-	T1	NS	D
Czech Republic	NA,NE	NA,NE	0	-	-	-	-	-	0,0	0,0	0,0
Estonia	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Hungary	173	82	77	1,2%	-5	-6%	-96	-55%	D	NS,PS	D
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	1	15	13	0,2%	-2	-15%	12	1206%	T2	NS	D
Malta	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Poland	0	0	0	-	-	-	-	-	0,0	0,0	0,0
Romania	NE	NE	NE	-	-	-	-	-	NA	NA 4	NA5
Slovakia	0	0	0	0,0%	0	-20%	0	-22%	T1	PS	CS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**6.683**	**5.923**	**6.364**	**100,0%**	**441**	**7%**	**-320**	**-5%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

3.9.3 Reference approach (new Member States)

Table 3.165 Comparison between Eurostat and national reference approach for CO_2 from fuel combustion for the new MS (CRF 1.A) ([28])

Apparent consumption

2007	Liquid fuels			Solid fuels			Gaseous fuels			Total fuels		
	National	Eurostat	Difference	National	Eurostat	Difference	National	Eurostat	Difference	National	Eurostat	Difference
	PJ	PJ	%	PJ	PJ	%	PJ	PJ	%	PJ	PJ	%
EU15	22.858	22.407	2%	9.238	9.333	-1%	15.610	15.702	-1%	47.706	47.442	1%
BG	212	205	4%	336	328	2%	123	126	-3%	671	659	2%
CY	97	97	0%	1	1	0%	NA	-	-	99	99	0%
CZ	394	397	-1%	870	886	-2%	299	300	0%	1.564	1.582	-1%
EE	28	46	-40%	154	153	0%	34	34	0%	215	233	-8%
HU	299	307	-3%	134	134	0%	448	448	0%	882	889	-1%
LV	70	64	9%	4	4	0%	57	57	0%	131	126	4%
LT	111	113	-1%	11	11	2%	121	121	0%	244	245	-1%
MT	NA	40	-	NA	-	-	NA	-	-	NA	40	-
PL	999	997	0%	2.339	2.316	1%	518	518	0%	3.857	3.831	1%
RO	414	415	0%	420	426	-2%	539	544	-1%	1.372	1.385	-1%
SK	143	142	0%	173	170	2%	213	213	0%	529	525	1%
SI	102	107	-4%	66	67	-2%	38	38	0%	207	213	-3%
EU27	25.728	25.338	2%	13.747	13.830	-1%	18.000	18.101	-1%	57.475	57.269	0%

CO_2 emissions

2007	Liquid fuels			Solid fuels			Gaseous fuels			Total fuels		
	National	Eurostat	Difference	National	Eurostat	Difference	National	Eurostat	Difference	National	Eurostat	Difference
	Tg	Tg	%	Tg	Tg	%	Tg	Tg	%	Tg	Tg	%
EU15	1.432	1.422	1%	857	883	-3%	865	869	0%	3.153	3.175	-1%
BG	14	13	3%	35	32	11%	7	7	-3%	55	52	7%
CY	7	7	1%	0	0	-11%	NA	-	-	7	7	1%
CZ	26	24	11%	83	86	-3%	17	17	0%	126	126	0%
EE	2	3	-40%	15	15	-4%	2	2	8%	18	20	-8%
HU	17	17	1%	13	13	5%	25	25	0%	55	55	1%
LV	5	4	9%	0	0	-1%	3	3	0%	8	8	5%
LT	8	8	-1%	1	1	1%	6	6	0%	15	15	0%
MT	NA,NE	3	-	NA,NE	-	-	NA,NE	-	-	NA,NE	3	-
PL	57	62	-9%	226	216	5%	24	27	-12%	306	305	0%
RO	30	27	9%	41	42	-3%	30	30	0%	100	98	1%
SK	8	8	-4%	16	16	2%	11	12	-3%	35	36	-1%
SI	7	7	0%	7	7	2%	2	2	-12%	16	16	-1%
EU27	1.611	1.606	0%	1.294	1.310	-1%	991	999	-1%	3.896	3.916	0%

([28]) Minus means that Member State-based estimates are lower than the Eurostat-based estimates.

4 Industrial processes (CRF Sector 2)

This chapter starts with an overview on emission trends in CRF Sector 2 Industrial processes. Then for each EU-15 key source overview tables are presented including the Member States' contributions to the key source in terms of level and trend, and information on methodologies and emission factors. The quantitative uncertainty estimates are summarised in a separate section. Finally, the chapter includes a section on recalculations and on sector-specific QA/QC activities. In addition, overviews of Member States' responses to UNFCCC review findings for industrial processes source categories are provided.

4.1 Overview of sector (EU-15)

CRF Sector 2 Industrial Processes is the third largest sector contributing 8 % to total EU-15 GHG emissions in 2007. The most important GHGs from this sector are CO_2 (6 % of total GHG emissions), HFCs (1.4 %) and N_2O (0.9 %). The emissions from this sector decreased by 11 % from 372 Tg in 1990 to 332 Tg in 2007 (Figure 4.1). In 2007, the emissions increased by 2.3 % compared to 2006. Cement production dominates the trend until 1997. Factors for declining emissions in the early 1990s were low economic activity and cement imports from Eastern European countries. Between 1997 and 1999 the trend is dominated by reduction measures in the adipic acid production in Germany, France and the UK. In addition, between 1998 and 1999 large reductions were achieved in the UK due to reduction measures in HCFC production.

The key sources in this sector are:

2 A 1 Cement Production:(CO_2)
2 A 2 Lime Production:(CO_2)
2 A 3 Limestone and Dolomite Use:(CO_2)
2 B 1 Ammonia Production:(CO_2)
2 B 2 Nitric Acid Production:(N_2O)
2 B 3 Adipic Acid Production:(N_2O)
2 B 5 Other:(CO_2)
2 B 5 Other:(N_2O)
2 C 1 Iron and Steel Production:(CO_2)
2 C 3 Aluminium production:(PFC)
2 E 1 By-product Emissions:(HFC)
2 F 1 Refrigeration and Air Conditioning Equipment :(HFC)
2 F 2 Foam blowing:(HFC)
2 F 4 Aerosols/ Metered Dose Inhalers:(HFC)
2 F 9 Other:(SF_6)

Figure 4.1 CRF Sector 2 Industrial Processes: EU-15 GHG emissions for 1990–2007 in CO_2 equivalents (Tg)

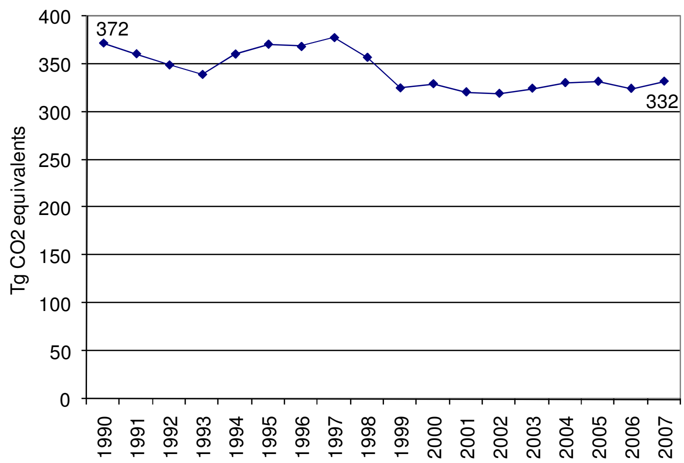
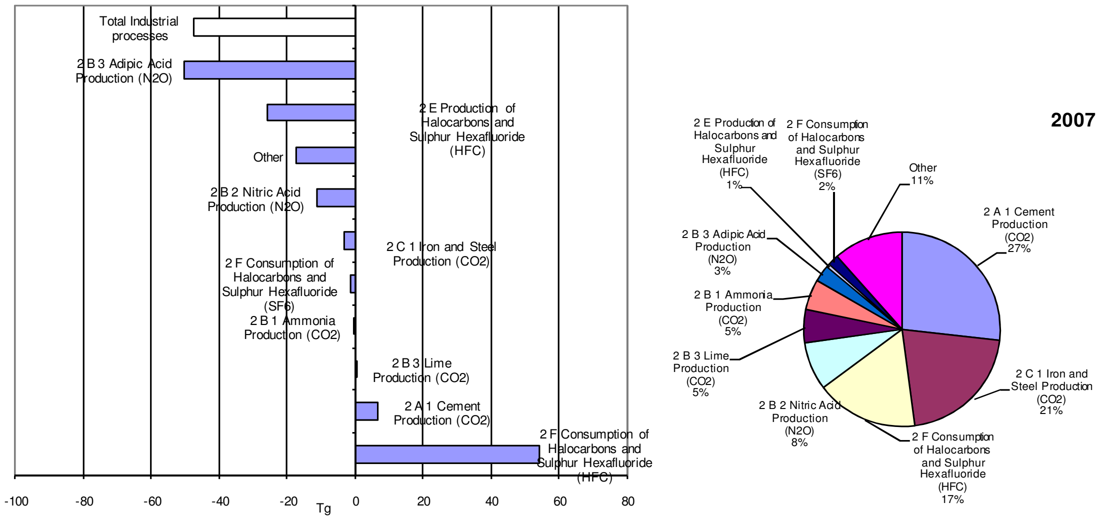


Figure 4.2 shows that large emission reductions occurred in adipic acid production (N_2O) mainly due to reduction measures in Germany, France, the UK and Italy, and in production of halocarbons and SF_6 (HFCs). Large HFC emission increases can be observed from consumption of halocarbons and SF_6. Figure 4.2 shows that the three largest key sources account for about 65 % of total process-related GHG emissions in the EU-15.

Figure 4.2 **CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2007 in CO_2 equivalents (Tg) and share of largest key source categories in 2007**



4.2 Source categories (EU-15)

4.2.1 Mineral products (CRF Source Category 2A) (EU-15)

The source category 2A Mineral Products includes three key sources: CO_2 from 2A1 Cement Production, CO_2 from 2A2 Lime Production and CO_2 from 2A3 Limestone and Dolomite Use. In source category 2A1 Cement Production by-product CO_2 emissions in cement production are reported that occur during the production of clinker, an intermediate component in the cement manufacturing process. Source category 2A2 Lime Production accounts for CO_2 emitted through the calcination of the calcium carbonate in limestone or dolomite for lime production. Source category 2A3 Limestone and Dolomite Use covers a number of industrial applications generating CO_2 through the heating of limestone or dolomite, such as in metallurgy (iron and steel), glass manufacture, agriculture, construction or environmental pollution control.

Table 4.1 summarises Member States' emissions from Mineral Products in 1990 and 2007. CO_2 emissions from Mineral Products increased by 9 %. Spain had largest emission increases in absolute terms and France largest absolute emission reductions in the period 1990-2007.

Table 4.1 2A Mineral Products: Member States'total GHG and CO_2 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)
Austria	3,269	3,506	3,269	3,506
Belgium	5,337	5,606	5,337	5,606
Denmark	1,073	1,607	1,073	1,607
Finland	1,254	1,266	1,254	1,266
France	15,066	13,196	15,066	13,196
Germany	22,508	21,128	22,508	21,128
Greece	6,379	7,056	6,379	7,056
Ireland	1,104	2,580	1,104	2,580
Italy	21,100	23,678	21,100	23,678
Luxembourg	611	489	611	489
Netherlands	923	1,148	923	1,148
Portugal	3,385	4,847	3,384	4,845
Spain	15,659	22,345	15,659	22,345
Sweden	1,919	2,180	1,919	2,180
United Kingdom	10,143	8,686	10,119	8,668
EU-15	**109,730**	**119,318**	**109,706**	**119,298**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CO_2 emissions from Cement Production account for 2 % of total EU-15 GHG emissions in 2007. In 2007, CO_2 emissions from Cement Production were 8 % above 1990 levels in the EU-15 (Figure 4.3).

Figure 4.3 2A1 Cement Production: EU-15 CO_2 emissions

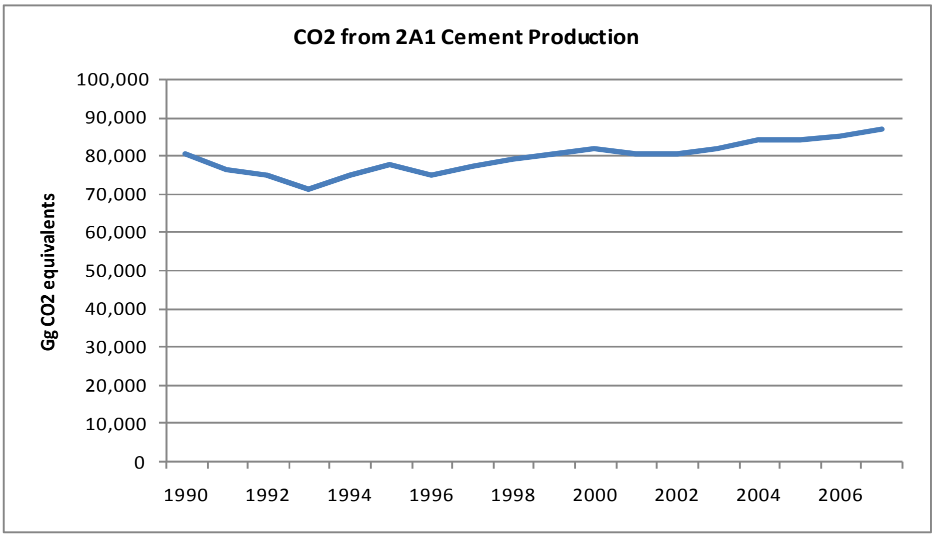


Table 4.2 provides information on emission trends of the key source CO_2 from 2A1 Cement Production by Member State. Spain and Italy are the largest emitters accounting for 40 % of EU-15 emissions, followed by Germany (16 %). CO_2 emissions in Italy peaked in 1995 due to a high increase of clinker production in 1995 after an economic recession in 1993-1994. Germany, France and the United Kingdom had large reductions in absolute terms between 1990 and 2007, whereas especially Spain but also Ireland, Italy and Portugal had large increases. Relative emission growth compared to 1990 was highest in Ireland (169 %) and Denmark (59 %). The emission trend in cement production is influenced by economic and population growth, e.g. in Ireland the construction sector was growing strongly with general economic growth and increased population.

Table 4.2 2A1 Cement production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	2,033	1,954	2,131	2.4%	177	9%	97	5%
Belgium	2,824	3,112	3,087	3.5%	-25	-1%	264	9%
Denmark	882	1,395	1,407	1.6%	12	1%	525	59%
Finland	734	574	600	0.7%	26	4%	-134	-18%
France	10,948	9,165	9,334	10.7%	168	2%	-1,615	-15%
Germany	15,146	13,208	14,306	16.4%	1,098	8%	-840	-6%
Greece	5,641	6,461	6,272	7.2%	-189	-3%	631	11%
Ireland	884	2,348	2,374	2.7%	26	1%	1,490	169%
Italy	16,084	17,474	17,914	20.6%	440	3%	1,830	11%
Luxembourg	557	431	426	0.5%	-5	-1%	-131	-23%
Netherlands	416	400	403	0.5%	3	1%	-13	-3%
Portugal	3,107	3,942	4,065	4.7%	122	3%	958	31%
Spain	12,534	17,322	17,305	19.9%	-18	0%	4,770	38%
Sweden	1,272	1,470	1,365	1.6%	-104	-7%	93	7%
United Kingdom	7,295	5,893	6,117	7.0%	224	4%	-1,178	-16%
EU-15	**80,357**	**85,150**	**87,106**	**100.0%**	**1,956**	**2%**	**6,748**	**8%**

Table 4.3 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A1 Cement Production for 1990 and 2007. The table shows that all MS except Denmark report clinker production as activity data. In response to the recommendations of the review team 2008 Denmark announced to provide clinker production data with the aim of completing the time series for clinker production as activity (FCCC/ARR/2008/EC, para 49).

The implied emission factors per tonne of clinker produced vary slightly from 0.48 for Denmark and the Netherlands to 0.57 for the UK; most MS use country-specific and plant-specific emission factors. The EU-15 IEF (excluding Denmark) is 0.53 t CO_2/t of clinker produced. The table also suggests that more than 95 % of EU-15 emissions are estimated with higher Tier methods.

The ERT identified that the implied emission factors for 2006 are lower than in 1990 for some MS (FCCC/ARR/2008/EC, para 48). Large drops in the inventories 2009 could be found for Denmark, Greece, Ireland and the Netherlands. UK exhibits an increase of the IEF from 1990 to 2007. Explanations for the development of the implied emission factors are given in the following overview:

- *Implied Emission Factor, Denmark*

  The identified decrease of EF from 2005 to 2006 is not relevant anymore in the submission 2009 because revised EFs are available for the years 1998-2005.

- *Implied Emission Factor, Greece*

  Greece derives data from ETS reporting of the plants for 2005-2007, as all the cement industries in Greece belong to the ETS. In order to improve the IEF estimation, data on the clinker production has been requested by the plants. Using these data the emission factor of the previous period has been changed, as requested by the ERT in the in-country review.

- *Implied Emission Factor, Ireland*

  Ireland had only 2 cement plants in 1990. In 2000 a 3rd plant opened and in 2003 an additional 4th plant was considered for the estimation of CO_2 emissions from clinker production. All plants have different EFs for process CO_2: In 1990 the IEF for the 2 plants was 0.549 t CO_2/t clinker, whereas in 2006 the IEF for all 4 plants was 0.5336 t CO_2/t clinker. Each individual plant produces differing quantities of clinker and has different EFs of 0.5348, 0.5368, 0.5310 and 0.5280 t CO_2/t clinker.

- *Implied Emission Factor, Netherlands*

  The Netherlands uses a plant specific methodology as cement clinker is produced in one plant. Because of changes in raw material composition it is not possible to estimate reliable CO_2 process emissions by multiplying clinker production (as AD) with a default EF. For that reason the company has chosen to base the calculation of CO_2 emissions on the carbonate content of the process input.

The first carbonate input in the kiln is the raw material marl. The second carbonate input in the kiln is sewage sludge. CO_2 emissions from both sources are calculated on a monthly basis by multiplying the amount of raw material by a derived process EF. Besides the CO_2 emissions resulting from calcination of the carbonate input in the kiln, the company considers the CO_2 emission from the burning off the small amount of organic carbon in the raw material as a process emission.

- *Implied Emission Factor, UK*

  Emission factors for 2005 to 2007 are taken from operator reported data, used for calculating the emissions reported to EU ETS. Prior to 2005, a constant value has been assumed (equal to the reported 2005 value).

Table 4.3 2A1 Cement Production: Information on methods applied, activity data, emission factors for CO_2 emissions

				1990				2007			
Member State	Method applied	Activity data	Emission factor	Activity data		Implied emission factor	CO_2 emissions	Activity data		Implied emission factor	CO_2 emissions
				Description	(kt)	(t/t)	(Gg)	Description	(kt)	(t/t)	(Gg)
Austria	CS	PS	CS	Clinker production	3694	0.55	2033	Clinker production	3992	0.53	2131
Belgium	T3	PS	PS	Clinker production	5292	0.53	2824	Clinker production	5733	0.54	3087
Denmark	CS/T2	PS	PS	Cement production	1620	0.54	882	Cement production	2946	0.48	1407
Finland	T2	PS	CS	Clinker production	1470	0.50	734	Clinker production	1201	0.50	600
France	C	AS	PS	Clinker production	20854	0.53	10948	Clinker production	18046	0.52	9334
Germany	CS	AS	CS	Clinker production	28577	0.53	15146	Clinker production	26992	0.53	14306
Greece	CS	PS	PS	Clinker production	10645	0.53	5641	Clinker production	12035	0.52	6272
Ireland	T2	PS	PS	Clinker production	1610	0.55	884	Clinker production	4441	0.53	2374
Italy	T2	NS	CS, PS	Clinker production	29786	0.54	16084	Clinker production	33742	0.53	17914
Luxembourg	T2	PS	CS PS	Clinker production	1048	0.53	557	Clinker production	817	0.52	426
Netherlands	CS	PS	PS	Clinker production	770	0.54	416	Clinker production	845	0.48	403
Portugal	T2	PS	D	Clinker production	6128	0.51	3107	Clinker production	8018	0.51	4065
Spain	T2	AS	CS	Clinker production	23212	0.54	12534	Clinker production	32046	0.54	17305
Sweden	T2	PS	PS	Clinker production	2348	0.54	1272	Clinker production	2493	0.55	1365
UK	T2	NS	CS	Clinker production	13199	0.55	7295	Clinker production	10641	0.57	6117
EU15				**EU15 w/o DK (99%)**	**148,632**	**0.53**	**79,475**	**EU15 w/o DK (98%)**	**161,043**	**0.53**	**85,699**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.4 summarizes the methodological information provided by EU-15 Member States in their national inventory reports for cement production. A number of Member States use data collected from plants under the EU emission trading scheme.

Table 4.4 2A1 CementProduction: Summary of methodological information provided by Member States

Cement Production	
Member State	**Methodology comment**
Austria	Emissions were estimated using a country specific method similar to the IPCC Tier 2 methodology. AD (clinker production) as well as emission were taken from studies from the Austrian cement production industry covering the years 1988 to 2003. The determination of the emission data took place by inspection of every single plant, recording and evaluation of plant specific records and also plant specific measurements and analysis carried out by independent scientific institutes. AD for 2004 were reported directly by the Association of the Austrian Cement Industry. For 2005 - 2007 verified CO2 emissions, reported under the ETS, were used for the inventory. These data cover the whole cement industry in Austria. The methodology for these emission calculations is the same like in the years before. CO2 emissions from the raw meal calcination (decarbonising) were calculated from the raw meal composition determined at every Austrian plant, considering also the MgCO3 content of the raw meal. [NIR 2009].
Belgium	The AD is the clinker production collected directly from individual plants following the Tier 2 method. An average EF by plant has been estimated in 2002 and is applied on the all time-series 1990-2001. Since 2002, the EF varies each year and was calculated directly by the plant. Since 2004, plant data's include information on the CaO content of the clinker and non-carbonate sources of CaO. The CO2 EF is estimated as described for Tier 2 method. [NIR 2009]
Denmark	The CO2 emission from the production of cement has been estimated from the annual production of cement expressed as TCE (total cement equivalents) and an EF estimated by the company . The EF has been estimated from the loss of ignition determined for the different kinds of clinkers produced, combined with the volumes of grey and white cements produced. Determination of loss of ignition takes into account all the potential raw materials leading to release of CO2 and omits the Ca-sources leading to generation of CaO in cement clinker without CO2 release. From the year 2005 the CO2 emission compiled for the EU-ETS is used in the inventory . [NIR 2009]
Finland	Emissions were calculated using Tier 2 methodology from the good practice guidance (equations 3.1 and 3.3, pp. 3.10 and 3.13, IPCC 2000). Activita data for the cement kiln dust was available for years 1996 - 2005 (plant 1) and 1996 - 2006 (plant 2). For plant 3, no data was available. Missing data was imputed using means of the data available. The clinker production data was complete and no imputation was necessary. Data for the years 1990-2007 for clinker production are received directly from the company. The emission factor was calculated considerung weight fractions in clinker and the molecular mass ratios of CO2 to CaO and MgO. CKD correction factors vary from year to year. [NIR 2009]
France	Methodology based on national statistics (clinker statistics) from cement association and national EFs from industry. Since 2004 detailed plant-specific emissions reported under the EU-ETS are used. In France 2 plants produce a special type of cement with a specific higher EF. [NIR 2009]
Germany	Methodology based on AD from associations of industries (clinker production) and a CS EF (which is also obtained from associations of industries based on PS data). [NIR 2009]
Greece	Methodology based on AD and parameters for emission calcualtions collected from industry using the Tier 2 methodology. Information reported by operators under the EU ETS is used for the years 2005 - 2007. [NIR 2009]
Ireland	Estimation was re-examined during the preparation of the Irish National Allocation Plan under the EU ETS and IEFs from 2001 onwards are now based on plant-specific information. The new information was obtained from a number of additional cement producers who had entered the Irish market in 2000, in addition to the single larger original manufacturer.As the EU ETS subsequently became operational, plant specific CO2 emissions and corresponding clinker production is also available for all cement plants for the years 2004 through 2007. The process CO2 emissions were calculated using the Tier 2 method, based on reliable data on clinker production, corrected as appropriate for CKD, and CaO content of the clinker. The process emission factors in 2006 ranged from 0.529 t CO2/ t clinker to 0.537 t CO2/ t clinker with a weighted average of 0.535 t CO2/t for all clinker production. [NIR 2009]
Italy	Methodology based on AD from national statistics (clinker production). EFs are estimated on the basis of information provided by the plants and by the Italian Cement Association under EPER and the EU ETS. [NIR 2008].
Luxembourg	CO2 emissions have been calculated using Tier 2 methodology (IPCC GPG 2000). The AD of the clinker production were received from the operator of the plant. The EF for CO2 was calculated based on information from the operator about the raw material composition and the process. CKD equals 1.00 [NIR 2008].
Netherlands	For cement clinker production the environmental reports (MJVs) of the single Dutch company are used. Emission data obtained from the environmental report related to clinker production figures give an IEF of 0.48 - 0.54 t/t clinker (IPCC Default = 0.51 t/t clinker) [NIR 2009]
Portugal	Total clinker production for 1990-2007 as reported in the National Statistical Database from INE is fully consistent with the sum of the information received from each individual plant (used for estimation of emissions). The EF was estimated according to the GPG equation 3.3. The default IPCC CaO fraction in clinker was considered in the inventory (64.6%). The final EF is 0.507 ton CO2/ ton clinker. [NIR 2009]
Spain	Clinker production data and the applied EF are obtained from associations of cement manufacturing sector (OFICEMEN). The EF was derived in 2005 based on the average of 12 cement plants and takes into account the small MgO content. [NIR 2009]
Sweden	Emissions have been estimated based on ETS data as well as direct information from the company based on clinker production. A cement kiln dust (CKD) correction factor is used. For CO2 estimates for 1990-2004, the cement company uses the GHG protocol made on initiative by the WRI for the WBCSD. Since 2005, data on clinker production has been acquired through the ETS. [NIR 2009]
UK	The methodology used for estimating CO2 emissions from calcination is to use data provided by the British Cement Association (2008), which in turn is based on data generated by UK cement clinker producers for the purposes of reporting to the EU Emission Trading Scheme. The data are available for 2005 and 2007 only, and so the value for 2005 has been applied to earlier years as well. Previously, estimates had been based on the IPCC Tier 2 approach (IPCC, 2000), yielding an emission factor of 137.6 t C/kt clinker. The revised emission factors are about 10% higher than this figure and the reasons for this disparity are that the previous emission factor (i) slightly underestimated the CaO content of clinker produced; and (ii) failed to take account of CO2 emitted from dolomite (i.e. the method assumed a zero MgO content, which was not correct). [NIR 2009]

Table 4.5 summarizes the recommendations from the review of the initial reports in relation to the category 2A1 Cement Production. The overview shows that there are few findings that are not resolved and that the remaining unresolved findings are mostly not very significant methodological

problems.

Table 4.5 2A1 Cement Production: Findings of the UNFCCC review of the initial report in relation to CO_2 emissions and responses in 2009 inventory submissions

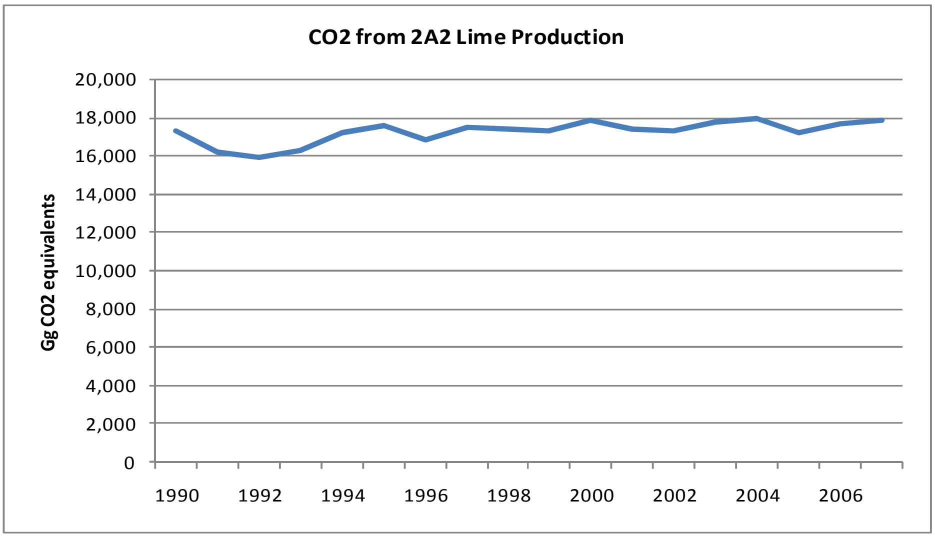
Member State	Review findings and responses related to 2A1 Cement Production	
	Comment UNFCCC report of the review of the 2008 submission	**Status in 2009 submission**
Austria	Austria's CO2 IEF for clinker (0.53–0.57 t/t) is higher than the IPCC default factor (0.51 t/t). Austria explained that this is due to different compositions of raw materials used. The ERT noted that a study was conducted to determine EFs for each cement plant, taking into consideration raw material composition. AD were sourced from the Association of the Austrian Cement Industry, and for 2005 and 2006 a data verification process under the EU ETS was in place. The ERT recommends that Austria continue with periodic monitoring of the raw materials. (para 37)	The analysis of the raw material was carried out by independent scientific institutes. Clinker production was checked with a publication from the Association of the Austrian Cement Industry to ensure completeness.
Belgium	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Denmark	New findings from centralized review 2008 not yet available (if occuring).	
Finland	Finland used plant-specific EFs for the whole time series. The ERT noted that the IEF is not stable, with notable decrease by 8.0 per cent in 2004. The ERT further noted that the NIR contains discrepancies in the determination of calcium oxide and magnesium oxide contents in clinker. In response to ERT questions during the review, Finland explained that the emissions for the most recent year represents the best available data, and that it is continuing to explore this issue and will report findings in its next annual submission. The ERT welcomes further exploration of this matter and recommends that Finland provide the findings in its next annual submission. (para 39)	A new methodology was adopted in agreement with the producer. The year to year changes with the current IEF are not greater then 0.37 per cent.
France	The implied emission factor (IEF) for this category fluctuated between 0.5 and 0.9 per cent during the period 2003-2005. The 2006 value is 1.5 per cent lower than the 1990 value. During previous stages of the review, France informed the ERT that clinker particulates have been included in the estimates since 2004, and a specific EF is applied for the two plants that produce aluminate cement. During the review, France clarified that some cement plants only included cement kiln dust (CKD) in their CO2 emissions for 2006 and that CKD was not considered in the calculations made before 2006. Under the European Union Emissions Trading Scheme, all plants are required to report CKD emissions for 2008, which will make available more detailed information about emissions from CKD. The ERT recommends that France take this new information into account in its 2010 submission and recommends that France consider recalculating the time series when detailed CKD data become available. The ERT also recommends that France explore the possibility of applying the new plant-specific EF of aluminate cement production for the entire time series in order to ensure time-series consistency. Fran	Not yet addressed.
Germany	New findings from centralized review 2008 not yet available (if occuring).	
Greece	Plant-specific AD obtained under EU ETS reporting is used for 2005 and 2006; however, Greece has reported clinker production in the CRF. The ERT recommends that Greece report AD as equivalent carbonates, and to use the corresponding EF. Greece is also recommended to improve the time-series consistency of the emission estimate by using plant-specific carbonates-to-clinker ratios reported under the EU ETS for clinker production to recalculate the period 1990–2004, in line with the IPCC good practice guidance. (para 92)	CO2 emissions for the period 1990-2004 have been recalculated, following the UNFCCC reporting guidelines.Gaps in activity data time series will be filled in as soon as new data become available.
Ireland	The CO2 IEF is fairly stable between 1990 and 2002 and decreases thereafter. The 2006 value (0.53 t/t) is 2.8 per cent lower than the 1990 value (0.55 t/t). The ERT noted that the information submitted by the Party to the ERT is not sufficient to confirm that the time series is consistent. Ireland is encouraged to include further information in its next NIR to justify the change in the CO2 IEF after 2002. (para 37)	Further information on clinker production is provided. Time-series of process CO2 emissions for cement production is considered to be consistent for the period 1990-2007. No recalculations have been made.
Italy	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Luxembourg	Luxembourg applies a tier 2 methodology based on the calcium oxide (CaO) content of clinker, in line with the IPCC good practice guidance. Data on CaO content are provided once every five years by the only cement production plant in the country and are interpolated for the other years by the Environmental Agency of Luxembourg. The ERT recommends that Luxembourg collect and use annual data for the CaO content in clinker, given that the cement company acquires this information on a daily basis. The ERT recommends that Luxembourg find out if dolomite is used as a raw material as well as limestone and recommends that the Party modify the methodology used if necessary. The ERT noted that Luxembourg has already planned this improvement. (para 69, 70)	NIR 2009 not yet available.
Netherlands	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Portugal	New findings from centralized review 2008 not yet available (if occuring).	
Spain	New findings from centralized review 2008 not yet available (if occuring).	
Sweden	New findings from centralized review 2008 not yet available (if occuring).	
UK	New findings from centralized review 2008 not yet available (if occuring).	

CO_2 emissions from 2A2 Lime Production account for 0.4 % of total GHG emissions in 2007.

Between 1990 and 2007, CO_2 emissions from this source increased by 3 % in the EU-15. The decrease of CO_2 emissions by 7 % in 1990-1991 was dominated by emission reductions in Germany, Belgium and the UK, which were due to decreased activity data. The contribution to the change of EU-15 emission trends was 57 % for Germany, whereas Belgium contributes 13 % to the the EU-15 emission change 1990-1991 and the UK 11 %.

The emissions increased by 6 % during 1993 and 1994, which was caused by an elevation in activity data in Germany and France. The contribution to the change of EU-15 emission trends was 53 % for Germany, whereas France contributes 24 % to the the EU-15 emission change 1993-1994 (Figure 4.4).

Figure 4.4 2A2 Lime Production: EU-15 CO_2 emissions



Germany was responsible for 32 % of the emissions from this source. The decrease of emissions in the early 1990ies was dominated by the drop in German lime production due to the sector's restructuring following German reunification, as well as of economic factors and development of competing and substitue products. The decreases in Germany (-8 %) but also in the UK (-42 %) were offset by emission increases in other EU-15 Member States between 1990 and 2007 in particular Spain, Portugal and Italy (Table 4.6).

Table 4.6 2A2 Lime Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	396	586	596	3.3%	10	2%	199	50%
Belgium	2,097	2,139	2,040	11.4%	-99	-5%	-57	-3%
Denmark	116	69	67	0.4%	-2	-3%	-49	-42%
Finland	383	510	480	2.7%	-30	-6%	97	25%
France	2,545	2,489	2,434	13.6%	-55	-2%	-111	-4%
Germany	6,135	5,502	5,671	31.6%	169	3%	-464	-8%
Greece	432	409	469	2.6%	60	15%	37	9%
Ireland	214	180	197	1.1%	16	9%	-17	-8%
Italy	2,042	2,426	2,434	13.6%	8	0%	392	19%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NE	NE	NE	-	-	-	-	-
Portugal	178	478	499	2.8%	21	4%	321	181%
Spain	1,123	1,627	1,737	9.7%	111	7%	615	55%
Sweden	498	629	629	3.5%	0	0%	131	26%
United Kingdom	1,192	688	688	3.8%	0	0%	-503	-42%
EU-15	**17,350**	**17,733**	**17,942**	**100.0%**	**208**	**1%**	**592**	**3%**

Emissions of the Netherlands are not estimated as there is only a small amount of lime production and data are not available.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.7 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A2 Lime Production for 1990 to 2007. The table shows that most MS use lime production as activity data for calculating CO_2 emissions. The EU-15 IEF (excluding Denmark and the UK) is

0.75 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.44 for United Kingdom and 0.85 for Greece. The table also suggests that 33 % of the emissions are estimated using higher tier methodologies.

The following outliers in IEF could be identified:

- *Implied Emission Factor Lime production, Ireland*

  The variations of IEF (reaching the highest IEF among EU-15 in 1997) is caused by the combination of lime production for some plants and an intermediate product in one periclase plant.

- *Implied Emission Factor Lime production, Sweden*

  The comparable low IEF for Sweden (0.56 t CO_2/t of lime produced) is caused by the inclusion of emissions from sugar and pulp and paper industry, which recycles lime. Therefore the total IEF for lime production is lower than the IEF for conventional lime production (0.79 t CO_2/t of lime produced).

- *Implied Emission Factor Lime production, UK*

  The comparable low CO_2 IEF for United Kingdom (0.44 t CO_2/t of lime produced) could be explained with the emission factor used (120 t carbon/kt limestone consumed) which is based on the stoichiometry of the chemical reaction, assuming pure limestone.

Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. Draft 2006 IPCC Guidelines define three tiers, an output-based approach that uses default values (Tier 1), an output-based approach that estimates emissions from CaO and CaO·MgO production and country-specific information for correction factors (Tier 2) and an input-based carbonate approach (Tier 3), the latter requiring plant-specific data. Lime production is covered under the EU emissions trading scheme and monitoring guidelines under the EU ETS (Comission Decision of 29/01/2004 establishing guidelines for the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council) allow methods equivalent to either Tier 2 or Tier 3 above. The use of plant-specific data reported and verified under the EU ETS by Member States therefore can be considered as equivalent to Tier2 or Tier 3 as defined in draft 2006 IPCC Guidelines.

Table 4.7 2A2 Lime Production: Information on methods applied, activity data, emission factors for CO_2 emissions

				1990				2007			
Member State	Method applied	Activity data	Emission factor	Activity data		Implied emission factor	CO_2 emissions	Activity data		Implied emission factor	CO_2 emissions
				Description	(kt)	(t/t)	(Gg)	Description	(kt)	(t/t)	(Gg)
Austria	CS	PS	CS	Lime Production	513	0.77	396	Lime Production	782	0.76	596
Belgium	T3	PS	PS	Lime production	2661	0.79	2097	Lime production	2677	0.76	2040
Denmark	CS	NS	D	Production of Lime and Bricks	156	0.74	116	Production of Lime and Bricks	90	0.75	67
Finland	T2	PS	CS	Lime Production	519	0.74	383	Lime Production	658	0.73	480
France	C	AS	PS	Lime Production	3319	0.77	2545	Lime Production	3311	0.74	2434
Germany	D	AS	D	Lime Production	7719	0.79	6135	Lime Production	7149	0.79	5671
Greece	T3	PS	PS	Lime Production	491	0.88	432	Lime Production	549	0.85	469
Ireland	T2	PS	PS	Lime Production	255	0.84	214	Lime Production	252	0.78	197
Italy	D	NS	CS,PS	Lime Production	2583	0.79	2042	Lime Production	3444	0.71	2434
Portugal	D	NS,PS	D	Lime Production	268	0.66	178	Lime Production	664	0.75	499
Spain	D	AS, PS	D, PS	Lime Production	1475	0.76	1123	Lime Production	2332	0.74	1737
Sweden	D	PS	D, CS	Lime Production	880	0.57	498	Lime Production	1138	0.55	629
UK	T2	NS	CS	Limestone consumption	2708	0.44	1192	Limestone consumption	1565	0.44	688
EU15				**EU15 w/o DK and UK (93%)**	**20,683**	**0.78**	**16,043**	**EU15 w/o DK and UK (96%)**	**22,958**	**0.75**	**17,186**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Table 4.8 provides a more detailed overview on methods used in EU-15 Member States and the coverage of this source category. Austria, Finland, Greece, Ireland and Italy included an explicit reference to the use of plant-specific data under the EU ETS. Some Member States include lime production and use in some industries such as sugar or pulp and paper resulting in different EFs.

Table 4.8 2A2 Lime Production: Summary of methodological information provided by Member States

Lime Production	
Member State	**Methodology comment**
Austria	Emissions were estimated using a CS method based on detailed production data. AD and emission values were reported by the Association of the Stone & Ceramic Industry. Since 2005 verified CO2 emissions reported under the ETS were used for the inventory. These data cover the whole lime producing industry in Austria. The methodology for this emission calculation is the same like in the years before. The reported CO2 emission data is based on data of each lime production plant in Austria, considering the CaO and MgO content either from limestone or lime at the different plants and calculating CO2 emissions from the stoichiometric ratios (using IPCC default emission factors). [NIR 2009]
Belgium	The AD is the lime and dolomite lime production and is collected directly from individual plants. The EFs are also collected directly from individual plants. The emissions are estimated by using a plant-specific EF (741-839 kg CO2/t lime or dolomite). A part of the lime production is coming from the kraft pulping process: the CO2 liberated during the conversion of calcium carbonate to calcium oxide in the lime kiln in the kraft pulping process contains carbon which originates in wood. This CO2 is not included in the net emissions. [NIR 2009]
Denmark	The CO2 emission from the production of burnt lime (quicklime) as well as hydrated lime (slaked lime) has been estimated from the annual production figures, registered by Statistics Denmark, and emission factors. The EFs applied are 0.785 kg CO2/kg CaO as recommended by IPCC (IPCC (1996), vol. 3, p. 2.8) and 0.541 kg CO2/kg hydrated lime (calculated from company information on composition of hydrated lime (Faxe Kalk, 2003)).[NIR 2009]
Finland	The amount of (quick)lime (CaO) produced annually is used as AD. AD for the years 1990−1997 is partly collected from the industry and partly taken from industrial statistics and companies' reports. AD for years 1998-2003 was received directly from lime producing companies. For the year 2004 part of the AD was collected from industrial statistics and VAHTI database due to refusal of disclose of a company. Since the year 2005 the AD was received from the Energy Market Authority which grants the emission permits to companies for the EU Emission Trading Scheme. The received data was compared to data from industrial statistics and the VAHTI database. EF for lime production is based on the actual CaO and MgO contents of lime derived by measurements. EF for lime production is calculated from emission and product data of the years 1998−2002. [NIR 2009]
France	Higher tier methodology considering types of lime. AD from associations are used. Stochiometric EF for lime, and CS EF for hydraulic lime used based on national data. [NIR 2009]
Germany	Default- EF based on stochiometric relationships. The approach conforms to the specifications in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC 2000, Chapter 3.1.2). AD for lime and dolomite-lime production are collected by the German Lime Association (BVK) and provided annually in aggregated form. [NIR 2009]
Greece	Lime and hydrated lime production were estimated taking into consideration both information collected during the formulation of the NAP for the period 2005 – 2007. The lime production of Greece refers to high-calcium and hydraulic lime. Both values are provided by the NSSG for the years 1993-2007, whereas for the years 1990-1993 the missing data have been calculated using the trend extrapolation method as described in the IPCC GPG. Lime production in the national statistics is reported as non hydrated lime, hydrated lime and hydraulic lime. The hydrated lime production data are converted to non hydrated lime using the correction for the proportion of hydrated lime as described in the IPCC GPG, using a water content of 28%. [NIR 2009]
Ireland	The estimation was revised based on estimates provided by lime producers calculated in accordance with the methods under the EU ETS described in Decision 2004/156/EC, thus enabling the inventory agency to review and revise the previously submitted estimates. The CORINAIR default value for CO2 emissions from lime production (0.75 t CO2/t lime) was used consistently to estimate process emissions from this source using the Tier 1 method for all inventory years up to 2003. For later years data from the EU ETS have been used. They indicate implied EFs in the range 0.75 to 0.88 t CO2/t lime produced. [NIR 2009]
Italy	AD obtained from national statistics. EF have been estimated on the basis of detailed information supplied by plants in the framework of the European emission trading scheme and checked with the industrial association. [NIR 2008]
Luxembourg	Not occuring.
Netherlands	Lime production are not estimated since production was negligible in the early 1990s and has stopped later. [NIR 2009]
Portugal	Higher tier methodology considereing different types of lime and using default EF. Production data from national statistics until 2000, linear trend extrapolation for 2001-2007. AD for lime production in iron and steel industry only available for period 1991-1994, extrapolation based on energy consumption in steel industry for the years until 2001 when lime production in the iron and steel industry ceased. [NIR 2009]
Spain	Higher tier methodology considereing different types of lime and using EF obtained from national association [NIR 2009]
Sweden	AD for conventional lime, quicklime and hydraulic lime production is collected from their trade association and covers all, in total eight plants. For the conventional producers, the emissions of CO2 are calculated by multiplying the amount of quicklime and dolomite lime with the IPPC´s default emission factors. AD also covers lime produced within the sugar industry to purify sugar, collected directly from the only sugar producing company in Sweden. The gases produced within the lime production are reused and the carbon is bound, causing lower emissions. The source category also includes AD based on the amount of make-up lime within the pulp and paper industry in the recycling of cooking chemicals and this AD is collected from the pulp and paper trade association. Most of the lime can be reused and only 5% of the lime needed is new make-up lime. The emissions are calculated by using EFs from the pulp and paper industry. The same EF has been used since 2002 by recommendation from the trade association. [NIR 2009]
UK	Estimation of lime production is based on limestone and dolomite consumption data from British Geological Survey. The use of consumption data rather than production data is simpler and probably more reliable since it is not necessary to consider the different types of lime produced. An EF of 120 t carbon/kt limestone was used, based on the stoichiometry of the chemical reaction and assuming pure limestone. For dolomite, an EF of 130 t carbon/kt dolomite would have been appropriate; however dolomite calcination data are not given separately by the British Geological Survey, but included in the limestone data: the use of the limestone factor for this dolomite calcination will cause a small under-estimate of emissions. Dolomite calcination is believed to be a small proportion of the total hence the underestimate is unlikely to be significant. The limestone calcination data exclude limestone calcined in the chemical industry since a large proportion of this is use in the Solvay process, which does not release CO2. The calcination of limestone in the sugar industry is also excluded for the same reason. [NIR 2009]

Table 4.9 summarizes the recommendations from 2008 UNFCCC inventory review in relation to the category 2A2 Lime Production. The overview shows that there are few findings that are not resolved and that the remaining unresolved findings are mostly no very significant problems.

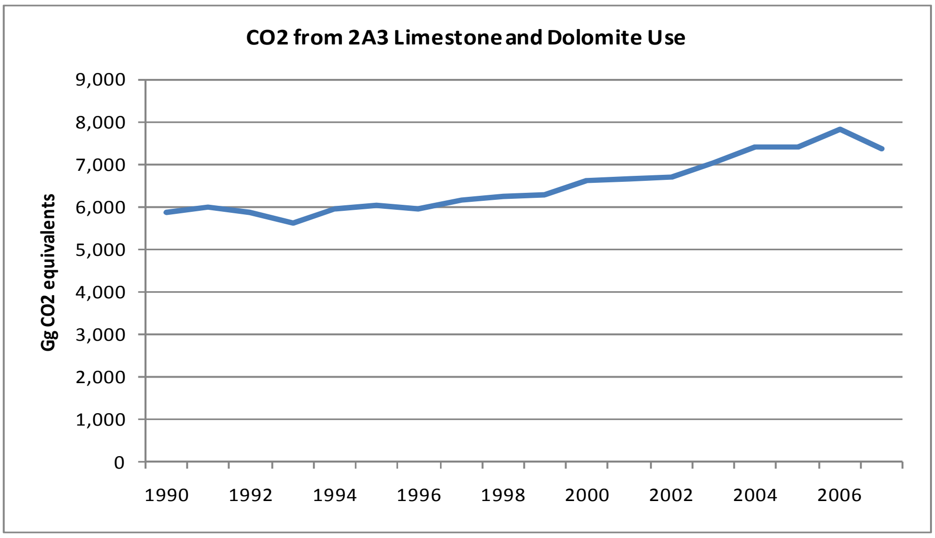
Table 4.9 2A2 Lime Production: Findings of the UNFCCC review of the initial report in relation to CO_2 emissions and responses

in 2009 inventory submissions

Member State	Review findings and responses related to 2A2 Lime Production	
	Comment UNFCCC report of the review of the 2008 submission	**Status in 2009 submission**
Austria	The ERT recommends that Austria provide, in its next NIR, clear documentation on lime production, limestone and dolomite use and soda ash use, with respect to non-marketed lime production. (para 38, 39)	Information under which sectors emissions from non-market lime production is reported is included in the 2009 NIR. Detailed information on non-market lime production in sugar industry is provided.
Belgium	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Denmark	New findings from centralized review 2008 not yet available (if occuring).	
Finland	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
France	The trend in IEFs for CO2 for lime production fluctuates and has been identified as an outlier. The Party reports in the NIR that the EF fluctuates depending on the share of hydraulic lime used in lime production. The ERT recommends that France increase transparency by reporting the share of calcium oxide and magnesium oxide used in lime production, as well as the AD used. During previous review stages, France informed the ERT that emissions have been estimated on a plant-by-plant basis since 2004, whereas estimates for the period 1994-2003 were derived from the data submitted for a subset of the industrial plants. For the other plants, an EF approach was used. The ERT encourages the Party to report on the number of plants included in the subset that provided the emission estimates and to report on the number of plants for which the EF approach was used. The ERT encourages France to explore the possibility of recalculating the data for earlier years to ensure time-series consistency.During the previous review, France explained that all of the lime produced in paper mills and in the sugar industry is produced from CO2 fr	An additional type of lime is included (magnesium or dolomite lime). Different emission factors for types of lime have been included, emission factors have been recalculated. The number of plants included in the subset that provided the emission estimates and for which the EF approach was used has been reported (p. 93). With that the calculation of decarbonisation of non-hydraulic lime is now additionally based on emissions declared by DRIRE (p.594). AD and the share of calcium and magnesium oxide used in lime production are not reported, no recalculation has been done. The external input of limestone for calcination in paper mills, sugar industry and other industries has not been investigated further.
Germany	New findings from centralized review 2008 not yet available (if occuring).	
Greece	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Ireland	The trend in the CO2 IEF is unstable. The 2006 value (0.78 t/t) is 6.9 per cent lower than the 1990 value (0.84 t/t). There are fluctuations in the IEF; these were questioned during the review but the Party did not provide any explanations. The ERT encourages Ireland to explain and justify the time series consistency and the fluctuations in the CO2 IEF for lime production. (para 38)	Not yet addressed.
Italy	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Luxembourg	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Portugal	New findings from centralized review 2008 not yet available (if occuring).	
Spain	New findings from centralized review 2008 not yet available (if occuring).	
Sweden	New findings from centralized review 2008 not yet available (if occuring).	
UK	New findings from centralized review 2008 not yet available (if occuring).	

CO_2 emissions from 2A3 Limestone and Dolomite Use account for 0.2 % of total GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from this source increased by 26 % in the EU-15 and decreased by6% from 2006 to 2007 (Table 4.10, Figure 4.5). Italy was responsible for 34 % and Spain for 29 % and the UK for 20 % of the emissions from this source. Emissions from this source category increased in all MS between 1990 and 2007 with the largest absolute growth in Spain.

Figure 4.5 2A3 Limestone and Dolomite Use: EU-15 CO_2 emissions



The increase of CO_2 emissions by 6 % in 1993-1994 was dominated by the increase of emissions in the Netherlands, the UK, Spain and Finland. The change of activity data contributed 71% to the change of EU-15 emission trends for the Netherlands, whereas this share was only 32% for the UK. The remaining 68% are due an increase of the implied emission factor in this MS. Reverse emissions trends and thus offsetting the incresase of emissions to some extent could be found for Italy and Greece.

CO_2 emissions decreased by 6 % in 2006-2007. Among MS which contribute more than 20 % to the total CO_2 emissions from Limestone and Dolomite Use in EU-15, Spain and the UK were the main contributors to this reduction.

Table 4.10 2A3 Limestone and Dolomite Use: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	222	296	303	4.1%	7	2%	80	36%
Belgium	IE	IE	IE	-	-	-	-	-
Denmark	18	74	51	0.7%	-23	-31%	33	181%
Finland	88	151	152	2.1%	1	1%	64	73%
France	IE	IE	IE	-	-	-	-	-
Germany	IE	IE	IE	-	-	-	-	-
Greece	286	315	297	4.0%	-18	-6%	11	4%
Ireland	0	3	2	0.0%	0	-12%	2	2099%
Italy	2,375	2,529	2,513	34.0%	-16	-1%	139	6%
Luxembourg	IE	IE	IE	-	-	-	-	-
Netherlands	232	269	261	3.5%	-8	-3%	29	12%
Portugal	33	94	97	1.3%	3	3%	63	190%
Spain	1,220	2,473	2,129	28.8%	-344	-14%	908	74%
Sweden	109	141	144	2.0%	3	2%	35	32%
United Kingdom	1,285	1,491	1,443	19.5%	-48	-3%	158	12%
EU-15	**5,869**	**7,835**	**7,392**	**100.0%**	**-443**	**-6%**	**1,522**	**26%**

Belgium reports emissions in the source category 2A7.
France reports emissions in the source categories 2A1 (cement production), 2A2 (lime production) and 2A7a (glass production).
Germany reports emissions in the source categories where limestone and dolomite is used (1A1a, 2A1, 2A2, 2A4, 2A7, 2C1).
Luxembourg reports emissions in the source category 2C1.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.11 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2A3 Limestone and Dolomite Use for 1990 to 2007. The table shows that almost all MS use limestone and dolomite consumption as activity data for calculating CO_2 emissions. The EU-15 IEF excluding Denmark is 0.44 t CO_2/t of lime produced. The implied emission factors per tonne of lime produced vary between 0.23 for the Netherlands and 0.56 for the UK. The very low value for Denmark (0.04) reflects different processes where limestone and dolomite are employed and not comparable to other countries; Activity data in Sweden is incomplete and the implied emission factor therefore not correct. Neither 1996 IPCC Guidelines for Greenhouse Gas inventories nor IPCC Good Practice Guidance (2000) clearly define a lower or higher tier method. The use of plant-specific data reported and verified under the EU ETS by Member States can be considered as equivalent to a Tier2 or Tier 3 method.

Table 4.11 2A3 Limestone and Dolomite Use: Information on methods applied, activity data, emission factors for CO_2 emissions

Member State	Method applied	Activity data	Emission factor	1990 Activity data: Description	1990 Activity data: (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2007 Activity data: Description	2007 Activity data: (kt)	2007 Implied emission factor (t/t)	2007 CO_2 emissions (Gg)
Austria	D	PS	CS, D	Limestone and Dolomite Use	503	0.44	222	Limestone and Dolomite Use	697	0.43	303
Belgium	T3	PS	C/CS	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Denmark	T1/T2	NS	D		506	0.04	18		462	0.11	51
Finland	T1	PS	D	Limestone and Dolomite Use	206	0.43	88	Limestone and Dolomite Use	366	0.42	152
France	NA	NA	NA	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Germany	NA	NA	NA	Limestone and Dolomite Use	IE	IE	IE	Limestone and Dolomite Use	IE	IE	IE
Greece	CS	PS	PS	Limestone Consumption	649	0.44	286	Limestone Consumption	669	0.44	297
Ireland	T2	PS	PS	Limestone Consumption	0.2	0.44	0.1	Limestone Consumption	5	0.44	2
Italy	D	NS	D, CS,PS	Carbonates input to brick, tiles, ceramic production	5397	0.44	2375	Carbonates input to brick, tiles, ceramic production	5712	0.44	2513
Netherlands	CS	NS	D	Limestone and Dolomite Use	733	0.32	232	Limestone and Dolomite Use	1149	0.23	261
Portugal	D	NS	D	Limestone consumption	74	0.45	33	Limestone consumption	211	0.46	97
Spain	D	PS, AS	D	Limestone and Dolomite Use	2758	0.44	1220	Limestone and Dolomite Use	4842	0.44	2129
Sweden	D	PS	D	Limestone and Dolomite Use	234	0.47	109	Limestone and Dolomite Use	315	0.46	144
UK	T2	NS,AS	D,CS	Limestone and Dolomite Use	3044	0.42	1285	Limestone and Dolomite Use	2577	0.56	1443
EU15				**EU15 w/o DK (99%)**	**13,599**	**0.43**	**5,851**	**EU15 w/o BE and DK (99%)**	**16,541**	**0.44**	**7,341**

The following outliers in IEF could be identified:

- *Implied Emission Factor Limestone and Dolomite Use, Netherlands*

  The comparable low IEF (2007) could be explained by the activity data of limestone use which is not complete.

- *Implied Emission Factor Limestone and Dolomite Use, UK*

  The comparable high IEF (2007) is due to the inclusion of CO_2 emissions from gypsum produced in the flue gas desulphurisation process. The activity data does not reflect this particular process, and therefore the IEF is higher than might otherwise be expected.

Table 4.12 provides a more detailed overview on methods used in EU-15 Member States and the coverage of this source category. Austria, Belgium, Finland, Greece, Ireland, Italy, Portugal and Sweden report using plant-specific data reported and verified under the EU ETS.

Table 4.12 2A3 Limestone and Dolomite Use: Summary of methodological information provided by Member States

Limestone and dolomite use	
Member State	**Methodology comment**
Austria	Emissions were estimated using the methodology and the IPCC default EF for the years 1990-2004. AD for limestone and dolomite used in glass industry were reported by the Association of Glass Industry for the years 2002-2004, for the years before AD was estimated using a constant ratio of limestone and dolomite used per ton of glass produced (glass production was reported by the Association of Glass Industry for all years). AD for limestone used in blast furnaces for the years 1998 to 2002 was reported directly by the plant operator of the two integrated iron and steel production sites that operate blast furnaces. For the years before and after AD was estimated using the average ratio of limestone used per ton of pig iron produced of the years 1998-2002. Since 2005 verified CO2 emissions and AD, reported under the ETS, were used for the inventory. These data cover limestone and dolomite use in the glass, iron and steel and chemical industry. AD for limestone used for desulphurization were taken from a national report on desulphurization technologies in Austria. For 2005 and 2006 additional information due to emissions reported under the ETS was included. [NIR 2009]
Belgium	CO2 emissions in the "limestone and dolomite use" category contains the production of glass and ceramics. Emissions from limestone and dolomite use in the iron and steel industry are reported under 2C. Emissions are estimated using plant specific AD and EF, partially based on EU ETS data. CO2-emissions due to the use of limestone in pollution control are negligible and not estimated. [NIR 2009]
Denmark	The CO2 emission from the production of bricks and tiles has been estimated from information on annual production registered by Statistics Denmark, corrected for amount of yellow bricks and tiles. The EF lime (0.44 kg CO2/kg CaCO3) has been used to calculate the emission factor for yellow bricks: 0.079 tonne CO2/tonne yellow bricks. The CO2 emission from the production of container glass/glass wool has been estimated from production statistics published in environmental reports from the producers and EFs based on release of CO2 from specific raw materials (stoichiometric determination). Consumption of limestone for flue gas cleaning estimated from statistics of gypsum and stoichiometric relations between gypsum and CO2 release, EF 0.2325 ton CO2/t gypsum. The CO2 emission from the production of expanded clay products has been estimated from production statistics compiled by Statistics Denmark and an emission factor of 0.045 tonne CO2/tonne product. The CO2 emission from the refining of sugar is estimated from production statistics for sugar and a number of assumptions: consumption of 0.02 tonne CaCO3/tonne sugar and precipitation 90% CaO resulting in an EF at 0.0088 tonne CO2/tonne sugar. [NIR 2009]
Finland	The consumption of limestone and dolomite has been used as AD when calculating emissions from lime stone and dolomite use. AD since 2005 is collected directly from individual companies and the EU ETS data. Data for earlier years has been partly taken from industrial statistics and from individual companies. EFs for calculating emissions from limestone and dolomite and soda ash use are based on IPCC default factors. [NIR 2009]
France	Limestone consumption reported under the respective sectors. [NIR 2009]
Germany	Limestone consumption is reported in the sectors that use limestone and in 2A7 Other. [NIR 2009]
Greece	Estimate includes limestone use in steel, aluminium and ceramics production. AD and plant-specific EF from operators under EU ETS. [NIR 2009]
Ireland	The reported emissions for 2.A.3 Limestone and Dolomite Use refer to the manufacture of bricks and ceramics up to the year 2000 and thereafter also include the emissions from limestone use in the peat-fired power plants, that started operation in 2001 and 2007. The inclusion of this new source leads to a higher IEF after 2001. Information on the raw materials used in brick manufacture (clay, carbonates and shale) has been supplied for the years 1990-2005 by three companies who are participants in the EU emissions trading scheme. CO2 emissions estimates from the three individual companies are used in inventory calculations. Limestone has been used to capture sulphur emitted from peat burning in one new electricity generating station since 2001. The CO2 emissions from this use of limestone are estimated on the basis of limestone quantity reported by the company and an emission factor of 0.44 t CO2/t limestone, which is the stoichiometric ratio of CO2 to CaCO3. [NIR 2009]
Italy	CaCO3 and limestone/dolomite use from plants under EU ETS, EF from bricks and ceramics industry and EU ETS. [NIR 2008]
Luxembourg	Limestone consumption reported under 2.A.1 and 2.A.7. [NIR 2008]
Netherlands	Limestone and dolomite use: environmental reports are used for emission data. AD on plaster production for use in desulphurising installation for power plants are based on the environmental reports of the coal-fired power plants. Data on the consumption of limestone and dolomite are based on statistical information obtained from Statistics Netherlands. EF= 0.440 t/t (IPCC default). [NIR 2009]
Portugal	Emissions resulting from production of calcium and magnesium nitrates and consumption of sodium carbonates in paper pulp production were estimated. Consumption in blast furnaces is included in energy emissions. EF based on stoichiometric relation of materials. AD from national statistics and EU ETS. Recent years since 2000 extrapolated. [NIR 2009]
Spain	Includes emissions from glass, bricks and tiles and magnesites and flue gas desulphurization. AD and EF for magnesite and desulphurization from plants, AD and EF for glass, bricks and tiles from industrial associations. Lime and dolomite use in iron and steel industry is included in source category 2C1. [NIR 2009]
Sweden	The calculations are made by applying the IPCC Guidelines default emission factors for limestone and dolomite for the different production sectors. Emissions arise mainly from production of glass (mainly two big companies), mineral wool (two companies) and ore-based iron pellets (one company). It also includes the use within production of steel (two plants), chemical products-detergents (one plant), tile (one plant) and from scrubbers in energy production plants (five plants). Data on the use of limestone and dolomite have been acquired from the ETS and through direct contacts with the companies. [NIR 2009]
UK	Includes use in sinter production, glass production and steel industry. Emissions are calculated using EFs of 120 t carbon/kt limestone and 130 t carbon/kt dolomite, in the case of glass processes involving calcinations, and 69 t carbon/kt gypsum produced in the case of FGD processes. These factors are based on the assumption that all of the CO2 is released to atmosphere. Data on the usage of limestone and dolomite for glass and steel production are available from the British Geological Survey and the Iron & Steel Statistics Bureau, respectively and gypsum produced in FGD plant is available from the British Geological Survey. Corus UK Ltd has provided analytical data for the carbon content of limestones and dolomites used at their steelworks and these have been used to generate EFs of 111 t carbon/kt limestone and 123 t carbon/kt dolomite for sintering and basic oxygen furnaces. [NIR 2009]

Table 4.13 summarizes the recommendations from UNFCCC review of the initial report in relation to the category 2A3 Limestone and Dolimite Use. The overview shows that most findings were addressed and resolved.

Table 4.13 2A3 Limestone and Dolomite Use: Findings of the UNFCCC review of the initial report in relation to CO_2 emissions and responses in 2009 inventory submissions

Member State	Review findings and responses related to 2A3 Limestone and Dolomite Use	
	Comment UNFCCC report of the review of the 2008 submission	**Status in 2009 submission**
Austria	Austria reported limestone and dolomite use for activities in the glass industry, in the iron and steel industry and in desulphurization in chemical industries. Emissions from this category increased by 33.2 per cent between 1990 and 2006, mainly due to increased limestone use in the iron and steel industries. Glass production data were reported by the Association of the Glass Industry for the years 2002–2004; for the years before 2002, AD were based on a constant ratio of limestone and dolomite used per tonne of glass produced. During the review Austria explained that such backtracking of limestone and dolomite consumption in the glass industry already includes production from recycled glass. The ERT recommends that Austria include this information in its next NIR. (para 40, 41)	Information on recycled glass included in 2009 NIR.
Belgium	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Denmark	New findings from centralized review 2008 not yet available (if occuring).	
Finland	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
France	Emissions from limestone and dolomite use are reported as 'IE' in the CRF tables, but no explanation is provided in CRF table 9. The NIR states that the use of limestone in the production of cement, lime and glass are reported under the respective source categories. The ERT recommends that the Party explore other possible uses of limestone and recommends that it estimate these emissions in its next inventory submission. (para 60)	Explanation was included in CRF table 9. CO2 emissions from limestone and dolomite use is included in combustion sector 1.A.2.a Iron and Steel.
Germany	New findings from centralized review 2008 not yet available (if occuring).	
Greece	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Ireland	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Italy	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Luxembourg	No recommendation for improvement of this source category in Initial Review Report.	No follow-up necessary.
Netherlands	The ERT recommends that the Netherlands improve the documentation on the other uses of limestone and dolomite besides flue gas cleaning. In response to the ERT, the Party explained that other uses include dolomite used in agriculture and limestone used in glass production. The ERT recommends that the Netherlands report dolomite used in agriculture in the LULUCF sector in line with the IPCC good practice guidance on LULUCF, and to confirm that there is no double counting of limestone used in glass production. (para 45)	The new LULUCF data include now the use of limestone and associated CO2 emissions in agriculture. To eliminate double counting , the emission from limestone use (as reported in 2.A.3) is now corrected.
Portugal	New findings from centralized review 2008 not yet available (if occuring).	
Spain	New findings from centralized review 2008 not yet available (if occuring).	
Sweden	New findings from centralized review 2008 not yet available (if occuring). The ERT recommends that Sweden follow the Revised 1996 IPCC Guidelines and account for all CO2 emissions from limestone use in category 2.A.3 (not addressed before)	ERT's recommendation was addressed in NIR 2009.
UK	New findings from centralized review 2008 not yet available (if occuring).	

Table 4.14 provides an overview about the emission sources reported in the category 2A7 Other Mineral Products in 2007 as well as total emissions in this category. The most frequent source reported under Other Mineral Products is glass production (12 Member States), followed by bricks and tiles production. Some Member States include emissions from brick and tile production and glass production under 2A3 Limestone and Dolimite Use. Germany is the largest contributor to this category with 24 %, followed by France (19 %).

Table 4.14 2A7 Other Mineral Products: Emission sources reported for the year 2007

Member State	2.A.7 Other Mineral Products	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 total
Austria	Sinter production, bricks and tiles (decarbonizing)	459	IE,NA	IE,NA	459	9%
Belgium	Glass Production, ceramics	478	NA	NA	478	10%
Denmark	Glass Production, Yellow bricks. Expanded clay	80	IE,NA	IE,NA	80	2%
Finland	Glass production	22	NO	NO	22	0%
France	Glass Production, Brick and Tile Production	912	NA	NA	912	19%
Germany	Glass Production, Ceramics, Bricks and Tiles (decarbonizing)	1151	NO	NO	1,151	24%
Greece	Glass Production	17	NA,NO	NA,NO	17	0%
Ireland	Bricks and Tiles (decarbonizing)	7	NE,NO	NE,NO	7	0%
Italy	Glass production	549	NA	NA	549	11%
Luxembourg	Glass production	63	NO	NO	63	1%
Netherlands	Glass production	292	NO	NO	292	6%
Portugal	Glass Production	179	NO	NO	179	4%
Spain	Glass production, Magnesia production, Porous Tiles, Potassium Carbonate, Ferrum Carbonate, Coal (reduction agent in glass industry), Non-porous Tiles, Barium Carbonate, Lithium Carbonate	463	NA	NA	463	9%
Sweden	Light expanded clay aggregate, Glass and mineral wool production	11	NA	NA	11	0%
UK	Fletton Brick Production	181	1	NE	200	4%
EU-15 Total		**4,865**	**1**	**0**	**4,884**	**100%**

Table 4.15 provides information on the contribution of Member States to EC recalculations in CO_2 from 2A Mineral products for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 4.15 2A Mineral products: Contribution of MS to EC recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	-0.4	0.0	
Belgium	-4.9	-0.1	-12.8	-0.2	
Denmark	0.0	0.0	0.3	0.0	
Finland	-53.3	-4.1	9.2	0.7	
France	0.0	0.0	-0.3	0.0	
Germany	-59.9	-0.3	-190.5	-1.0	
Greece	-75.5	-1.2	0.0	0.0	
Ireland	0.4	0.0	0.0	0.0	
Italy	0.0	0.0	-828.7	-3.4	Emission factor: changes in EF due to use of data collected from the European emissions trading scheme for cement and lime production
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	-44.0	-4.6	-29.7	-2.5	
Portugal	0.0	0.0	334.1	7.7	
Spain	-9.5	-0.1	-88.2	-0.4	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	44.4	0.5	
EU-15	**-246.9**	**-0.2**	**-762.6**	**-0.6**	

4.2.2 Chemical industry (CRF Source Category 2B) (EU-15)

Chemical industry includes the following key categories: CO_2 from 2B1 Ammonia Production, N_2O from 2B2 Nitric Acid Production and from 2B3 Adipic Acid Production and CO_2 and N_2O from 2B5 Other Chemical Industry.

Source category 2B1 Ammonia Production covers CO_2 emissions that occur during the production of ammonia, a chemical used as a feedstock for the production of several chemicals. In most instances, anhydrous ammonia is produced by catalytic steam reforming of natural gas (mostly CH_4) or other fossil fuels. CO_2 at plants using this process is released primarily during regeneration of the CO_2 scrubbing solution, with additional but relatively minor emissions resulting from condensate stripping. Source category 2B2 Nitric Acid Production accounts for N_2O emitted as a by-product of the high temperature catalytic oxidation of ammonia (NH_3) in the production of nitric acid. Adipic Acid Production (2B3) also emits N_2O as a by-product when a cyclohexanone/cyclohexanol mixture is oxidized by nitric acid.

Table 4.16 summarises information on Member States' emissions from chemical industry in 1990 and 2007 for total GHG, CO_2 and N_2O. Between 1990 and 2007, CO_2 emission from 2B Chemical Industry increased by 16 %. The absolute increase was largest in Germany, Portugal and Belgium, the absolute reductions were largest in France, Ireland and Italy. Between 1990 and 2007, N_2O emission from 2B Chemical Industry decreased by 64 %. The absolute decreases were largest in UK and France, emissions increased only in Portugal.

Table 4.16 2B Chemical Industry: Member States' contributions total GHG and CO_2 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2007 (Gg CO2 equivalents)
Austria	1,512	820	585	531	912	270
Belgium	4,579	4,549	645	2,646	3,934	1,902
Denmark	1,044	2	1	2	1,043	NA,NO
Finland	1,781	2,006	125	524	1,656	1,482
France	27,670	7,374	3,244	1,809	24,423	5,565
Germany	35,680	30,797	11,909	15,556	23,771	15,241
Greece	1,110	761	IE,NA,NE,NO	321	1,109	440
Ireland	2,026	NO	990	NO	1,035	NO
Italy	8,927	3,209	2,199	1,311	6,676	1,891
Luxembourg	NO	NO	NO	NO	NO	NO
Netherlands	11,052	8,690	3,702	3,622	7,096	4,802
Portugal	1,209	2,771	634	2,132	567	627
Spain	3,768	2,152	832	736	2,884	1,359
Sweden	901	300	69	47	832	252
United Kingdom	27,695	5,899	2,885	3,070	24,641	2,753
EU-15	**128,953**	**69,329**	**27,820**	**32,307**	**100,579**	**36,584**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.17 provides information on the contribution of Member States to EC recalculations in CO_2 from 2B Chemical industry for 1990 and 2006 and main explanations for the largest recalculaltions in absolute terms.

Table 4.17 2B Chemical Industry: Contribution of MS to EC recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.2	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	-5.1	-3.9	-10.1	-6.8	
France	-7.7	-0.2	18.6	1.4	
Germany	86.7	0.7	119.9	0.8	
Greece	0.0	0.0	314.9	0.0	Method: This is the first time that CO2 emissions from ammonia production are estimated.
Ireland	1.1	0.1	0.0	0.0	
Italy	13.1	0.6	0.0	0.0	
Luxembourg	NE	0.0	NE	0.0	
Netherlands	0.0	0.0	-0.2	0.0	
Portugal	0.0	0.0	0.0	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	-709.9	-20.7	Emission factor: Revision to the emission factor used for ammonia production, Activita data: Revision to the activity data provided by industry
EU-15	**88.0**	**0.3**	**-266.5**	**-0.9**	

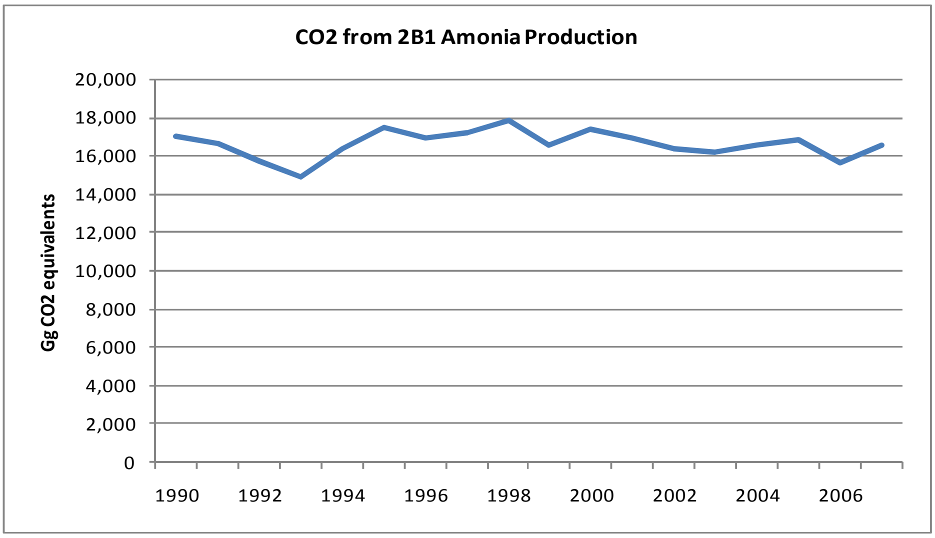
Table 4.18 provides information on the contribution of Member States to EC recalculations in N_2O from 2B Chemical Industry for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 4.18 2B-Chemical Industry: Contribution of MS to EC recalculations in N_2O for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.1	0.0	-1.4	-0.1	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	0.0	0.0	
Germany	-5.8	0.0	-5.8	0.0	
Greece	396.1	55.6	-191.0	-30.1	Emission factor: The plant informed the inventory team on the use of medium pressure conditions. Activity data: Plant specific activity data were made available.
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	0.0	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	0.0	0.0	
EU-15	**390.4**	**0.4**	**-198.2**	**-0.5**	

CO_2 emissions from 2B1 Ammonia Production account for 0.4 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from this source decreased by 3 % (Table 4.19, Figure 4.6). Germany, the Netherlands and Portugal are responsible for 62 % of these emissions in the EU-15. France, Ireland and Italy had large reductions in absolute terms between 1990 and 2007. The reasons for this were a change to low emitting technology in France and production decreases in the other two countries. The largest growth had Portugal, followed by Belgium.

Figure 4.6 2B1 Ammonia Production: EU-15 CO_2 emissions



The raise of CO_2 emissions by 10 % in 1993-1994 was dominated by the increase of emissions in Belgium, Portugal, and the Netherlands, whereas Italy showed a reverse trend in CO_2 emissions. The emissions in Belgium increased noticably from 1993 on because new production installations became available in the Flemish region. The contribution to the EU-15 emission change 1993-1994 was dominated by activity data rather than implied emission factors.

Decrease in CO_2 emissions by 7 % in 2006, which was followed by an again increase of emissions by 6 % was mainly caused by France and the UK. For last-mentioned MS data for 1997 onwards is based on operator reported data and reflect actual trends in emissions.

Germany – representing the highest share of CO_2 emissions from Ammonia Production – further plans to move to Tier 3 as part of the plant-specific improvement (FCCC/ARR/2008/EC, para 51).

Table 4.19 2B1 Ammonia Production: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	517	542	473	2.9%	-68	-13%	-43	-8%
Belgium	420	1,290	1,301	7.9%	11	1%	881	209%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	44	NO	NO	-	-	-	-44	-100%
France	3,050	1,312	1,764	10.7%	452	34%	-1,286	-42%
Germany	4,596	5,138	5,200	31.4%	63	1%	604	13%
Greece	IE	315	321	1.9%	7	2%	321	-
Ireland	990	NO	NO	-	-	-	-990	-100%
Italy	1,710	657	649	3.9%	-7	-1%	-1,060	-62%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	3,096	3,071	3,016	18.2%	-55	-2%	-80	-3%
Portugal	569	1,903	1,996	12.1%	94	5%	1,427	251%
Spain	709	582	622	3.8%	40	7%	-87	-12%
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	1,322	849	1,209	7.3%	359	42%	-113	-9%
EU-15	**17,023**	**15,659**	**16,553**	**100.0%**	**894**	**6%**	**-470**	**-3%**

Emissions of Greece are reported in Energy - Chemicals.
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.20 shows information on methods applied, activity data, emission factors for CO_2 emissions from 2B1 Ammonia Production for 1990 to 2007. The table shows that most MS report Ammonia Production as activity data. The implied emission factors per tonne of ammonia produced vary for 2007 between 1.07 for Austria and 1.94 for Ireland. The EU-15 IEF (excluding Greece, Ireland, the Netherlands, Portugal and the UK) is 1.49 t CO_2/t of ammonia produced. The table also suggests about 60 % of EU-15 emissions are estimated with higher Tier methods. Germany as the highest emitter in this source category is using a default EF based on a recommendation by the ERT; the German energy balance does not differentiate between energy and non-energy use of natural gas in ammonia production.

Table 4.20 2B1 Ammonia Production: Information on methods applied, activity data, emission factors for CO_2 emissions

Member State	Method applied	Activity data	Emission factor	1990 Activity data: Description	1990 Activity data: (kt)	1990 Implied emission factor (t/t)	1990 CO_2 emissions (Gg)	2007 Activity data: Description	2007 Activity data: (kt)	2007 Implied emission factor (t/t)	2007 CO_2 emissions (Gg)
Austria	CS,T2	NS,PS	CS	Ammonia Production	461	1.12	517	Ammonia Production	441	1.07	473
Belgium	T3	PS	D/PS	Ammonia Production	360	1.17	420	Ammonia Production	1088	1.20	1301
Finland	T1	PS	D	Ammonia Production	28	1.55	44	Ammonia Production	NO	NO	NO
France	C	AS	PS	Ammonia Production	1928	1.58	3050	Ammonia Production	1262	1.40	1764
Germany	D	NS	D	Ammonia Production	2532	1.82	4596	Ammonia Production	2865	1.82	5200
Greece	T1a	PS	PS	Ammonia Production	313	IE	IE	Ammonia Production	166	1.94	321
Ireland	T1	NS	CS	Natural Gas Feedstocks	430	2.30	990	Natural Gas Feedstocks	NO	NO	NO
Italy	D	NS,PS	C, PS	Ammonia Production	1455	1.18	1710	Ammonia Production	578	1.12	649
Netherlands	T1b	C	CS	Ammonia Production	C	C	3096	Ammonia Production	C	C	3016
Portugal	D,T2	NS,PS	CS,PS	Ammonia Production	C	C	569	Ammonia Production	C	C	1996
Spain	D	PS	PS	Ammonia Production	573	1.24	709	Ammonia Production	526	1.18	622
UK	T1	PS	CS	Natural gas consumption PJ net	45	29.53	1322	Natural gas consumption PJ net	33	36.42	1209
EU15				**EU15 w/o GR, IE, NL, PT and UK (65%)**	**7338**	**1.51**	**11046**	**EU15 w/o NL, PT and UK (62%)**	**6927**	**1.49**	**10332**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The implied emission factors for 2007 are lower than in 1990 for some MS. Large drops in the inventories 2009 could be found for Austria, France, Italy and Spain. Explanations for the development of the implied emission factors and for outliers in IEFs are given in the following overview:

- *Implied Emission Factor Ammonia Production, Austria*

Emissions are calculated by natural gas non-energy use from the energy balance. The split in energy and non-energy use made by the operator might not always consistent. This will be checked for the next submission.

- *Implied Emission Factor Ammonia Production, Italy*

  The average emission factors derive from data reported by plants in the national EPER/E-PRTR and were lowered by the two production plants in 2007.

- *Implied Emission Factor Ammonia Production, UK*

  The comparable high IEF (2007) could be explained by the activity data which is natural gas consumption in PJ for this source.

Table 4.21 provides a more detailed overview of the methodologies and data sources used by Member States for this source category as reported in the NIR 2009.

Table 4.21 2B1 Ammonia Production: Summary of methodological information provided by Member States

Ammonia Production	
Member State	**Methodology comment**
Austria	AD since 1990 and CH4 emission data from 1994 onwards were reported directly by the only ammonia producer in Austria and thus represent plant specific data. The composition of the synthesis gas is measured regularly at the only ammonia producer in Austria. CO2 emissions are calculated from the natural gas input with a standard emission factor (55.4 t/TJ). In this methodology it is assumed that all natural gas is transformed to CO2 and emitted at once. But, according to information from the producer, there are also CH4 emissions during start-ups of the ammonia production. Therefore this CH4 has to be subtracted from total CO2 to avoid double counting. Furthermore, CO2 and CH4 emissions from urea production are reported, that both derive directly from ammonia. These emissions are reported under urea production – where they occur – and are also subtracted from total CO2 emissions from ammonia production to avoid double counting of emissions. Account was taken for the carbon bound in the melamine production. [NIR 2009]
Belgium	In Flanders the emissions of CO2 originating from the production of ammonia are obtained as a result of the yearly surveys carried out by the chemical federation in cooperation with the Vito. In the past the same methodology as in Wallonia was used, nowadays the methodology is adapted because a part of the emissions of CO2 is recuperated in the plant and no longer emitted. In the Walloon region, until 2004, the CO2 emissions were calculated based on the natural gas used as feedstock. 100% per cent of the carbon content of the natural gas was presumed to be emitted; the default IPCC emission factor for CO2 for natural gas (55,8 kton CO2/PJ) was used to calculate the total CO2 emissions. The amount of natural gas used in the process was given directly by the plant. Since 2005, CO2 emissions have been given directly by the reporting of the plant under the emission trading scheme. [NIR2009]
Denmark	Not occuring.
Finland	The annual ammonia production figures have been obtained from the production plant. The CO2 emissions have been calculated with the mean value of two IPCC default emission factors (1.55 tonne CO2/tonne ammonia produced). [NIR 2009]
France	Emission data obtained directly from plants, CS EF calculated on this basis. [NIR 2009]
Germany	Emissions are estimated from ammonia production data from national statistics and the IPCC default EF. [NIR 2009]
Greece	CO2 emissions have been estimated using Tier 1a methodoloy. AD concerning fuel consumption for the years 1998-2007 have been provided by the plant using natural gas. Ammonia production for the whole time-series has been made available by the NSSG, and for the years 1998-2007 by the one plant still operating in Greece. [NIR 2009]
Ireland	Emissions are calculated using natural gas consumption data as indicated in the national energy balance provided by SEI and a CS EF for natural gas. [NIR 2009] Ammonia production was closed in 2002.[NIR 2005]
Italy	AD from international industrial statistical yearbooks (UN) and from national EPER registry were used. For the years 1990-2001 CO2 EF have been calculated based on information reported from EPER for 2002 and 2003. Assumption that no modifications to the production plants have occurred over the period. For the years 2002-2006 the average emission factors result from PS data from EPER. [NIR 2008]
Luxembourg	Not occuring.
Netherlands	Emissions are calculated from the amount of natural gas used as feedstock (equivalent to IPCC Tier 1b) obtained from national statistics. CS EF based on a 17% fraction of carbon in the gas-feedstock oxidised during the ammonia manufacture, which was calculated from the carbon not contained in the urea produced. [NIR 2009]
Portugal	Emissions are estimated using feedstock (Vaccum Residual Fuel Oil) consumption data from national statistics and an EF based on the VRF carbon content. [NIR 2009]
Spain	Production data and country-specific EF from some plants and IPCC default factors and production statistics for the other plants.[NIR 2009].
Sweden	There is an annual production of about 5 Gg of ammonia in Sweden, according to UN statistics . This ammonia is however not intentionally produced, but is a by-product in one chemical industry producing various chelates and chelating agents, such as EDTA, DTPA and NTA . Emissions from this industry are included in CRF code 2B5 Other. [NIR 2009]
UK	Emissions of CO2 from feedstock use of natural gas were calculated by combining reported data on CO2 produced, emitted and sold by the various ammonia processes. Where data were not available, they have been calculated from other data such as plant capacity or natural gas consumption. A correction has to be made for CO2 produced at one site where some of this CO2 is subsequently 'recovered' through sequestration in methanol. the default carbon emission factor for natural gas was used to convert between carbon and natural gas. [NIR 2009]

Table 4.22 summarizes the recommendations from 2008 UNFCCC inventory review in relation to the category 2B1 Ammonia Production. The overview shows that most recommendations were implemented and that the remaining unresolved findings are mostly not very significant.

Table 4.22 2B1 Ammonia Production: Findings of the 2008 UNFCCC inventory review in relation to CO_2 emissions and responses in 2009 inventory submissions

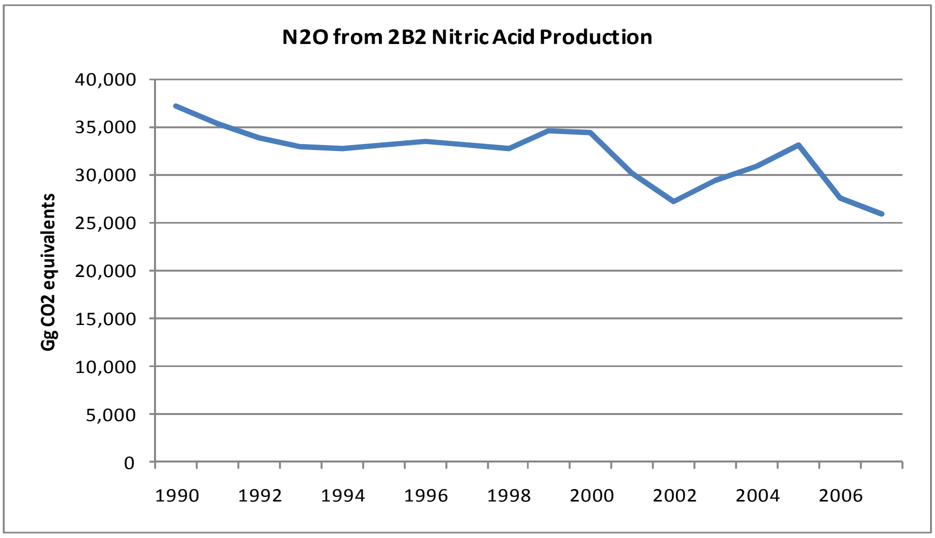
Member State	Review findings and responses in relation to 2B1 Ammonia Production	
	Comment UNFCCC report of the review of the 2008 submission	Status in 2009 submission
Austria	Austria reports CO2 and CH4 emissions from ammonia (NH3) production. During the review, Austria explained to the ERT that emissions of CH4 come from leakage in ammonia production and from start-ups during ammonia production, which are subsequently subtracted from CO2 emissions to avoid double counting. The ERT recommends that Austria give a clearer explanation of these emissions in its next inventory report. (para 41)	Information about the amount of methane emittend as leakage has been included in NIR 2009.
Belgium	In the Flemish Region, annual surveys provide information on CO2 emissions (on a confidential basis) undertaken by the Flemish Institute for Technological Research (VITO). Belgium informed the ERT that the AD time series in the Flemish Region were missing in the national AD and that it intends to review this anomaly before the next annual submission. (para 51)	Not yet adressed.
Finland	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
France	The IEF for this category decreased from 1.59 t CO2/t NH3 in 1990 to 1.43 t CO2/t NH3 in 2005 and increased to 1.72 t CO2/t NH3 in 2006. According to the OMINEA report, the decrease in the EF is due to the use of more efficient catalysts. However, the NIR states that the IEF increase in the latest year is due to extraordinary conditions at one specific production plant. The ERT recommends that France explain the fluctuations in the IEF by reporting on the catalysts used and the conditions at the production plants in order to increase transparency in its next annual submission. In the NIR, France reports on the difficulties it has experienced in distinguishing between fuel used for ammonia production and fuel used for ammonia combustion (about 10 per cent of the total fuel use). As a result, emissions from both ammonia production and ammonia combustion are included under ammonia production (CRF table 2.B.1). The ERT noted that this may result in double counting between the chemicals (CRF table 1.A.2.c) and the ammonia production (CRF table 2.B.1) categories. It remains unclear in the NIR whether or not this potential double count France reports in the NIR that some of the CO2 from ammonia production is used t	The problems with double counting between 2B1 and 1A2c will be corrected in the next report. There is no further reporting on catalysts and the conditions at the production plants. The methodology has not been revised in relation to urea production .
Germany	New findings from centralized review 2008 not yet available (if occuring).	
Greece	CO2 emissions associated with the use of lignite and natural gas used as feedstock are currently reported in the energy sector. The ERT recommends that Greece allocate these emissions to the ammonia production category in line with the Revised 1996 IPCC Guidelines. Additional information provided by Greece during the in-country review suggests that Greece has at its disposal data on plantlevel ammonia (NH3) production, fuel input per unit of NH3 (GJ/tonne ammonia) and the carbon content factor of the feedstock/fuel used (kg C/GJ). The ERT encourages Greece to explore using this new information to estimate emissions from this category for all years of the inventory time series, using methods prescribed by the Revised 1996 IPCC Guidelines or the IPCC good practice guidance. Alternatively, Greece can use the default EF in the IPCC good practice guidance for natural gas input per unit of ammonia, and couple this with country-specific carbon content to estimate the CO2 emission. (para 94)	There is only one plant still operating in Greece. For this plant CO2 emissions from natural gas are included under industrial processes for the years 1998-2007. The other ammonia production plant shut down in 2000 and was using liquid fuels until ist closure. The possibility of collecting all available data on liquid fuels consumption will be investigated.
Ireland	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Italy	AD taken from international statistical yearbooks are checked against the data in the national EPER registry. An EF equaling 1.175 t CO2/t ammonia production has been calculated on the basis of information reported by the production plants for 2002 and 2003 in the framework of the national EPER registry and has been applied to the years 1990-2001. Since no modifications were made to the production plants during the period 1990-2002, the 2002-2003 values were assumed to be representative. The EFs for 2002-2006 obtained from plant data are reported to EPER every year. Natural gas is used as feedstock in the ammonia production plants and the amount of fuel used is reconciled with the figures reported in the energy sector. The ERT recommends that Italy verify emission data published in the national EPER registry to demonstrate data accuracy. (para 40)	NIR 2009 not yet available.
Luxembourg	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Netherlands	Emission estimates are calculated from natural gas consumption and a country-specific EF. AD on the use of natural gas are obtained from Statistics Netherlands but are reported as 'confidential'. The EF is based on a 17 per cent fraction of the carbon in the gas feedstock not being oxidized that is derived from a study covering 1993-1997 and based on the carbon contained in the urea product. The ERT recommends that the Netherlands review and update this fraction if the process conditions may have changed since 1997.(para 44)	Not yet adressed.
Portugal	New findings from centralized review 2008 not yet available (if occuring).	
Spain	New findings from centralized review 2008 not yet available (if occuring).	
Sweden	New findings from centralized review 2008 not yet available (if occuring).	
UK	New findings from centralized review 2008 not yet available (if occuring).	

Abbreviations explained in the Chapter ‘Units and abbreviations’.

N_2O emissions from 2B2 Nitric acid production account for 0.6 % of total EU-15 GHG emissions in

2007. Between 1990 and 2007, N_2O emissions from this source decreased by 30 % (Figure 4.7, Table 4.23). Germany accounts for 37 % of EU-15 emissions from this source, followed by the Netherlands (17 %) and France (13 %). Nearly all Member States had reductions from this source between 1990 and 2007. France had the greatest reductions in absolute terms, due to a decrease in production and a decrease of the IEF. Production stopped in Denmark, Ireland, and Luxembourg. The largest growth was in Germany, followed by Portugal.

Figure 4.7 2B2 Nitric acid production: EU-15 N_2O emissions



The decrease in N_2O emissions by 12 % in 2000-2001 and further 10 % 2001-2002 was dominated by the drop in emissions in France, UK, the Netherlands. Whereas Germany also acoounted for the EU-15 emission decrease in 2000-2001, the country's emissions showed a reverse trend 2001-2005 and contributed most to the increase in emissions. The peak in Germany's N_2O emissions in 2005 was due to change of the data collection system of a big nitric acid producer.

The Netherlands dominated the decrease of emissions 2006-2007 by contributing 77 % to the EU-15 emission change. This considerable drop in emissions was caused by technical measures implemented at all nitric acid plants in the third quarter of 2007.

Table 4.23 2B2 Nitric acid production: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	912	280	270	1.0%	-10	-4%	-642	-70%
Belgium	3,562	2,081	1,361	5.3%	-719	-35%	-2,201	-62%
Denmark	1,043	NO	NO	-	-	-	-1,043	-100%
Finland	1,656	1,438	1,482	5.7%	44	3%	-174	-10%
France	6,570	3,676	3,409	13.1%	-267	-7%	-3,161	-48%
Germany	4,673	8,479	9,555	36.9%	1,076	13%	4,882	104%
Greece	1,109	443	440	1.7%	-3	-1%	-670	-60%
Ireland	1,035	NO	NO	-	-	-	-1,035	-100%
Italy	2,086	1,225	1,109	4.3%	-116	-9%	-977	-47%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	6,330	5,597	4,305	16.6%	-1,292	-23%	-2,025	-32%
Portugal	567	619	627	2.4%	7	1%	60	11%
Spain	2,884	1,555	1,359	5.2%	-196	-13%	-1,525	-53%
Sweden	814	457	244	0.9%	-213	-47%	-569	-70%
United Kingdom	3,904	1,759	1,763	6.8%	5	0%	-2,140	-55%
EU-15	**37,145**	**27,610**	**25,925**	**100.0%**	**-1,684**	**-6%**	**-11,220**	**-30%**

Table 4.24 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B2 Nitric Acid Production for 1990 to 2007. The table shows that all MS report Nitric Acid Production as activity data; for some MS this information is confidential. The implied emission factors

per tonne of nitric acid produced vary for 2007 between 0.0017 for Austria and 0.0078 for Finland. The EU-15 IEF (excluding Netherlands and Portugal) is 0.0050 t N_2O/t of nitric acid produced. The decrease of the IEF is mainly due to changing production ratios in the different MS having different technological standards and the closure of older plants in some MS. The table also suggests that about 45 % of EU-15 emissions are estimated with higher tier methods for 2007. Germany as the country with the highest emissions from this source category estimates that the EF applied has an uncertainty of 50% as it does not take plant technology and abatement measures into account; Germany has initiated the necessary work to move to tier 3 in the future.

Table 4.24 2B2 Nitric Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

				1990				2007			
Member State	Method applied	Activity data	Emission factor	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)	Activity data		Implied emission factor (t/t)	N_2O emissions (Gg)
				Description	(kt)			Description	(kt)		
Austria	CS	PS	PS	Nitric Acid Production	530	0.0056	2.9	Nitric Acid Production	499	0.0017	0.9
Belgium	T3	PS	PS	Nitric Acid Production	1436	0.0080	11.5	Nitric Acid Production	1199	0.0037	4.4
Denmark	NO	NO	NO	Nitric Acid Production	450	0.0075	3.4	Nitric Acid Production	NO	NO	NO
Finland	T2	PS	PS	Nitric acid production medium pressure plants	549	0.0097	5.3	Nitric acid production medium pressure plants	615	0.0078	4.8
France	C	AS	PS	Nitric Acid Production	3200	0.0066	21.2	Nitric Acid Production	2355	0.0047	11.0
Germany	CS	NS	CS	Nitric Acid Production	2741	0.0055	15.1	Nitric Acid Production	5604	0.0055	30.8
Greece	D	PS	D	Nitric Acid Production	511	0.0070	3.6	Nitric Acid Production	203	0.0070	1.4
Ireland	T1	PS	PS	Nitric Acid Production	339	0.0099	3.3	Nitric Acid Production	NO	NO	NO
Italy	D	PS	D, PS	Nitric Acid Production	1037	0.0065	6.7	Nitric Acid Production	505	0.0071	3.6
Netherlands	T2	Q/NS	PS	Nitric Acid Production	C	C	20.4	Nitric Acid Production	C	C	13.9
Portugal	D	NS,PS	C,OTH	Nitric Acid Production	C	C	1.8	Nitric Acid Production	C	C	2.0
Spain	D	PS, AS	CS	Nitric Acid Production	1329	0.0070	9.3	Nitric Acid Production	626	0.0070	4.4
Sweden	T2	PS	PS	Nitric Acid Production	374	0.0070	2.6	Nitric Acid Production	249	0.0032	0.8
UK	CS	PS	CS	Nitric Acid Production	2408	0.0052	12.6	Nitric Acid Production	1606	0.0035	5.7
EU15				**EU15 w/o NL and PT (81%)**	**14,904**	**0.0065**	**98**	**EU15 w/o NL and PT (81%)**	**13,462**	**0.0050**	**68**

Abbreviations explained in the Chapter 'Units and abbreviations'.

The ERT identified that no reasons for the decline of IEFs in many member States were given in the latest NIR (FCCC/ARR/2008/EC, para 52). Explanations for the development of the implied emission factors and for outliers in IEFs are therefore given in the following overview. Besides changing production ratios in the different member States (which also have different technological standards), also the closure of older plants in Belgium, Denmark, Ireland, Italy and Sweden resulted in reduced emissions.

- *Implied Emission Factor, Austria*

  Comparable low IEF could be explained with the installation of a N_2O decomposition facility in 2004.

- *Implied Emission Factor, Finland*

  Decline in IEF is caused by the use of a new kind of catalyst in one plant from May 2005 on and by confidential reasons.

- *Implied Emission Factor, Sweden*

  Comparable low IEF is due to the installation of catalytic abatement at one of the production units at the active facility in 2007.

- *Implied Emission Factor, UK*

  Emissions are calculated based on operater reported data in the UK. The emission factors calculated for each of the plants vary, reflecting different process conditions, and the fluctuations in IEFs in the overall time series reflects the changing proportions of total nitric acid produced by each of theoperating plants. Detailed information about each of the nitric actid plants could not be provided to confidential reasons.

Table 4.25 provides a more detailed overview on methodologies and data sources used in EU-15 Member States for the estimation of emissions from Nitric Acid Production.

Table 4.25 2B2 Nitric Acid Production: Summary of methodological information provided by Member States

Nitric Acid Production	
Member State	**Methodology comment**
Austria	Following the IPCC Guidelines plant specific measurement data was collected. Activity and emission data of N2O emissions was obtained directly from the plant operator. Since 1998, emissions are measured continuously. Based on the analysed emission data of 1998 and due to the fact that the production technology has not changed between 1990 and 1998 emission factors per ton of product were calculated for the used technologies. With these estimates of plant specific emission factors and the production volume of the individual plants the total emission of N2O per year was calculated. [NIR 2009]
Belgium	Emissions are estimated in Flanders using an emission factor of 8 kg N2O/ton HNO3 from CITEPA. The three plants involved in Flanders since 1990 agreed with this factor of 8 kg N2O/ton HNO3 and give their nitric acid production figures each year. Since 2000 only one plant is still involved in this sector. From 2003 on lower emission factors in this plant are reported, based on monitoring results (approx. 5.6 kg N2O/ton HNO3). The use of catalysts reduces these emissions. The producer of nitric acid in the Walloon region provides the N2O emissions based on their production and on monitoring. There are three installations on the plant. The global emission factor used in this region is 4.3 kg/t in 2006. For the time being, there is only one installation with an abatement technology (SCR) installed in 1996. However, this installation did not lead to a decrease in the N2O emissions given the strong increase of the production since 1996. [NIR 2009]
Denmark	The N2O emission from the production of nitric acid/fertiliser is based on measurement for 2002. For the previous years, the N2O emission has been estimated from annual production statistics from the company and an emission factor of 7.5 kg N2O/tonne nitric acid, based on the 2002 emission measured. The production of nitric acid ceased in the middle of 2004. [NIR 2009]
Finland	The annual nitric acid production figures have been obtained from the production plants. Emission factors are plant specific and are based on measurements started in 1999 and was done by an outside consultant. At one site emission factors has been defined to be 7.6 kg/t and 9.5 kg/t for the whole time series. At other sites emission factors are about 9.2 kg/t. The new plant has a continuous measurement unit. A portable measurement device to measure emissions of the other plants of the company has been purchased and the emissions are now measured periodically. This has improved the emissions factors for 2005 and will improve the accuracy of the emission factors in future. [NIR 2009]
France	Emission data obtained from association based on plant-specific data until 2001. Since 2002 plant-specific information directly reported to authorities available for all sites. Common good practice Guidance for the N2O estimation was adopted in all plants in 2002. [NIR 2009]
Germany	Activity data taken from national statistics, since 2002 the share of nitirc acid is estimated from a more aggregated production figure. Country-specific emission factor is assumed to be constant and is within the range provided by German industry. [NIR 2009]
Greece	Estimates are based on activity data from NSSG and the individual industrial units for 1990-2007 and average IPCC default EF (IPCC GPG 2000). No N2O abatement technologies are used. [NIR 2009]
Ireland	Nitric acid production ceased in 2002 with the liquidation of Irish Fertilizer Industries. [NIR 2009]
Italy	Emissions are calculated based on data from EPER, national statistics and plant-specific EF. IPCC default EF for low and medium pressure plants that are now closed. [NIR 2008]
Luxembourg	Not occuring.
Netherlands	Activity data are confidential. Emissions are reported by the companies. An IPCC Tier 2 method is used to estimate N2O emissions. The emission factors are based on plant-specific measured data which are confidential. The emissions are based on data reported by the nitric acid manufacturing industry and are included in the national Pollutant Release & Transfer Register (PRTR). [NIR 2009]
Portugal	Estimates are calculated from nitric acid production data (national statistics and extrapolations for recent years) and PS EF. Plant-specific EFs are monitored at one of the three plants. [NIR 2009]
Spain	Production data and EF obtained from national business association. Additional information were derived from the FEIQUE (the Business Federation of the Chemical Industry in Spain) and MITYC. CS EF form industrial association is used compiled from plant-specific data. [NIR 2009]
Sweden	Activity data, such as the produced amount of nitric acid, has been obtained from the facilities and from official statistics. Emission estimates of N2O have been reported in the companies' environmental reports or have been provided by the facilities directly. Emission data are not available for all facilities for 1991-1993. Since two plants have been shut down, it is no longer possible to acquire this information. Calculations have therefore been made based on production statistics and an assumed emission factor. The assumed emission factor of 7 kg/Mg for 1991 - 1993 is based on the calculated emission factors for 1990 and 1994 and is in line with the default factors for nitric acid production in IPCC Good Practice Guidance. [NIR 2009]
UK	Estimates are based on PS data as well as calculated using nitric acid production data and production capacities. Emissions partly provided directly by operators, site specific EF and default EFs. [NIR 2009]

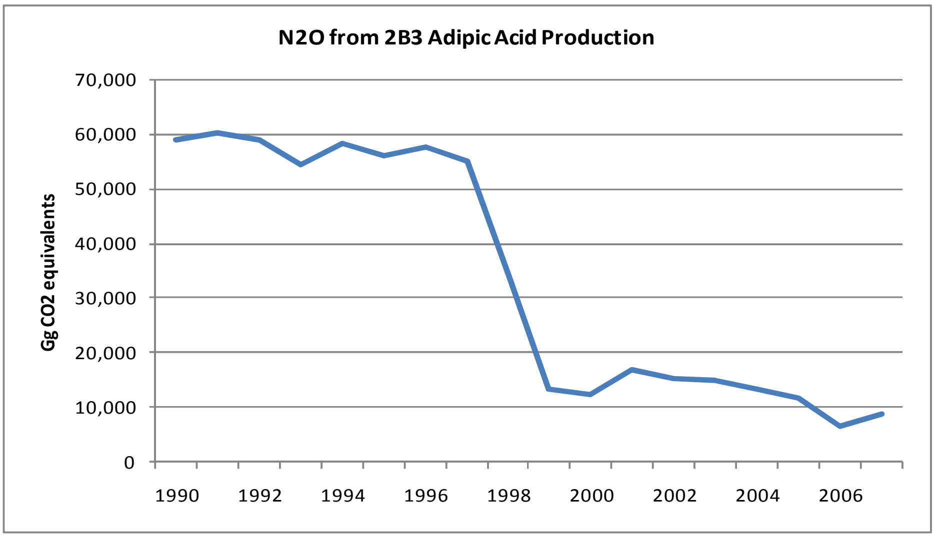
Table 4.26 summarizes the recommendations from the UNFCCC review of the initial report in relation to the category 2B2 Nitric Acid Production. The overview shows that recommendations were mostly implemented.

Table 4.26 2B2 Nitric Acid Production: Findings of the 2008 UNFCCC inventory review in relation to CO_2 emissions and responses in 2009 inventory submissions

Member State	Review findings and responses related to 2B2 Nitric Acid Production	
	Comment UNFCCC report of the review of the 2008 submission	**Status in 2009 submission**
Austria	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Belgium	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Denmark	No recommendation for improvement of this source category in Intial Review Report. The review on the submission 2007 and 2008 has not been finalized.	No follow-up necessary.
Finland	Finland used plant-specific AD and EFs to estimate N2O emissions from nitric acid production. The EFs were based on plant-specific measurements and have changed annually. Finland explained that the inter-annual changes of the EFs were due to replacement of plants, the use of new catalysts and changes to some processes. In addition, in response to the recommendation of the previous review, Finland provided the trends of some plant-specific EFs in the NIR. The ERT noted that the IEF decreased by 14.1 per cent in between 1990 and 2006. In response to a request by the ERT, Finland provided additional information on complete trends of EFs and confirmed that the methodologies and data used were adequate. Also Finland informed the ERT that it cannot give complete trends for plant specific EFs for confidentiality reasons. The ERT recommends that Finland provide complete trends of EFs and relevant data calculations to the extent possible in its next annual submission. (para 40)	Finland couldn' t give any more precise data due to confidential reasons in Nitric acid production. The quality system of measurements in the plants will be studied as a source category-specific QC procedure.
France	N2O emissions from nitric acid production have decreased from 21.2 Gg in 1990 to 11.9 Gg in 2006 due to a decrease in the number of nitric acid production plants (the number of plants decreased from 19 to 10 during this period) and due to the implementation of control measures at the remaining plants in 2002. Since 2002, the emission estimates have been based on reports from industry. As recommended during the previous review, France has included a more detailed explanation for the decrease. However, the ERT encourages France to improve transparency further by reporting on the methods that the industrial plants use to estimate emissions, the number of plants that use specific production and emission control technology, and by reporting the years when the nitric acid production plants have been closed. (para 50)	The closing years of 9 nitric acid production plants have now been reported on p.95. There is no further reporting on the methods that the industrial plants use to estimate emissions or the number of plants that use specific production and emission control technology.
Germany	New findings from centralized review 2008 not yet available (if occuring).	
Greece	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Ireland	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Italy	The inter-annual changes of IEFs are significant. Italy explained that the changes were dependent on the production levels of the different plants. In response to the ERT request, Italy provided additional information during the review, including confidential information, and acknowledged that the methodologies and data used were adequate and in line with the IPCC good practice guidance. (para 41)	NIR 2009 not yet available.
Luxembourg	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Portugal	New findings from centralized review 2008 not yet available (if occuring).	
Spain	New findings from centralized review 2008 not yet available (if occuring).	
Sweden	New findings from centralized review 2008 not yet available (if occuring).	
UK	New findings from centralized review 2008 not yet available (if occuring).	

N_2O emissions from 2B3 Adipic Acid Production account for 0.2 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, N_2O emissions from this source decreased by 85 % (Figure 4.8, Table 4.27). Only France, Germany, Italy and the UK produce adipic acid and all four countries were able to decrease emissions from this source category significantly due to the retrofitting of installations with abatement technologies.

Figure 4.8 2B3 Adipic Acid Production: EU-15 N_2O emissions



The country's share in EU-15 change of emission trend was 64 % for Germany in 1997-1998 and 37 % for France. In addition the UK contributes 55 % to the EU-15 emission change in 1998-1999 (France 25 % and Germany 22 %). The increase of N_2O emissions in 2001-2002 and 2006-2007 was dominated by the raise of emissions in Germany due damaged abatment techniques.

Table 4.27 2B3 Adipic Acid Production: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NO	NO	NO	-	-	-	-	-
Belgium	0	0	0	-	-	-	-	-
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	14,806	1,538	1,570	17.5%	33	2%	-13,235	-89%
Germany	18,805	3,004	5,624	62.7%	2,620	87%	-13,181	-70%
Greece	NO	NO	NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	4,579	1,421	782	8.7%	-640	-45%	-3,798	-83%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NA	NA	NA	-	-	-	-	-
Sweden	NO	NO	NO	-	-	-	-	-
United Kingdom	20,737	605	990	11.0%	385	64%	-19,748	-95%
EU-15	**58,927**	**6,568**	**8,965**	**100.0%**	**2,397**	**37%**	**-49,962**	**-85%**

Table 4.28 shows information on methods applied, activity data, emission factors for N_2O emissions from 2B3 Adipic Acid Production for 1990 to 2007. The table shows that in 2007 adipic acid was produced in four MS only. All four use adipic acid production as activity data but the information is confidential in France, Germany and the UK. The implied emission factors per tonne of adipic acid produced is only provided by Italy with 0.3 t/t for 1990 and 0.03 t/t for 2007. The table suggests that 100 % of EU-15 emissions are estimated with higher Tier methods.

Table 4.28 2B3 Adipic Acid Production: Information on methods applied, activity data, emission factors for N_2O emissions

Member State	Method applied	Activity data	Emission factor	1990 Activity data Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 N_2O emissions (Gg)	2007 Activity data Description	2007 Activity data (kt)	2007 Implied emission factor (t/t)	2007 N_2O emissions (Gg)
France	C	PS	PS	Adipic acid production	C	C	47.8	Adipic acid production	C	C	5.1
Germany	CS	(?)	D,PS	Adipic acid production	C	C	60.7	Adipic acid production	C	C	18.1
Italy	D	PS	PS	Adipic acid production	49	0.30	14.8	Adipic acid production	84	0.03	2.5
UK	CS	PS	CS	Adipic acid production	C	C	66.9	Adipic acid production	C	C	3.2
EU15				**EU15**			**190**	**EU15**			**29**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.29 provides a more detailed overview on methodologies and data sources used in EU-15 Member States for the estimation of emissions from adipic acid production.

Table 4.292B3 Adipic Acid Production: Summary of methodological information provided by Member States

Adipic Acid Production	
Member State	**Methodology comment**
Austria	Not occuring
Denmark	Not occuring
Finland	Not occuring
France	Emission data obtained from industry on plant level and verified with other declarations reported by the plant to other national authorities. Estimation method used by plant is provided. [NIR 2009]
Germany	Estimates are based on detailed plant-specific data since mid-90ies; before that emissions are calculated using nitric acid production and the IPCC default value. [NIR 2009]
Italy	Production and emission data obtained from industry on plant level. IPCC default EF used until 2003 because no abatement technology was installed. The decrease of N2O emissions in 2004 and 2005 is the result of the application of the BAT to reduce emission in the only existing in Italy adipic acid production plant. The technology has been applied in trial for few months both in 2004 and in 2005. The technology of catalitic decomposition of N2O was fully operative from December 2005. [NIR 2008 and additional explanation]
UK	Production data and emission estimates have been estimated based on data provided by the process operator (Invista, 2006). The emission estimates are based on the use of plant-specific emission factors for unabated flue gases, which were determined through a series of measurements on the plant, combined with plant production data and data on the proportion of flue gases that are unabated. The abatement system is a thermal oxidation unit and is reported by the operators to be 99.99% efficient at N2O destruction. In 2004 it was operational 92.6 % of the time (when compared to plant operation). Variation in the extent to which this abatement plant is operational, account for the large variations in emission factors for the adipic acid plant since 1999. A small nitric acid plant is associated with the adipic acid plant that also emits nitrous oxide. From 1994 onwards this emission is reported as nitric acid production but prior to 1994 it is included under adipic acid production. This will cause a variation in reported effective emission factor for these years. This allocation reflects the availability of data. [NIR 2009]

Table 4.30 summarizes the recommendations from the UNFCCC review of the initial report in relation to the category 2B3 Adipic Acid Production.

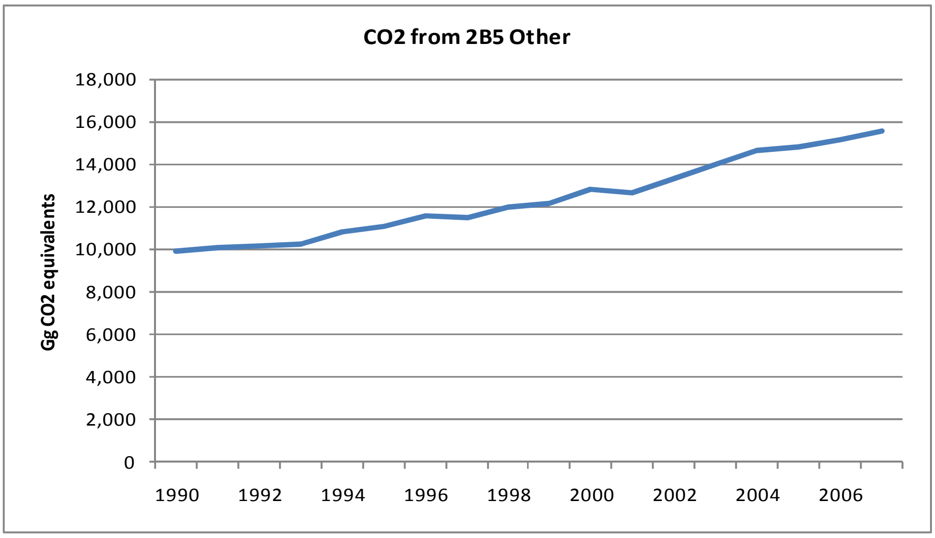
Table 4.30 **2B3 Adipic Acid Production: Findings of the 2008 UNFCCC inventory review in relation to CO_2 emissions and responses in 2009 inventory submissions**

Member State	Review findings and responses related to 2B3 Adipic Acid Production	
	Comment UNFCCC report of the review of the 2008 submission	**Status in 2009 submission**
Austria	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Belgium	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Finland	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
France	There is only one plant that produces adipic acid in France and the emissions from this plant decreased considerably between 1990 and 2006 due to a decrease in production and the installation of an emission control system. The emission estimate is based on reports from the plant and these data are confidential. In order to increase transparency, the ERT encourages France to report on how the plant estimates these emissions in its next inventory submission. (para 51)	Not yet addressed.
Germany	New findings from centralized review 2008 not yet available (if occuring).	
Greece	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Ireland	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Italy	N2O emissions decreased by 69 per cent during the period 1990-2006 because abatement technology had been installed. However, information on the technology's features, which is necessary to assess EF values, has not been provided in the NIR. In response to the ERT request made during the review, Italy explained that the efficiency and the number of hours that the abatement technology was in operation were included in the estimations. The ERT recommends that Italy demonstrate the accuracy of the EF values by providing the aforementioned information in its next annual submission. (para 42)	NIR 2009 not yet available.
Luxembourg	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Portugal	New findings from centralized review 2008 not yet available (if occuring).	
Spain	New findings from centralized review 2008 not yet available (if occuring).	
Sweden	New findings from centralized review 2008 not yet available (if occuring).	
UK	New findings from centralized review 2008 not yet available (if occuring).	

The ERT identified that the NIR does not include a section on 2B4 Carbide Production (FCCC/ARR/2008/EC, para 55). This is due to the fact that carbide production is not a key source in the sector 2 Industrial processes. An overview of Member States' methodologies, emission factors, quality estimates and emission trends is only provided in this report if identified with the key category analysis at EU-15 level.

CO_2 emissions from 2B5 Other account for 0.4 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, CO_2 emissions from this source increased by 56 % (Figure 4.9, Table 4.31). Germany is responsible for 66 % of these emissions in the EU-15. Emissions mainly increased in Germany, due to the increased production of methanol in the past and a new producer for carbon black. Additionally emissions of the conversion loss increased with further development of the production. Belgium and Finland also show increase of emissions.

Figure 4.9 **2B5 Other: EU-15 CO_2 emissions**



The noticable increase of CO_2 emissions in Finland 2006-2007 was caused by a new plant for hydrogen production. The trend in emissions CRF 2.B.5 Carbon from NEU products during 1990-2007 is dominated by emissions from the breakdown of organic chemicals contained in household consumer products (detergents) subsequent to release to sewer. The activity data used to calculate emissions are extrapolated from data for a single year using household numbers and population as proxy statistics, both of which have increased every year of the time series.

For an overview of sources included in the source 2B5 see Table 4.33

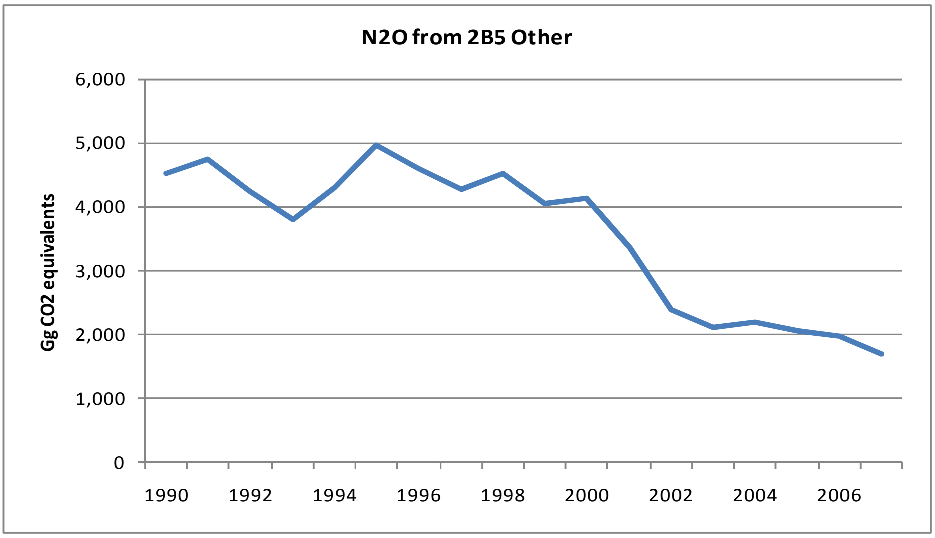
Table 4.31 2B5 Other: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	31	27	21	0.1%	-6	-22%	-10	-32%
Belgium	224	1,354	1,345	8.7%	-9	-1%	1,121	500%
Denmark	1	2	2	0.0%	0	-1%	1	170%
Finland	81	139	524	3.4%	385	276%	442	544%
France	36	43	44	0.3%	1	3%	9	24%
Germany	6,870	10,263	10,338	66.5%	75	1%	3,468	50%
Greece	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	0	-100%
Italy	475	650	660	4.2%	10	2%	185	39%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	606	646	606	3.7%	-40	-6%	1	0%
Portugal	65	131	136	0.8%	5	3%	70	108%
Spain	NA	NA	NA	-	-	-	-	-
Sweden	NA	NA	NA	-	-	-	-	-
United Kingdom	1,563	1,870	1,861	12.0%	-9	0%	298	19%
EU-15	**9,951**	**15,126**	**15,538**	**100.0%**	**412**	**3%**	**5,586**	**56%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 2B5 Other account for 0.04 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, N_2O emissions from this source decreased by 62 % (Figure 4.10, Table 4.32). Belgium, the Netherlands and France are responsible for 96 % of these emissions in the EU-15. Emission decreases in France had the most influence on the reductions in the EU-15.

Figure 4.10 2B5 Other: EU-15 N_2O emissions



Emissions in France decreased due to the installation of catalytic treatment in the glyoxylic acid production in 1999.

Table 4.32 2B5 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Belgium	372	484	541	31.9%	57	12%	169	45%
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Finland	NO	NO	NO	-	-	-	-	-
France	3,047	755	586	34.6%	-170	-22%	-2,462	-81%
Germany	293	62	62	3.7%	0	0%	-231	-79%
Greece	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Ireland	NO	NO	NO	-	-	-	-	-
Italy	11	NA,NO	NA,NO	-	-	-	-11	-100%
Luxembourg	NO	NO	NO	-	-	-	-	-
Netherlands	766	662	497	29.4%	-165	-25%	-269	-35%
Portugal	0	0	0	0.0%	0	4%	0	135%
Spain	NA	NA	NA	-	-	-	-	-
Sweden	18	9	8	0.5%	-1	-12%	-10	-56%
United Kingdom	NO	NO	NO	-	-	-	-	-
EU-15	**4,508**	**1,973**	**1,694**	**100.0%**	**-279**	**-14%**	**-2,814**	**-62%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.33 provides an overview of all sources reported under 2B5 Other Chemical Production by EU-15 Member States for the year 2007. The largest contributor to emissions is Germany with 59 %. CO_2 Emissions in Germany are dominated by the production of carbon black and methanol as well as catalytic burning and conversion loss. Country specific emission factors are based on a study from 2006 and activity data on national statistics. In the UK CO_2 emissions are due to carbon from non energy use of products. In Belgium non energy use of fuels in the chemical industry, flaring as well as the production of ethylene oxide, acrylic acid from propene, cyclohexanone from cyclo-hexane and production of paraxylene/meta-xylene are reported in this source category.

Table 4.33 2B5 Other: Overview of sources reported under this source category for 2007

Member State	2.B.5 Other Chemical Industry	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	Ethylene, Other chemical industry, CO2 from nitric acid production	20.9	0.8	NA,NO	37.0	0.2%
Belgium	Caprolactam Production, Other chemical production	1,345.1	0.0	1.7	1,886.2	10.7%
Denmark	Catalysts/Fertilizers, Pesticides and Sulphuric acid	2.2	NA,NO	NA,NO	2.2	0.0%
Finland	Hydrogen, chemicals production	523.8	NO	NO	523.8	3.0%
France	Glyoxylic acid production, Anhydrid Phtalic Production, Other chemical production	44.5	0.0	1.9	630.3	3.6%
Germany	Carbon Black, Methanol, Caprolactam, Catalytic Burning, Conversion loss, N-Dodecandiacid	10,338.1	0.0	0.2	10,400.5	59.0%
Greece	Organic chemicals production	NA,NE,NO	NA,NO	NA,NO	-	0.0%
Ireland		NO	NO	NO	-	-
Italy	Carbon Black, Ethylene, Dichloroethylene, Styrene, Titanium Dioxide Production, Propylene, Caprolactam	660.0	0.3	NA,NO	667.1	3.8%
Luxembourg		NO	NO	NO	-	-
Netherlands	Carbon Black, Ethylene, Styrene, Methanol, Graphite, Caprolactam, Other chemical industry, Carbon electrodes, Ethene oxide production	606.4	12.0	1.6	1,355.8	7.7%
Portugal	Carbon Black, Ethylene, Ammonium sulphate, Monomer and polymer production, Production of explosives	135.6	0.6	0.0	147.7	0.8%
Spain	Carbon Black, Ethylene, Styrene	NA	2.0	NA	42.9	0.2%
Sweden	Pharmaceutical industry, Other inorganic chemical production, Other organic chemical production, Base chemicals for plastic industry	NA	0.0	0.0	8.7	0.0%
UK	Ethylene, Methanol, Chemical Industry (All), Carbon from NEU products	1,861.0	3.6	NO	1,937.2	11.0%
EU-15 Total		**15,538**	**19**	**5**	**17,639**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

In reponse to the recommentation by the ERT in its review report, the methodologies for the largest emission sources in this category are provided (FCCC/ARR/2008/EC, para 53). Table 4.34 gives an overview on methodologies and data sources used in Germany, UK and Belgium for the estimation of emissions from other chemical production.

Table 4.34 2B5 Other Chemical Production: Summary of methodological information provided by Member States

Other Production	
Member State	**Methodology comment**
Belgium	Caprolactam Production: Emissions of N2O were estimated based on monitoring data provided by the only plant in Belgium. Detailed information about the plant specific emission factor and methodology could not be provided due to confidentiality reasons. [NIR 2009]
	Other chemical production include CO2 emissions from the production of e.g. ethylene oxide, acrylic acid from propene, cyclohexanone from cyclo-hexane, paraxylene/meta-xylene) the emissions from flaring in the chemical industry. Data and estimates are reported by the chemical industry. [NIR 2009]
Germany	Carbon Black: Estimation of CO2 emissions is based on IPCC default CO2-EFs from IPCC-Guidelines 2006 (Table 3.23, Furnace Black Process) and AD, which were provided by the Federal Statistical Office. [NIR 2009]
	Methanol: Estimation of CO2 emissions is based on country-specific EFs from German manufacturers and AD from production statistics of the Federal Statistical Office. [NIR 2009]
	Catalytic Burning: Estimation of CO2 emissions is based on country-specific EFs and AD from refineries. [NIR 2009]
	Conversion loss: Estimation of CO2 emissions is based on country-specific EFs and AD from German energy balance. [NIR 2009]
UK	Ethylene, Methanol, Chemical Industry (All): Chemical Industry (All): Methane emissions are reported for production of ethylene and methanol (ceased in 2001). Estimates are based on data from Pollution Inventory. For ethylene production processes in Scotland and additional data for some of the methane-emitting processes in England and Wales have been obtained from process operators and from the Scottish Pollutant Release Inventory. Data available are in the form of emission estimates, usually generated by the process operators and based on measurements or calculated based on process chemistry. [NIR 2009]

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.35 summarizes the recommendations from the 2008 UNFCCC inventory review in relation to the category 2B5 Other Chemical Production.

Table 4.35 2B5 Other Chemical Production: Findings of the 2008 UNFCCC inventory review in relation to CO_2 emissions and responses in 2009 inventory submissions

Member State	Review findings and responses related to 2B5 Other	
	Comment UNFCCC report of the review of the 2008 submission	**Status in 2009 submission**
Austria	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Belgium	The ERT concluded that the estimation of emissions from glass production is not internally consistent. The ERT established that emissions are calculated in the Walloon Region using the core inventory of air emissions (CORINAIR) EFs, whereas in the Flemish Region measurement data are used with either EU ETS data or a default value reported by the glass federation (when other company data are not available) to estimate emissions. The EF for the Flemish Region is 17 per cent lower than the highest CORINAIR EF. The ERT recommends that Belgium harmonize the methods and data used across the regions in order to maintain consistency in the national inventory. (para 55)	Not yet adressed.
Denmark	No recommendation for improvement of this source category in Intial Review Report. The review on the submission 2007 and 2008 has not been finalized.	No follow-up necessary.
Finland	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
France	N2O: Emissions from glyoxylic acid production are reported under this category. There is only one production site in France and an abatement technique is used there. The production site reports emissions. In order to increase transparency, the ERT encourages France to report on how the plant estimates these emissions in its next inventory submission. (para 52)	Not yet addressed.
Germany	New findings from centralized review 2008 not yet available (if occuring).	
Greece	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Ireland	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Italy	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Netherlands	No recommendation for improvement of this source category in Review Report.	No follow-up necessary.
Portugal	New findings from centralized review 2008 not yet available (if occuring).	
Spain	New findings from centralized review 2008 not yet available (if occuring).	
Sweden	New findings from centralized review 2008 not yet available (if occuring).	
UK	New findings from centralized review 2008 not yet available (if occuring).	

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.3 Metal production (CRF Source Category 2C) (EU-15)

Table 4.36 summarises information by Member State on total GHG emissions, CO_2, SF_6 and PFC emissions from Metal Production. Between 1990 and 2007, CO_2 emission from 2C Metal Production decreased by 5 %. The absolute decrease was largest in Germany and Italy, the absolute growth was largest in Finland. This source category includes the following key sources: CO_2 from 2C1 Iron and Steel Production, PFC from 2C3 Aluminium Production.

Table 4.36 2C Metal Production: Member States' contributions to total GHG, CO_2, PFC and SF_6 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)	PFC emissions in 1990 (Gg CO2 equivalents)	PFC emissions in 2007 (Gg CO2 equivalents)	SF_6 emissions in 1990 (Gg CO2 equivalents)	SF6 emissions in 2007 (Gg CO2 equivalents)
Austria	5,029	5,499	3,725	5,499	1,050	NO	253	NO
Belgium	1,946	1,485	1,946	1,427	-	NA,NO	-	NA
Denmark	60	0	28	NA,NO	NO	NO	31	NO
Finland	1,867	2,469	1,862	2,460	NO	NO	NO	C,NO
France	7,527	4,135	3,685	3,389	3,032	425	809	319
Germany	52,449	49,554	49,767	47,004	2,489	193	189	2,355
Greece	630	608	372	549	258	59	NA,NO	NA,NO
Ireland	NO	NO	NO	NO	NO	NO	NO	NO
Italy	5,622	2,247	3,892	1,935	1,673	200	NA,NO	54
Luxembourg	985	203	985	203	NA,NO	NA,NO	NA,NO	NA,NO
Netherlands	5,155	2,179	2,909	2,078	2,246	101	NO	NO
Portugal	16	16	16	16	NE	NO	NE	NO
Spain	4,417	4,054	3,511	3,913	883	124	NA	NA
Sweden	2,813	3,065	2,413	2,706	377	246	24	113
United Kingdom	4,096	2,916	2,309	2,658	1,333	82	426	148
EU-15	**92,611**	**78,429**	**77,420**	**73,837**	**13,341**	**1,430**	**1,732**	**2,990**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.37 provides information on the contribution of Member States to EC recalculations in CO_2 from 2C Metal production for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 4.37 2C Metal Production: Contribution of MS to EC recalculations in CO_2 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0	0	105	2	
Belgium	0	0	-22	-1	
Denmark	0	0	0	0	
Finland	0	-	-26	-	
France	0	0	0	0	
Germany	0	0	0	0	
Greece	-110	-23	2	0	
Ireland	0	0	0	0	
Italy	-91	-2	-78	-4	
Luxembourg	0	0	39	23	
Netherlands	0	0	-15	-1	
Portugal	0	0	0	0	
Spain	0	0	0	0	
Sweden	0	0	518	25	Other changes: Corrected CO2 emission in order to achive better correspondence to information in environmental reports
UK	0	0	-8	0	
EU-15	**-201**	**0**	**515**	**1**	

Table 4.38 provides information on the contribution of Member States to EC recalculations in PFC from 2C3 Aluminium production for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 4.38 2C3 Aluminium Production: Contribution of MS to EC recalculations in PFC for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006	
	Gg	Percent	Gg	Percent
Austria	0.0	0.0	0.0	0.0
Belgium	0.0	0.0	0.0	0.0
Denmark	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.0	0.0
France	0.0	0.0	0.0	0.0
Germany	0.0	0.0	0.0	0.0
Greece	0.0	0.0	0.6	0.9
Ireland	0.0	0.0	0.0	0.0
Italy	0.0	0.0	0.0	0.0
Luxembourg	0.0	0.0	0.0	0.0
Netherlands	0.0	0.0	0.0	0.0
Portugal	NE	NE	NE	0.0
Spain	0.0	0.0	0.0	0.0
Sweden	0.0	0.0	0.0	0.0
UK	0.0	0.0	5.2	4.2
EU-15	**0.0**	**0.0**	**5.8**	**0.4**

CO_2 emissions from 2C1 Iron and Steel Production account for 2% of total EU-15 GHG emissions in 2007. Germany is responsible for 68% of these emissions in the EU-15. Germany had the largest decreases in absolute terms between 1990 and 2007 while the largest increases were in Austria. Between 1990 and 2007 emissions are fluctuating. The emission trend follows mainly the emissions from Germany that are fluctuating due to varying production figures.Overall, between 1990 and 2007, CO_2 emissions from this source decreased by 5 % (Figure 4.11 and Table 4.39).

Figure 4.11 2C1 Iron and Steel Production: EU-15 CO_2 emissions

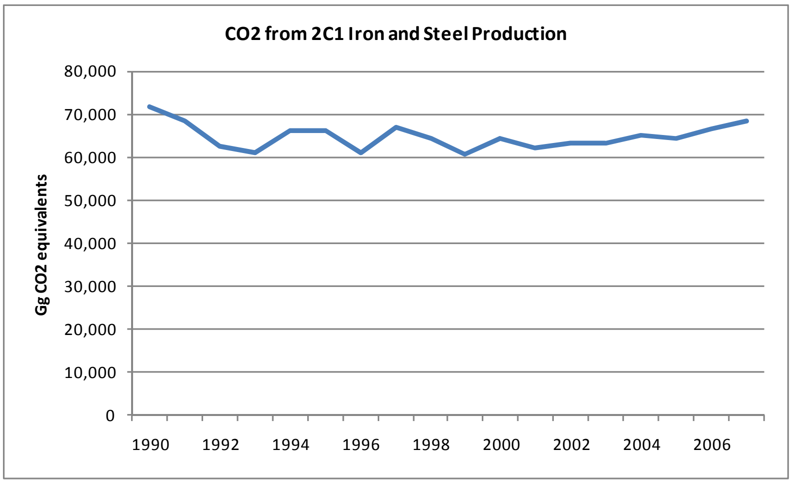


Table 4.39 2C1 Iron and Steel Production: Member States' contributions to CO_2 emissions and information on method applied, activity data and emission factor

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,546	5,193	5,482	8.0%	289	6%	1,936	55%	T2	NS,PS	CS,D
Belgium	1,946	1,597	1,427	2.1%	-170	-11%	-519	-27%	D/T3	PS	PS
Denmark	28	NA,NO	NA,NO	-	0	-	-28	-100%	T1	NS	D
Finland	1,861	2,438	2,460	3.6%	22	1%	598	32%	CS, T3	PS	PS
France	3,151	3,054	2,679	3.9%	-375	-12%	-472	-15%	C	AS/ NS	CS
Germany	48,326	44,859	46,244	67.5%	1,384	3%	-2,082	-4%	T2	NS	CS
Greece	93	222	230	0.3%	8	3%	137	148%	T3	PS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	3,124	1,562	1,483	2.2%	-79	-5%	-1,641	-53%	D	NS	C, CS, PS
Luxembourg	985	210	203	0.3%	-6	-3%	-781	-79%	CS T2	NS PS	CS
Netherlands	2,514	1,395	1,647	2.4%	252	18%	-867	-34%	T2	PS	CS
Portugal	13	13	13	0.0%	0	3%	0	-3%	T2	PS	PS
Spain	2,491	2,353	2,363	3.4%	10	0%	-128	-5%	T2	PS, AS	PS, CS
Sweden	1,813	2,091	2,179	3.2%	88	4%	366	20%	CS, T1	PS	CS, PS
United Kingdom	1,859	1,571	2,096	3.1%	525	33%	238	13%	T3	NS,AS	CS
EU-15	**71,751**	**66,558**	**68,506**	**100.0%**	**1,948**	**3%**	**-3,245**	**-5%**			

Table 4.40 shows information on activity data, emission factors for CO_2 emissions from 2C1 Iron and Steel Production for 1990 and 2007. For 2C1 Iron and Steel Production it is not useful to give an average IEF for the EU-15 because the allocation of emissions (the split between process and combustion related emissions for pig iron production, which is the most important sub category) is very different in different MS. The table and the method descriptions included in Table 4.40 suggest that for 2007 more than 90% of the reported emissions are estimated using higher tier methods.

Table 4.40 2C1 Iron and Steel Production: Information on activity data, emission factors for CO_2 emissions

Member State	1990 Activity data: Description	1990 Activity data (kt)	1990 Implied emission factor (t/t)	1990 CO2 emissions (Gg)	2007 Activity data: Description	2007 Activity data (kt)	2007 Implied emission factor (t/t)	2007 CO2 emissions (Gg)
Austria	**Iron and steel production**		**0.26**	**3546**	**Iron and steel production**		**0.32**	**5482**
	Steel Production [kt]	4291	0.11	484	Steel Production [kt]	7578	0.11	826
	Iron Production [kt]	3444	0.88	3043	Iron Production [kt]	5888	0.78	4598
	Sinter Production [kt]	4384	IE	IE	Sinter Production [kt]	3528	IE	IE
	Coke Production [kt]	1725	IE	IE	Coke Production [kt]	1	IE	IE
	Other			20	Other			58
Belgium	**Iron and steel production**		**0.05**	**1946**	**Iron and steel production**		**0.05**	**1427**
	Steel	11532	0.09	1019	Steel	11027	0.05	582
	Pig Iron	9415	0.06	546	Pig Iron	6577	0.09	618
	Sinter	13735	0.03	381	Sinter	11301	0.02	219
	Coke	1512			Coke	1270		
	Other				Other			8
Denmark	**Iron and steel production**		**0.05**	**28**	**Iron and steel production**		**NA,NO**	**NA,NO**
	Steel	614	0.05	28	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NA	Other			NA
Finland	**Iron and steel production**		**0.56**	**1861**	**Iron and steel production**		**0.46**	**2460**
	Produced steel	2861	0.65	1858	Produced steel	4431	0.55	2455
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Produced coke	487	0.001	1	Produced coke	865	0.001	1
	Other			3	Other			3
France	**Iron and steel production**		**0.10**	**3151**	**Iron and steel production**		**0.08**	**2679**
	Steel: kt Production	19073	0.09	1639	Steel: kt Production	19380	0.07	1388
	Pig Iron: kt Production	14088	0.09	1210	Pig Iron: kt Production	12426	0.08	1033
	Sinter: kt Production	IE	IE	IE	Sinter: kt Production	IE	IE	IE
	Coke: kt Production	IE	IE	IE	Coke: kt Production	IE	IE	IE
	Other			302	Other			258
	2.C.1.5.1 Rolling mills, blast furnace charging	16848	0.02	302	2.C.1.5.1 Rolling mills, blast furnace charging	18740	0.02	316
Germany	**Iron and steel production**		**0.46**	**48326**	**Iron and steel production**		**0.42**	**46244**
	Steel	43939	1.10	48326	Steel	48550	0.95	46244
	Pig Iron	32263	IE	IE	Pig Iron	31150	IE	IE
	Sinter	29869	IE	IE	Sinter	29470	IE	IE
	Coke	NE	NE	NE	Coke	NE	NE	NE
	Other			NO	Other			NO
Greece	**Iron and steel production**		**0.09**	**93**	**Iron and steel production**		**0.09**	**230**
	steel production in EAF	999	0.09	93	steel production in EAF	2555	0.09	230
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other			NO

	1990				2007			
Member State	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)	Activity data		Implied emission factor (t/t)	CO2 emissions (Gg)
	Description	(kt)			Description	(kt)		
Ireland	**Iron and steel production**		**NO**	**NO**	**Iron and steel production**		**NO**	**NO**
	Steel	NO	NO	NO	Steel	NO	NO	NO
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NO	NO	Sinter	NO	NO	NO
	Coke	NO	NO	NO	Coke	NO	NO	NO
	Other			NO	Other			NO
Italy	**Iron and steel production**		**0.05**	**3124**	**Iron and steel production**		**0.03**	**1483**
	Steel: Production	25467	0.05	1346	Steel: Production	31506	0.02	696
	Pig Iron: Production	11852	0.15	1778	Pig Iron: Production	11111	0.07	787
	Sinter: Production	13577	NA	NA	Sinter: Production	11302	NA	NA
	Coke: Production	6356	NA	NA	Coke: Production	4727	NA	NA
	Other			NA	Other			NA
Luxembourg	**Iron and steel production**		**0.09**	**985**	**Iron and steel production**		**0.07**	**203**
	steel production	3506	0.12	404	steel production	2892	0.07	203
	pig iron production	2645	0.08	200	pig iron production	NO	NO	NO
	sinter production	4804	0.08	380	sinter production	NO	NO	NO
	coke production in non-integrated plants	NO	NO	NO	coke production in non-integrated plants	NO	NO	NO
	Other			NA	Other			NA
Netherlands	**Iron and steel production**		**0.49**	**2514**	**Iron and steel production**		**0.22**	**1647**
	Crude steel production	5162	0.01	43	Crude steel production	7364	0.01	59
	Pig Iron	NO	NO	NO	Pig Iron	NO	NO	NO
	Sinter	NO	NA	NA	Sinter	NO	NA	NA
	See 1B1b	IE	IE	IE	See 1B1b	IE	IE	IE
	Other			2471	Other			1589
	Carbon input	2298	0.97	2223	Carbon input	NE	NE	1061
	Limestone equiv. use	595	0.42	249	Limestone equiv. use	NE	NE	296
Portugal	**Iron and steel production**		**0.01**	**13**	**Iron and steel production**		**0.01**	**13**
	Steel	901	0.01	12	Steel	1463	0.01	13
	Pig Iron	IE	IE	IE	Pig Iron	IE	IE	IE
	Sinter	IE	IE	IE	Sinter	IE	IE	IE
	Coke	230	0.01	2	Coke	IE	NO	NO
	Other			NO	Other			NO
Spain	**Iron and steel production**		**0.09**	**2491**	**Iron and steel production**		**0.08**	**2363**
	Steel production	13163	0.08	1041	Steel production	18979	0.08	1444
	Pig iron production	5588	0.04	246	Pig iron production	4142	0.11	458
	Sinter production	7126	0.08	538	Sinter production	5559	0.06	344
	Coke production	3211	IE	IE	Coke production	2742	IE	IE
	Other			666	Other			117
Sweden	**Iron and steel production**		**0.12**	**1813**	**Iron and steel production**		**0.09**	**2179**
	Production of secondary steel	1743	0.08	147	Production of secondary steel	1922	0.10	197
	Production of primary iron	2845	0.59	1667	Production of primary iron	3947	0.50	1982
	Sinter	10977	IE	IE	Sinter	18792	IE	IE
	Coke	IE	IE	IE	Coke	IE	IE	IE
	Other			NA	Other			NA
UK	**Iron and steel production**		**0.08**	**1859**	**Iron and steel production**		**0.11**	**2096**
	Steel Production (EAF)	4546	0.01	37	Steel Production (EAF)	3056	0.01	22
	Iron Production (blast furnace)	12463	IE	IE	Iron Production (blast furnace)	10960	IE	IE
	Sinter	NA	IE	IE	Sinter	NA	IE	IE
	Coke consumed in blast furnaces	5180	IE	IE	Coke consumed in blast furnaces	4393	IE	IE
	Other			1822	Other			2074
	Blast furnace gas flared (PJ)	7	275.67	1805	Blast furnace gas flared (PJ)	6	270.43	1536
	Steel Production (OC)	13169	0.00	17	Steel Production (OC)	11203	0.00	12

According to the IPCC methodology, processes including auto-producers - power and heat production facilities located in iron and steel plants excluding heating of coke ovens (where usually coke oven gas is combusted) and fuel combustion (gaseous fuels and coke) in sinter plants (agglomeration of iron ores) should be taken into account in 1A2a; while processes including consumption of carbonaceous reducing agents, especially in blast furnaces, oxidation of carbon contained in a pig iron or scrap and the burning off carbonaceous electrodes should be taken into account in 2C1. Additionally, emissions coming from limestone and dolomite use in iron and steel plants should be included under 2A3 and Emissions coming from heating of coke ovens should be reported under 1A1c.

However, some EU-15 Member States do not keep this boundary for different reasons (local traditions used in history and in this context an attempt to keep consistency in data series). E. g. some Member States report emission from blast furnace gas and from converter gas under 1A2a instead of under 2C1, because they interpret it as emissions form energy supply.

Thus, for an overview of EU-15 total emissions it seems to be more convenient to take into account all emissions covered by the combined category 1A2a + 2C1. Resulting emissions for the EU-15 Member States in the combined category 1A2a + 2C1 are given in Table 4.41.

Table 4.41 CO_2 Emissions of EU-15 Member States in 1A2a and 2C1 Iron and Steel

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Share 2C1
	1A2a	2C1	Combined		
	2007	2007	2007		
Austria	6,225	5,482	11,707	7.4%	47%
Belgium	8,569	1,427	9,996	6.3%	14%
Denmark	437	NA,NO	437	0.3%	0%
Finland	3,413	2,460	5,873	3.7%	42%
France	16,737	2,679	19,416	12.2%	14%
Germany	5,863	46,244	52,107	32.7%	89%
Greece	201	230	431	0.3%	53%
Ireland	2	NO	2	0.0%	NA
Italy	17,221	1,483	18,704	11.7%	8%
Luxembourg	309	203	513	0.3%	40%
Netherlands	4,524	1,647	6,171	3.9%	27%
Portugal	232	13	245	0.2%	5%
Spain	7,056	2,363	9,419	5.9%	25%
Sweden	1,215	2,179	3,394	2.1%	64%
United Kingdom	18,736	2,096	20,833	13.1%	10%
EU-15	**90,740**	**68,506**	**159,246**	**100.0%**	**43%**

It is obvious, that the ratio 2C1 / (1A2a + 2C1) entitled as “Share 2C1” differs significantly for individual Member States. Therefore, boundary between 1A2a and 2C1 is not uniformly interpreted in individual Member States. The seven Member States that are significant CO_2 emitters from iron and steel production (accounting together for 90% of EU-15) allocate emissions in the following ways:

Germany: Nearly 90% of emissions is reported under 2C1. To calculate process specific emissions the Tier 2 approach is used (using a carbon / tonne pig iron factor for the ideal blast furnace process) and emissions are subtracted from total emissions calculated by the total fuel input to obtain energy related emissions. Process emissions include furthermore electrode combustion in the electric steel production. Emissions from carbonates used in metal production are reported in sector 2C1 instead of 2A3.

United Kingdom:Major share of emissions is reported under 1A2a. Emissions from pig iron, sinter and coke production are allocated in 1A2a instead of 2C1.

France:Major share of emissions is reported under 1A2a. In the CRF tables it is specified that emissions from sinter are reported under 1A2a and emissions from coke are included in 1B1b.

Italy: Major share of emissions is reported under 1A2a. CO_2 emissions due to the consumption of coke, coal or other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector. In the sector 2C1 emissions are reported from: the carbonates used in the sinter plant and in basic oxygen furnaces to remove impurities and to the steel and pig iron scraps, instead of sector 2A3; and graphite electrodes consumed in electric arc furnaces.

Austria: About half of emissions is reported under 2C1. Process specific emissions are calculated according to the IPCC good practice guidance Tier 2 approach (using a fix percentage of coke used as reducing agent); these emissions are subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category 1A2a Iron and Steel. Emissions from sinter and coke production are included in 1A2a. Emissions from limestone and dolomite use are reported under 2A3. Process emissions include furthermore electrode combustion in the electric steel production.

Belgium: Major share of emissions is reported under 1A2a. Emissions from coke are included in the energy sector. Emissions from carbonates used in metal production are reported in sector 2C1 instead of 2A3.

Spain: About three quarters of emissions is reported under 1A2a. Emissions from coke are included in the energy sector.

Table 4.42 summarises information by Member State on methods used for estimating CO_2 emissionsfrom 2C1 Iron and Steel Production.

Table 4.42 2C1 Iron and Steel Production : Information on activity data and methods used for CO_2 emissions for 1990 and 2007

Member states	Description of methods
Austria	Total CO_2 emissions from the two main integrated iron and steel production sites in Austria are reported directly by industry until 2002. They are calculated by applying a very detailed mass balance approach for carbon. For the years 2003 and 2004 total CO_2 emissions were not reported by industry, thus they were estimated using information from the national energy balance and from the years before. For 2005 and 2006 verified CO_2 emissions, reported under the EU ETS, were taken for the inventory. These data cover CO_2 emissions from pig iron and basic oxygen furnace steel. Process specific emissions are calculated by the Umweltbundesamt according to the IPCC good practice guidance; these emissions are subtracted from total CO_2 emissions reported by the company. The remaining emissions are reported in the energy sector as emissions due to combustion in category 1 A 2 a Iron and Steel. CO_2 emissions from pig iron production were calculated following closely the IPCC GPG guidelines Tier 2 approach, applying the default emission factor of table 3.6 of the IPCC GPG. CO_2 emissions from steel production (which corresponds to steel production at the two integrated sites operating basic oxygen furnaces) were calculated following the IPCC GPG guidelines Tier 2 approach. CO_2 emissions from electric steel production were estimated using a country specific methodology. For 2005 and 2006 CO_2 emissions from non-carbonatious ore and other additives were taken into account additionally. This information became available from background data reported under the ETS. Again it has to be stressed that this additional accounting does not affect total CO_2 emissions, but only improves the accuracy of the split made between process and combustion specific emissions.
Belgium	In Flanders, the calculation of the process CO_2 emissions from iron and steel production is based on the production figures of fluid steel and pig iron and on the consumption of electrodes of the two biggest industrial plants in this sector and with an emission factor approved by these plants (% carbon blown off in the convertor (1,11 to 1,17%)and an emission factor of 158 kg CO_2/ton pig iron). Total emissions of CO_2 in the iron and steel sector are estimated in the Flemish region on the basis of a complete C-balance of the biggest company involved (emissions of energy and process) in combination with energy and process data of the other (smaller) companies. The process emissions of the biggest company are put in this category 2C, the energy emissions (total minus process) are included in category 1A2a. Emissions of production of cokes are separately put in category 1A1c. See also section 3.2.3 in this context. In the Walloon region, iron is produced through the reduction of iron oxides (ore) with metallurgical coke (as the reducing agent) in a blast furnace to produce pig iron. Steel is made from pig iron and/or scrap steel using electric arc or basic oxygen. The emission estimates in this sub-sector include also emissions from the production of steel in basic oxygen type furnaces but not the emissions from the combustion of the fuel. Until 2004, the emission factors in the basic oxygen furnace steel plant are used as indicated in table 4.5.The plants approved these emission factors.Until 2002, 100 % of the CO_2 in the pig iron produced in the blast furnace has been estimated to be emitted in the basic oxygen furnace due to the lack of data's (purchased pig iron, C in steel produced, C in steel scrap).
Denmark	The CO_2 emission from the consumption of metallurgical coke at steelworks has been estimated from the annual production of steel sheets and steel bars combined with the consumption of metallurgical coke per produced amount (Stålvalseværket, 2002). The carbon source is assumed to be coke and all the carbon is assumed to be converted to CO_2 as the carbon content in the products is assumed to be the same as in the iron scrap. The emission factor (3.6 tonnes CO_2/ton metallurgical coke) is based on values in the IPCC-guideline (IPCC (1996), vol. 3, p. 2.26). Emissions of CO_2 for 1990-1991 and for 1993 have been determined with extrapolation and interpolation, respectively.
Finland	The calculation method of CO_2 emission from iron and steel industry is country specific. Both fuel based emissions and process emissions are calculated in connection with the ILMARI calculation system (see chapter 3.2 Emissions from fuel combustion) using plant/process level (bottom-up) data. The methodology is slightly plant-specific, because all plants are different from each other. The main common feature for all plants is, that fuel-based emissions for each installation are calculated in ILMARI system from the use of fuels, excluding coke and heavy bottom oil used in blast furnaces, and subtracted from total CO_2 emissions (described below). Fuel-based emissions are allocated to CRF 1A 2a and CRF1A 1c (coke ovens) The rest of emissions are allocated to process emissions in CRF 2C 1 (and CRF 2.A 1 in the case of lime kilns). Total CO_2 emissions for each installation (coke oven, sinter plant, blast furnace, lime kiln, steel converter, rolling mills, power plants/boilers) in each plant are mostly taken from VAHTI database. These emissions are basically

Member states	Description of methods
	calculated by plant operators using carbon inputs (fuel inputs and reducing materials) and they are reported by installations separately. From 2005 on, all four iron and steel plants in Finland report to the ETS. Starting from 2007 submission, the total CO_2 emissions for GHG inventory have been taken from the ETS data, although the split between process and fuel-based emissions has been done in the same way as in the previous years' calculation.
France	Country specific based on carbon mass balance approach Data sources: Annual pollutant emission reports; French Iron Association.
Germany	Because it is difficult to differentiate between process-related and energy-related emissions in oxygen steel production, the following actions are taken: 1. All of the CO_2 emissions resulting from use of reducing agents and fuels are calculated, 2. Process-related CO_2 emissions are determined from the carbon requirements for the ideal blast-furnace process and from limestone inputs in pig iron production, and CO_2 emissions are determined from electrode consumption in electric steel production. 3. Then, the determined emissions are aggregated and allocated to the total processrelated and energy-related CO_2 emissions from iron and steel production (2.C.1 and 1.A.2.a). This approach rules out the possibility of any double-counting, and it simplifies the process of summing up all carbon inputs and outputs. For determination of total CO_2 emissions from inputs of reducing agents and fuel, pig-iron and oxygen-steel production are considered in one step. CO_2 emissions from reducing agents are determined in keeping with Tier 2 of the IPCC GPG (2000). Since, consistently, about 97% of the pig iron produced in Germany is processed into oxygen steel, in a modified Tier 2 approach, separate carbon balancing for pig iron production (blast furnace) and oxygen steel works is unnecessary. CO_2 emissions from limestone use are determined in accordance with Tier 1. CO_2 emissions from electrode consumption in electric steel production are calculated from quantities of produced electric steel, via a standard factor for electrode consumption (1.3 kg C per tonne of electric steel), and via a stoichiometric factor (3.667 t CO/t C).
Greece	Steel production in Greece is based on the use of electric arc furnaces (EAF). There are no integrated iron and steel plants for primary production as no units for primary production of iron exist, but there are several iron and steel foundries. The methodology used for the estimation of emissions is based on tracked carbon oxidation throughout the production processes in electric arc furnace operation.
Ireland	NO
Italy	CO_2 emissions from iron and steel production refer to the carbonates used in sinter plants, in blast furnaces and in steel making plants to remove impurities; they are also related to the steel and pig iron scraps, and graphite electrodes consumed in electric arc furnaces. Basic information for this sector derives from different sources in the period 1990-2007. Activity data are supplied by official statistics published in the national statistics yearbook (ISTAT, several years) and by the sectoral industrial association (FEDERACCIAI, several years). For the integrated plants, emission and production data have been communicated by the two largest plants for the years 1990-1995 in the framework of the CORINAIR emission inventory, distinguished by sinter, blast furnace and BOF, and by combustion and processes emissions. From 2000 CO_2 emission and production data have been supplied by all the plants in the framework of the ETS scheme, for the years 2000-2004 disaggregated for sinter, blast furnace and BOF plants, from 2005 specifying carbonates and fuels consumption and related CO_2 emissions. For 2002-2006 data have also been supplied by all the four integrated iron and steel plants in the framework of the European EPER registry not distinguished for combustion and processes. Qualitative information and documentation available on the plants allowed us to reconstruct their history including closures or modifications of part of the plants; additional qualitative information regarding the plants collected and checked for other environmental issues or directly asked to the plant allowed us to individuate the main driving of the emission trends for pig iron and steel productions. Time series of carbonates used in basic oxygen furnaces have been reconstructed on the basis of the above mentioned information resulting in no emissions in the last years. Indeed, as regards the largest Italian producer of pig iron and steel, lime production has increased significantly from 2000 to 2007 by about 250,000 over 370,000 tonnes and the amount introduced in basic oxygen furnaces was, in 2004, about 490,000t (ILVA, 2006). Concerning the electric arc furnaces, additional information on the consumption of scraps, pig iron, graphite and electrodes and their average carbon content have been supplied together with the steel production by industry for a typical plant in 2004 (FEDERACCIAI, 2004) and checked with other sectoral study (APAT, 2003). On the basis of these figures an average emission factor has been calculated. CO_2 emissions due to the consumption of coke, coal or other reducing agents used in the iron and steel industry have been accounted for as fuel consumption and reported in the energy sector, including fuel consumption of derived gases.
Luxembourg	Sinter Plant (SP): The emissions in 1990 are calculated from the mass of carbon in the ore. It is therefore a country specific methodology. The data were collected directly from the operator. Blast furnace (BF) and basic oxygen furnace steel production (BOF): The 2000 IPCC-GPG Tier 2 methodology is applied for calculating the emissions in 1990. The emissions from iron production in BF and from steel production in BOF are calculated separately based on a carbon balance over the production processes. Electric arc furnace steel production (EAF): The 2000 IPCC-GPG Tier 2 methodology has been applied for calculating the emissions from the year 2004 onward. The emissions are calculated based on a carbon balance over the production process. [NIR 2008]
Netherlands	CO_2 emissions are estimated using a Tier 2 IPCC method and country-specific carbon contents of the fuels. Carbon losses are calculated from coke and coal input used as reducing agent in blast and oxygen furnaces , including other carbon sources such as limestone and the carbon contents in the iron ore (corrected for the fraction that ultimately remains in the steel produced). Only the net carbon losses are reported in category 2C1. The carbon contained in the blast furnace gas and oxygen furnace gas produced as by-products and subsequently used as fuels for energy purposes is subtracted from the carbon balance and is included in the Energy sector (1A1a and 1A2a, see *Sections 3.2.2 and 3.2.3*).
Portugal	Emissions are simply calculated from multiplication of activity levels by a suitable emission factor. To avoid double counting, carbon dioxide emissions in coquerie and blast furnace, from oxidation of the carbon that was used as a reducing agent were not estimated from steel or coke production data but simply from use of coke derivative fuels (coke gas and blast furnace gas) in all combustion equipments. Methodology to estimate

Member states	Description of methods
	emissions from combustion of coke gas and blast furnace gas were already discussed in chapter 3.2A – Energy Industries and emissions are included in source sector 1A.2 - manufacturing industries and construction - and 1A.1.c.1 - Manufacture of Solid Fuels. Emissions factors for production process where set mostly from CORINAIR/EMEP also with contributions from IPCC96 and US-EPA AP42. The CO_2 emission factors for Electric Arc Furnace, and that were used for each one of the two iron and steel plants that are included in the European Union Emission Trading Scheme (EU-ETS), were determined from consumption of carbon bearing materials in these units: limestone, calcium carbide and coke for years 2002 and 2003. It was assumed that the same carbon content exists in both scrap and final steel produced in EAF furnaces and consequently no additional emissions are estimated apart from carbon in additives.
Spain	La estimación de las emisiones de CO_2 en los procesos de fabricación de sínter, arrabio y acero se ha realizado utilizando el método de nivel 2 de IPCC según el cual se rastrea el carbono a través del proceso de producción, evitándose de esta manera la contabilidad por partida doble de las emisiones. La elección de este método ha sido posible debido a que se ha podido disponer de balances de masa de carbono en las materias de entrada y salida correspondientes para cada uno de los procesos encuadrados dentro de esta categoría, tal y como se describe más adelante en este mismo apartado, con distinción entre las tecnologías utilizadas en la fabricación de acero (acerías eléctricas vs acerías de oxígeno básico), dadas las diferencias sustanciales en cuanto a la tecnología y las materias primas utilizadas. En cuanto a las antorchas, la estimación de las emisiones de CO_2 se basa en el contenido de carbono de cada gas incinerado y en los factores de oxidación, tal y como se detalla más adelante en este mismo epígrafe.
Sweden	Generally emissions from combustion of conventional fuels such as residual fuel oil etc. are reported in CRF 1A2a and fuels acting as reducing agents are reported in CRF 2C1. Steel: The emissions include secondary steel plants using reducing agents such as coke, coal and electrodes in electric arc furnaces. In most cases data from the Swedish inquiry for the Swedish national allocation plan (NAP) for the EU emissions trading scheme could be used for the years 1998-2002. Data for remaining years (1990-1997 and 2003-2004) has been collected directly from the plants. From 2005, the equivalent data are acquired from the ETS, environmental reports and through contacts with the companies. The Good Practice Guidance method Tier 1 has been used for six of the plants. The Tier 1 method include plant-specific activity data only on carbon-containing input materials since data on outgoing carbon in produced steel and residual products is not available. For these plants, plant specific emission factors for CO_2 were used for all years to get as accurate emission estimates as possible. For the three remaining plants (two from 2004 and onwards), activity data on reducing agents and emissions are not available for all years. Instead plant specific methods are applied, where activity data on steel production has been used to estimate the emissions for 1990-1997 for two plants and for 1990-2006 for the third plant. Iron powder: In Sweden there is one producer of iron ore based iron powder. The emissions of CO_2 are calculated by using the Good Practice Guidance method Tier 2. The method includes plant specific activity data on emissions from carbon-containing input materials such as coke and anthracite and also specific carbon-contents of output iron and rest products for all years. Pig iron: Another way to make the correct calculations of process emissions from blast furnaces, as Sweden has done, is to base the calculations on the consumed amount of blast furnace gas, as all emissions from the blast furnace are collected in this gas and emitted when combusting it. The amount of blast furnace gas is used in the cowpers as activity data when calculating all emissions. Emissions are calculated as the product of fuel consumption, thermal value and emission factors (EF) in the same way as in the Energy sector.
United Kingdom	The methodology for the prediction of carbon dioxide emissions from fuel combustion, fuel transformation, and processes at integrated steelworks is based on a detailed carbon balance (this methodology is described in more detail within the section on CRF sector 1A2a).Carbon emissions from electric arc furnaces are calculated using an emission factor provided by Corus (2005)

Source: NIR 2009 unless stated otherwise

Table 4.43 summarizes the recommendations from the latest UNFCCC review of the inventory report in relation to the category 2C1 Iron and Steel Production. The overview shows that most recommendations could be implemented.

Table 4.43 2C1 Iron and Steel Production : Findings of the latest UNFCCC review of the inventory report in relation to CO_2 emissions and responses in 2009 inventory submissions

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment in the latest UNFCCC review report	Status in 2009 submission
Austria	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Belgium	The ERT noted that Belgium, and more specifically the Walloon Region, has reported CO_2 emissions data obtained from reporting under the European Union Emissions Trading Scheme (EU ETS) since 2005, but a tier 2 method that used CO_2 EFs was reported for the period 1990-2004. This may affect time-series consistency. The ERT recommends that Belgium provide information on and an explanation for the time-series consistency of this emission estimate in its next annual submission. The ERT noted that CO_2 emissions from sinter production are not reported consistently between the regions. In the Walloon Region, these emissions are attributed to steel, whereas in the Flemish Region these emissions are attributed to iron and steel under the energy sector. The ERT recommends that Belgium harmonize its reporting of emissions from sinter production in its next annual submission.	Resolved; More information on time-series is included in the NIR Partly resolved; the NIR states: Because different approaches approved by the different companies involved (a.o. based on historical background) it is not possible to harmonize these methodologies completely between the regions.

Member State	Review findings and responses related to 2.C.1 Iron and Steel Production	
	Comment in the latest UNFCCC review report	Status in 2009 submission
Denmark	However, the ERT found that “NE” should be also used for this category, because Denmark stated in the NIR that the CO_2 emissions from iron foundries have not yet been included and that it hopes to investigate and include them in the future. The ERT welcomes Denmark’s plan to include this source, and recommends that Denmark make efforts to carry out this plan, or otherwise report this category as “NE” in the next annual submission. During the review, Denmark informed the ERT that the use of notation keys would be corrected in the next submission and work on establishing the EF for CO_2 from iron foundries is currently being undertaken, the results of which are planned to be included in the 2010 submission.	Not resolved; improvements planned for 2010 submission.
Finland	The ERT noted that the VAHTI system was not complete and that some corrections were made in estimating total CO_2 emissions. Finland assessed the total CO_2 emissions estimated by the VHATI system as being almost accurate and informed the ERT that more detailed information would require publishing confidential plant level calculations. The ERT recommends that Finland provide relevant verification data, to the extent possible, to demonstrate the accuracy of CO_2 emissions from iron and steel production.	Partly resolved; A discussion is included in the NIR
France	The ERT noted that the description of the method used for this category in the OMINEA report is not transparent and that it presents the EFs in kg CO_2/Mg iron or steel, which is not in line with the IPCC good practice guidance. During the review, the Party explained that the emissions are estimated on the basis of coke consumption and the Party explained that the EF for CO_2 emissions based on iron and steel production has been recalculated for information purposes. The ERT recommends that France indicate this more clearly in its next inventory submission.	Partly resolved; A description is included in the Annex of the NIR
Germany	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Greece	The aggregate country-specific CO_2 EF was estimated to be 0.242 t/t steel in 2006 compared with the 1990 value of 0.203, that represents a 19.2 per cent potential underestimation of the base year emission. Greece is encouraged to use the EU ETS reports to determine the fraction of total carbon consumption used for the estimation of emissions accounted as residual carbon in slag. If this fraction is found not to be significant, Greece could consider using the CO_2 IEF for 2005-2007 for the estimation of the entire time series.	Resolved; Greece recalculated the time-series according to the ERT's recommendation.
Ireland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Italy	The IEF for CO_2 from iron and steel production decreased significantly during the period 1990-2006. In response to the ERT request made during the review, Italy explained that this is due to the use of lime in iron and steel production and provided a description of this use. The ERT acknowledged that data used in its estimations were supplied from many data sources and recommends that Italy explain in detail its data collection, data verification, and QA/QC procedures in its next annual submission.	Partly resolved; further information on data collection, but not on data verification, and QA/QC procedures has been included in NIR 2009.
Luxembourg	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Netherlands	The ERT recommends that the Netherlands improve the documentation in the NIR on the methodology, calculations, allocation to other sectors and underlying assumptions for the emissions from this category.	Resolved; methodology, calculation and allocation is described in NIR 2009.
Portugal	No recommendation for improvement for this source category in the report of the review of the initial report. [IRR]	No follow-up necessary
Spain	Spain intends to carry out further investigations and reviews in collaboration with the relevant industrial associations in order to improve the carbon balance and its estimates of industrial process emissions in electrical furnaces. Spain is encouraged to continue its efforts to improve these emission estimates and the allocation of non-energy emissions in the industrial process sector in its next annual inventory submission.	Not resolved; part of the planned improvements.
Sweden	In response to comments by the ERT, Sweden agreed that the data and methodology for estimating CO_2 emissions from iron and steel production need to be revised. Sweden is planning to carry out such revisions after considering the conclusions of a study made by the Swedish EPA in 2008, and plans to submit revised estimates in 2010. The ERT welcomes these proposed revisions and recommends that Sweden provide in its next submission a detailed and transparent description of the CO_2 emission calculation, including the tracking of carbon flow through the process.	Not resolved; part of the planned improvements.
UK	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary

Sources: Review Report 2008 unless stated otherwise; NIR 2009 unless stated otherwise

Table 4.44 summarise information by Member State on emission trends, methodologies, activity data and emission factors for the key source PFCs from 2C3 Aluminium Production. PFC emissions from 2C3 Aluminium production account for 0.04 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, PFC emissions from this source decreased by 89 % (Figure 4.12). France, Germany, Italy and Sweden are responsible for 74 % of these emissions in the EU-15. All Member States reduced their emissions from this source between 1990 and 2007. France, Germany and the Netherlands had the largest decreases in absolute terms. The decreasing trend of PFC emissions from this key source between 1990 and 2007 is due to production stop (AT, 90-92) or decline (DE, ES) and due to process improvements (FR, DE, ES, NL). The peak in 2002 is due to technologigal changes and not well optimized operations (NL, FR).

Figure 4.12 2C3 Aluminium Production: EU-15 PFC emissions

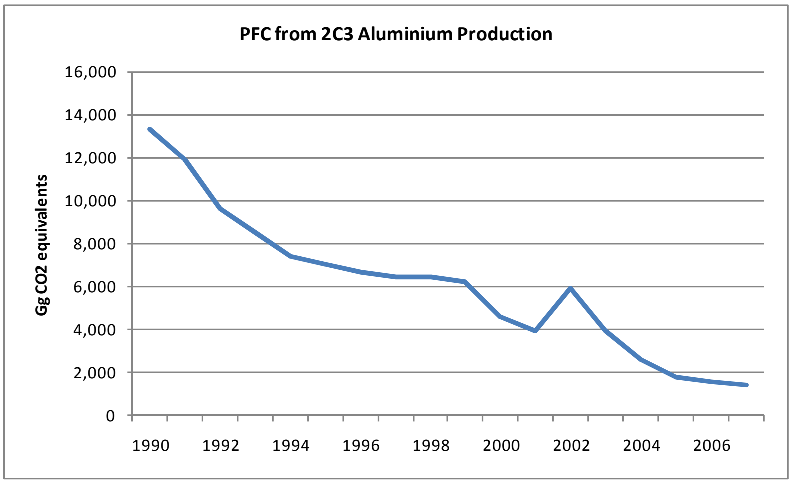


Table 4.44 2C3 Aluminium Production: Member States' contributions to PFC emissions and information on method applied, activity data and emission factor

Member State	PFC emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1,050	NO	NO	-	-	-	-1,050	-100%	T3b	NS	PS
Belgium	0	0	NO	-	-	-	-	-	NA	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Finland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	3,032	586	425	29.7%	-161	-28%	-2,607	-86%	C	NS	PS
Germany	2,489	188	193	13.5%	5	3%	-2,296	-92%	T3	AS/PS	CS
Greece	258	71	59	4.1%	-12	-18%	-199	-77%	T3	PS	PS
Ireland	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Italy	1,673	154	200	14.0%	46	30%	-1,473	-88%	T1, T2	PS	PS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	2,246	62	101	7.1%	39	63%	-2,145	-95%	T1a	PS	CS
Portugal	NE	NO	NO	-	-	-	-	-	NA	NA	NA
Spain	883	134	124	8.7%	-11	-8%	-759	-86%	T2	PS	PS
Sweden	377	244	246	17.2%	2	1%	-131	-35%	T2	PS	CS
United Kingdom	1,333	128	82	5.7%	-47	-36%	-1,251	-94%	CS	NS	CS, PS
EU-15	**13,341**	**1,568**	**1,430**	**100.0%**	**-139**	**-9%**	**-11,911**	**-89%**			

Table 4.45 shows information on activity data and emission factors for PFC emissions from 2C Metal Production for 1990 to 2007. The table shows that in 2007 aluminium production was reported by all MS as activity data; for some MS this information is confidential. The implied emission factors for CF_4 per tonne of aluminium produced vary for 2006 between 0.03 kg/t for the Uk and 0.36 kg/t for Sweden. The EU-15 IEF (excluding Greece) is 0.08 kg/t. The implied emission factors for C_2F_6 per tonne of aluminium produced vary for 2007 between less than 0.01 kg/t for Germany and the UK and 0.03 kg/t for France. The EU-15 IEF (excluding Greece) is 0.01 kg/t. The table suggests that for 2007 all reported emissions are estimated using higher tier methods (based on plant specific data). For 1990 Italy used a T1 approach to estimate emissions. The EU-15 IEFs generally decrease due to reduced

durations and frequencies of the anode effects.

Table 4.45 2C Metal Production: Information on methods applied, activity data, emission factors for PFC emissions

Member State	Method applied	Activity data	Emission factor	Gas	1990				2007			
					Activity data		Implied emission factor (kg/t)	Emissions (t)	Activity data		Implied emission factor (kg/t)	Emissions (t)
					Description	(kt)			Description	(kt)		
Austria	T3b	NS	PS	CF_4	Aluminium production	88	1.56	137	Aluminium production	NO	NO	NO
				C_2F_6	Aluminium production	88	0.19	17	Aluminium production	NO	NO	NO
France	C	NS	PS	CF_4	Aluminium production	326	1.13	369	Aluminium production	427	0.11	49
				C_2F_6	Aluminium production	326	0.21	69	Aluminium production	427	0.03	12
Germany	T3	AS/PS	CS	CF_4	Aluminium production	740	0.45	336	Aluminium production	554	0.05	26
				C_2F_6	Aluminium production	740	0.05	34	Aluminium production	554	0.00	3
Greece	T3	PS	PS	CF_4	Aluminium production	C	C	35	Aluminium production	C	C	8
				C_2F_6	Aluminium production	C	C	3	Aluminium production	C	C	1
Italy	T1, T2	PS	PS	CF_4	Aluminium production	232	0.86	198	Aluminium production	180	0.15	26
				C_2F_6	Aluminium production	232	0.18	42	Aluminium production	180	0.02	3
Netherlands	T1a	PS	CS	CF_4	Aluminium production	272	1.02	277	Aluminium production	297	0.04	13
				C_2F_6	Aluminium production	272	0.18	48	Aluminium production	297	0.01	2
Spain	T2	PS	PS	CF_4	Aluminium production	355	0.34	122	Aluminium production	405	0.04	18
				C_2F_6	Aluminium production	355	0.03	10	Aluminium production	405	0.003	1
Sweden	T2	PS	CS	CF_4	Aluminium production	96	0.56	54	Aluminium production	100	0.36	36
				C_2F_6	Aluminium production	96	0.03	3	Aluminium production	100	0.02	2
UK	CS	NS	CS, PS	CF_4	Aluminium production	290	0.60	174	Aluminium production	365	0.03	11
				C_2F_6	Aluminium production	290	0.08	22	Aluminium production	365	0.00	1
EU-15				**CF_4**	**EU-15 w/o GR (98%)**	**2399**	**0.69**	**1667**	**EU-15 w/o GR (96%)**	**2327**	**0.08**	**178**
				C_2F_6	**EU-15 w/o GR (99%)**	**2399**	**0.10**	**244**	**EU-15 w/o GR (97%)**	**2327**	**0.01**	**23**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.46 2C3 Aluminium Production: Description of national methods used for estimating PFC emissions

Member States	**Description of methods**
Austria	PFC emissions were estimated using the IPCC Tier 3b methodology. The specific CF4 emissions (and C2F6 emissions respectively) of the anode effect were calculated by applying the following formula (BARBER 1996), (GIBBS & JACOBS 1996), (TABERAUX 1996): kg CF4/tAl = (1.7 x AE/pot/day x F x AEmin)/CE For the aluminium production in Austria the rate of C2F6 is about 8% and the current efficiency (CE) about 85.4%. Activity data were taken from national statistics (1990 to 1992). Primary aluminium production in Austria was terminated in 1992.
Belgium	NO
Denmark	NO
Finland	NO
France	Deux types de technologies sont employées sur les sites, la plus ancienne, dénommée SWPB correspondant à une alimentation mécanisée sur les côtés des cuves, et la plus récente, dénommée PFPB correspondant à une alimentation ponctuelle automatique au centre de la cuve. Emission declarations from plants are used that follow a tier 2 approach .
Germany	The production figures for the year 2007 were taken from the aluminium-industry monitoring report for the year 2007 [GDA, 2008]. Emission data is available for PFC emissions from primary aluminium foundries, thanks to a voluntary commitment on the part of the aluminium industry. Since 1997, the aluminium industry has reported annually on the development of PFC emissions from this sector. The measurement data is not published, but it is made available to the Federal Environmental Agency. The measurements conducted in all German smelters in the years 1996 and 2001 form the basis for calculation of CF4 emissions. In this context, specific CF4 emission factors per anode effect were calculated, in keeping with the technology used. The number of anode effects is recorded and documented in the smelters. The total CF4 emissions were calculated by multiplying the total anode effects for the year by the specific CF4 emissions per anode effect determined in 2001. The total emission factor for CF4 is obtained by adding the CF4 emissions of the smelters and then dividing the sum by the total aluminium production of the smelters. C2F6 and CF4 occur in a constant ratio of about 1:10. The above-described method was applied to the entire time series, and the emissions for the years 1990 to 1996 were filled in via recalculations.
Greece	PFC emissions estimates are based on measurements data made by the aluminium industry according to the PESHINEY methodology (Tier 3b methodology, IPCC 2000).
Ireland	NO
Italy	For the estimation of PFC emissions from aluminium production, both IPCC Tier 1 and Tier 2 methods are used. These emissions, specifically CF4 and C2F6, have been calculated on the basis of information provided by national statistics (ENIRISORSE, several years; ASSOMET, several years) and the national primary aluminium producer (ALCOA, several years),, with reference to the document drawn up by the International Aluminium Institute (IAI, 2003) and the IPCC Good Practice Guidance (IPCC, 2000). The Tier 1 has been used to calculate PFC emissions relating to the entire period 1990-1999. From the year 2000, the more accurate Tier 2 method has been followed, based on default technology specific slope and overvoltage coefficients. Regarding the Tier 1 methodology, the emission factors for CF4 and C2F6 were provided, whereas for the Tier 2 site-specific values and, where they were not available, default coefficients were provided (ALCOA, 2004).

Member States	Description of methods
Luxembourg	NO
Netherlands	PFC emissions from primary aluminium production reported by the two facilities are based on the IPCC Tier 2 method for the complete period 1990-2007. Emission factors are plant specific and are based on measured data.
Portugal	NO
Spain	Para el cálculo de las emisiones de PFC, se ha optado por utilizar el método de nivel 2 referido en la Guía de Buenas Prácticas 2000 IPCC en el epígrafe 3.3 (ecuación 3.10 y Box 3.3 "Tabereaux approach"). Para la aplicación de la fórmula anterior se han utilizado los valores por defecto de la variable "pendiente" (slope = 1,698 (p/CE)) de la Guía de Buenas Prácticas 2000 IPCC (epígrafe 3.3.1, tabla 3.9), y de la información sobre las variables "AEF" y "AED" facilitadas por las plantas productoras mediante un cuestionario específico diseñado al efecto, distinguiendo por planta y series el método de fabricación seguido (ánodos precocidos picado lateral o central y proceso Söderberg de agujas verticales). Dentro de cada serie se recibe información del número de efectos ánodos por cuba y día y de la duración en minutes del efecto ánodo.
Sweden	Tier 2: Activity data used for the PFC emission calculations, anode effects in min/oven day and production statistics, were provided by the company, and specified for the Prebaked and Söderberg processes.
United Kingdom	The estimates were based on actual emissions data provided by the aluminium-smelting sector. There are two main aluminium smelting operators in the UK. One operator uses a Tier 2 methodology Smelter-specific relationship between emissions and operating parameters based on default technology-based slope and over-voltage coefficients, using the default factors for the CWPB (Centre Worked Prebaked) plant. The other operator uses a Tier 3b methodology (as outlined in the IPCC guidance) Smelter-specific relationship between emissions and operating parameters based on field measurements. Emissions estimates were based on input parameters, including frequency and duration of anode effects, and number of cells operating. Emission factors were then used to derive the type of PFC produced. All emissions occur during manufacturing. These emissions were provided directly by the operators.

Source: NIR 2009 unless stated otherwise

Table 4.47 summarizes the recommendations from the latest UNFCCC review of the inventory report in relation to the category 2C3 Aluminium Production. The overview shows that few recommendations were made, and some could be implemented.

Table 4.47 2C3 Aluminium Production: Findings of the latest UNFCCC review of the inventory report in relation to PFC emissions and responses in 2009 inventory submissions

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	Status in 2009 submission
Austria	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Belgium	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Denmark	No recommendation for improvement for this source category in the report of the review of the initial report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
France	Primary aluminium is only produced by one plant in France. The estimation of emissions is based on reports from the plant, which follow a tier 2 approach. According to the OMINEA report, the EFs for tetrafluoromethane (CF4) and hexafluoroethane (C2F6) have decreased from 1,131 g CF4/t aluminium to 150 g CF4/t aluminium and from 212 g C2F6/t aluminium to 37 g C2F6/t aluminium between 1990 and 2006, respectively. It remained unclear to the ERT whether or not a QA/QC process was in place. The ERT recommends that France apply QA/QC procedures to the plant-level data and that it report them in line with the UNFCCC reporting guidelines in its next inventory submission.	Partly resolved; the NIR includes that the emission declarations are verified by the local authorities (DRIRE) and validated by the Ministry of Environment.
Germany	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Greece	The ERT concludes that the considerable variations in the reported PFC emissions from this category require plant-level QA/QC to verify the trend. The ERT recommends that Greece endeavour to obtain information on the functioning or otherwise of the anode effect termination system in place for the control of PFCs as a means of verifying these variations.	Not resolved; no information on QA/QC activities is included in the NIR 2009.
Ireland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Italy	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Luxembourg	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary

Member State	Review findings and responses related to 2.C.3 Aluminium Production	
	Comment in the latest UNFCCC review report	Status in 2009 submission
Netherlands	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Portugal	No recommendation for improvement for this source category in the report of the review of the initial report. [IRR]	No follow-up necessary
Spain	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Sweden	Sweden is encouraged to continue using the tier 2 approach of the IPCC good practice guidance methodology in future emission estimates.	Resolved; Tier 2 approach used for latest emission estimates.
UK	The ERT commends the United Kingdom's plan to use for the more recent years the more detailed data which has recently become available. The ERT recommends that the United Kingdom document the recalculations transparently in the CRF as well as in the NIR. The ERT also recommends that documentation be included in the NIR explaining how time-series consistency has been maintained following the introduction of the new data source that replaces the Pollution Inventory.	Not resolved; no documentation on how time-series consistency is maintained is included

Sources: Review Report 2008 unless stated otherwise; NIR 2009 unless stated otherwise

Table 4.48 summarise information by Member State on emission trends and methodologies for the source category SF_6 from 2C Metal Production.

Table 4.48 2C-Aluminium and Magnesium Foundries: Description of national methods used for estimating SF_6 emissions

Member states	Description of methods
Austria	Emissions were estimated following the IPCC methodology using annual consumption data of SF_6. Information about the amount of SF_6 used was obtained directly from the aluminium and mag-nesium producers in Austria and thus represents plant-specific data (for verification data was checked against data from SF_6 suppliers). Actual emissions of SF_6 equal potential emissions and correspond to the annual consumption of SF_6.
Belgium	NO
Denmark	The emission of SF_6 has been decreasing in recent years due to the fact that activities under Magnesium Foundry no longer exist
Finland	Direct reporting method, Tier 1a. Tier 1b is not applicable to this category because all SF_6 used is imported in bulk. Emissions from this source are not reported separately due to confidentiality (Included in 2 F).
France	Les émissions de SF_6 sont déterminées par bilan matière à partir de l'estimation des consommations annuelles et de certaines informations communiquées par les industriels. Les quantités consommées sont considérées totalement relarguées à l'atmosphère.
Germany	Aluminium production: All of the SF_6 used in Germany to purify molten aluminium is emitted completely upon use (consumption = emission; EF = 1). The practice of assuming the equivalence between consumption (AR) and emissions conforms to the IPCC method (IPCC, 1996a: 2.34). SF_6 consumption was determined via direct surveys, regarding sales, of the few providers of the SF_6-containing gas mixture. The survey for the report year 2000 revealed that the gas mixture has no longer been sold since 2000. For the report year 2002, a first survey of gas providers' SF_6 sales figures was carried out, and these figures were compared with data obtained from a first survey of amounts consumed by industry. This made it possible to identify SF_6 users, in the area of aluminium casting, who use pure SF_6. Since 2002, annual surveys have been conducted of sales figures relative to the application "aluminium casting". Magnesium production: To date, SF_6-input quantities have been determined via direct surveys of foundries' annual consumption levels. This year, thusly determined input data were cross-checked for the first time against sales quantities as determined via surveys of gas sellers in this sector. The described procedure has been applied to all report years other than 1996 and 1999, for which lacking yearly data was obtained via interpolation. Good agreement was found, and thus in future only gas sellers will be surveyed
Greece	NO
Ireland	NO
Italy	For SF6 used in magnesium foundries, according to the IPCC Guidelines (IPCC, 1997), emissions are estimated from consumption data made available by the company (Magnesium products of Italy, several years), assuming that all SF6 used is emitted. The plant started its activity in September 1995. In 2007, SF6 has been used partially, replaced in November by HFC 125, due to the enforcement of fluorinated gases regulation (EC, 2006).
Luxembourg	NO
Netherlands	NO
Portugal	NO
Spain	NO
Sweden	The total annual amount of SF_6 used in the magnesium foundries is reported as emissions, according to the IPCC Guidelines and Good Practice Guidance. Data is obtained from companies using SF_6.
United Kingdom	For magnesium alloy production, emissions from 1998-2007 were estimated based on the emission data reported by the company to the UK's Pollution Inventory.These data are considered reasonably robust whilst earlier data (pre-1998) are estimated based on consultation with the manufacturer.In 2004, for the first time, one of the main industry users has implemented a cover gas system using HFC134a as a cover gas for some of its production capacity.There has not been a complete switch to HFC 134a, although the operator is considering this on an ongoing basis depending on suitability for the different alloys produced. In addition to having a significantly

Member states	Description of methods
	lower GWP than SF_6 (and thus reducing emissions on a CO_2 equivalent basis), use of HFC134a is further advantageous in that a significant fraction of it is destroyed by the high process temperatures thus reducing the fraction of gas emitted as a fugitive emission. It is assumed 90% of the used HFC cover gas is destroyed in the process (CSIRO 2005).As this is obviously a key assumption that affects the level of reported emissions, this factor for HFC destruction will be kept under review and the possibility of obtaining a UK-specific factor will be investigated in the future. Note that actual emissions of SF_6 for this sector are reported for practical reasons under 2C5 'Other metal production'. This is because the CRF Reporter does not allow reporting of HFC emissions under the 2C4 sector category.

Table 4.49 provides an overview of all sources reported under 2C5 Other Metal Production by EU-15 Member States for the year 2007. Three Member States report emissions from silicium, magnesium or non-ferrous metals: the largest contributor to emissions is Spain with 42 %.

Table 4.49 2C5 Other: Overview of sources reported under this source category for 2007

Member State	2.C.5 Other Metal Production	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA, NO	NA	NA	NA	NA,NO	NA,NO	NO	-	0.0%
Belgium	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Denmark	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Finland	Non-ferrous metals	0.2	NO	NO	NA,NO	NA,NO	NO	0.2	0.0%
France	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Germany	Magnesium production	NO	NO	NO	7.1	NA,NO	IE,NO	7.1	1.3%
Greece	NA, NO	NO	NO	NA	NA,NO	NA,NO	NA	-	0.0%
Ireland	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Italy	Magnesium Foundries	NA	NA	NA	0.9	NA	NA	0.9	0.2%
Luxembourg	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Netherlands	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Portugal	NA, NO	NO	NO	NO	NA,NO	NA,NO	NO	-	0.0%
Spain	Silicium production	232.2	NA	NA	NA	NA	NA	232	41.6%
Sweden	Non-ferrous metals	167.3	NE,NO	NA,NO	NA,NO	NA,NO	NA,NO	167	30.0%
UK	Non-ferrous metals	NO	NO	NO	2.3	NA,NO	0.0062	150.8	27.0%
EU-15 Total		**400**	**0**	**0**	**10**	**0**	**0.0062**	**559**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.2.4 Production of halocarbons and SF6 (CRF Source Category 2E) (EU-15)

Table 4.50 summarise information by Member State on emission trends for the key source HFCs from 2E Production of Halocarbons and SF_6.

Table 4.50 2E Production of Halocarbons and SF_6: Member States' contributions to total GHG and HFC emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2007 (Gg CO_2 equivalents)
Austria	NA, NO	NA,NO	NA	NA
Belgium	3,313	172	0	NA
Denmark	0	0	NO	NA,NO
Finland	0	0	NA,NO	NA,NO
France	4,691	561	3,635	465
Germany	4,409	199	4,329	199
Greece	935	0	935	NA,NO
Ireland	NA, NO	NA, NO	NA,NO	NA,NO
Italy	605	18	351	18
Luxembourg	0	0	NA,NO	NA,NO
Netherlands	4,432	267	4,432	267
Portugal	NE, NO	NE, NO	NE,NO	NA,NO
Spain	2,403	707	2,403	707
Sweden	0	0	NO	NA,NO
United Kingdom	11,385	230	11,374	176
EU-15	**32,172**	**2,154**	**27,459**	**1,832**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.51 provides information on the contribution of Member States to EC recalculations in HFC from 2E Production of Halocarbons for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 4.51 2E Production of Halocarbons and SF_6: Contribution of MS to EC recalculations in HFC for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	58.5	9.2	
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	-2,290.4	-100.0	Activity data: The one plant existing in Greece has closed in 2006.
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	-10.8	-3.3	
Portugal	NE	0.0	NE	0.0	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	0.0	0.0	84.3	27.8	
EU-15	**0.0**	**0.0**	**-2,158.4**	**-45.6**	

HFC emissions from 2E1 By-Product Emissions account for 0.1 % of total EU-15 GHG emissions in 2007. In 2007 France and Spain together account for 66 % of these emissions in the EU-15. Between 1990 and 2007, HFC emissions from this source decreased by 94 % (Figure 4.13). The initial increase of emissions from 1990 to 1997 by 54 % is due to increased production in UK, Spain, Greece and the Netherlands. Since 1997 emissions decreased in nearly all Member States strongly; in UK due to the installation of thermal oxider pollution abatement equipments; in the Netherlands due to the installation of a thermal afterburner; in Spain due to the installation of a condensation equipment; and in Greece due to production stop in 2006. In contrast to the trend described above, emissions in France decreased already between 1990 and 1997 due to the installation of a thermal afterburner and remained stable since then.

Figure 4.13 2E1 By-Product Emissions: EU-15 HFC emissions

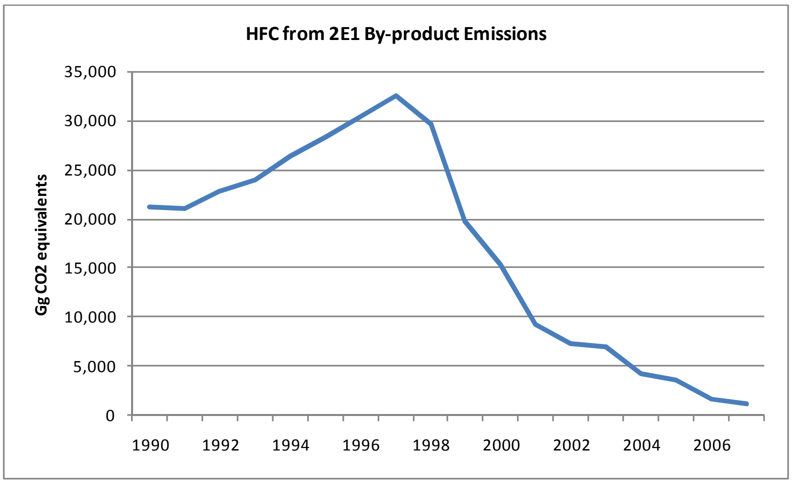


Table 4.52 2E1 By-Product Emissions: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Belgium	NO	NA,NO	NA,NO	-	-	-	-	-	T3	PS	PS
Denmark	NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Finland	NA,NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	1,663	577	399	32.1%	-178	-31%	-1,263	-76%	C	PS	PS
Germany	C,NA	C,NA	C,NA	-	-	-	-	-	(C,NA)	(C,NA)	(C,NA)
Greece	935	NA,NO	NA,NO	-	-	-	-935	-100%	NO	NO	NO
Ireland	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Italy	351	5	5	0.4%	0	0%	-346	-99%	CS	PS	PS
Luxembourg	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NO	NA
Netherlands	4,432	281	243	19.5%	-38	-14%	-4,190	-95%	T2	PS	PS
Portugal	NE,NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
Spain	2,403	517	423	34.0%	-94	-18%	-1,980	-82%	T1, T2	PS	D, PS
Sweden	NO	NA,NO	NA,NO	-	-	-	-	-	NA	NA	NA
United Kingdom	11,374	387	176	14.1%	-212	-55%	-11,198	-98%	T3	Q,PS	PS
EU-15	**21,158**	**1,767**	**1,245**	**100.0%**	**-522**	**-30%**	**-19,913**	**-94%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.53 shows information on methods used for HFC emissions from 2E1 By-Product Emissions for 1990 and 2007. For 2E1 By-Product Emissions it is not possible to give an average IEF for the EU-15 because for most countries activity data is confidential. Except for Greece, all reported emissions are estimated with higher Tier methods. This means that for the latest inventory year (2007) all reported emissions are estimated using higher tier methods (based on plant specific data).

Table 4.53 2E1 By-Product Emissions: Description of national methods used for estimating HFC emissions and abatements applied

Member States	Description of methods
Austria	NO
Belgium	NO
Denmark	NO

Member States	Description of methods
Finland	NO
France	Il existe un site en France, producteur de HCFC-22, émetteur de HFC-23. Les émissions ont été réduites de façon importante depuis 1992 après l'introduction d'un incinérateur. Les émissions sont déterminées à partir d'une approche bottum-up à partir des données communiquées directement par les sites industriels conformément aux déclarations faites aux DRIRE (arrêté du 24 décembre 2002 modifié).
Germany	Since 1995 emissions have been calculated (via mass balance) on the basis of the amount of H-CFC-22 produced, of annual measurements of HFC-23 concentrations in the facility's waste gas, of amounts of HFC-23 sold and of the amounts of HFC-23 delivered to the cracking facility; for the 1995 report year, emissions reduction measures (cracking facility) have been taken into account, as of the middle of the year, for the first production facility. Since produced quantities of H-CFC are not reported, no emission factor can be determined and compared with the IPCC standard emission factor. The producer reports only emissions of HFC-23. These are reported in aggregated form, together with emissions from the CRF sub - source category 2.E.2, since they are confidential. In 1995, in Frankfurt, a CFCcracking plant went into operation that cracks, at high temperature, excess HFC-23 produced during production of H-CFC-22 and that recovers hydrofluoric acid; i.e. no significant emissions are produced. HFC-23 produced at the second German production facility is captured in large amounts at the production system itself; the substance is then sold as a refrigerant or – following further distillative purification – as an etching gas for the semiconductor industry.
Greece	According to the IPCC Good Practice Guidance, the analytical methodology (Tier 2) should be applied for the calculation of HFC-23 emissions from HCFC-22 production, as it constitutes a key source. This methodology is based on the collection and elaboration of on site measurement data. However, due to the lack of such data, calculation of emissions is based on production statistics and a reference emission factor. It should be noticed that data on the production of HCFC-22 are confidential and therefore are not presented in the current report. HFC-23 emissions from HCFC-22 manufacture do not occur since 2006, since the plant manufacturing HCFC-22 has stopped operating since.
Ireland	NO
Italy	For source category "By-product emissions", the IPCC Tier 2 method is used, based on plant-level data communicated by the national producer (Solvay, several years). Also for source category "Fugitive emissions", emission estimates are based on plant- level data communicated by the national producer (Solvay, several years). [NIR 2008]
Luxembourg	NO
Netherlands	*Production of HCFC-22*(2E1): To comply with the IPCC Good Practice Guidance (IPCC, 2001) an IPCC Tier 2 method is used to estimate emission of this source category. HFC-23 emissions are calculated using both (measured) data on the mass flow of HFC23 produced in the process and a destruction factor to estimate the reduction of this HFC 23 flow by the thermal afterburner.
Portugal	NO
Spain	The information on HFC-23 emissions is based on the estimates made by the centres themselves, complemented for the years 1990-1998 by a default emission factor. Therefore, the estimation methodology applied in this case is a combination of Tier 1 and Tier 2 in the IPCC's terminology. No se presenta aquí la información sobre variables de actividad y parámetros de proceso por ser de carácter confidencial al corresponder actualmente la propiedad de las plantas únicamente a dos empresas. Cabe asimismo mencionar que en una de las plantas existe un descenso de la emisión a partir del año 2001 debido a la construcción y puesta en servicio de una instalación para disminuir la emisión de HFC-23 mediante su compresión, condensación, licuación y almacenamiento. El HFC-23 licuado se carga en cisternas y se envía a un gestor exterior para su tratamiento.
Sweden	NO
United Kingdom	Within the model, manufacturing emissions from UK production of HFCs, PFCs and HFC 23 (by-product of HCFC 22 manufacture) are estimated from reported data from the respective manufacturers. Manufacturers have reported both production and emissions data, but only for certain years, and for a different range of years for different manufacturers.Therefore the emissions model is based on implied emission factors, and production estimates are used to calculate emissions in those years for which reported data was not available.Two of the three manufacturers were members of the UK greenhouse gas Emissions Trading Schemes.As a requirement of participation in the scheme, their reported emissions are verified annually via external and independent auditors.All three now report their emissions to the Environment Agency's Pollution Inventory and these reported emissions have been used to calculate total emissions in later years for two of the operating plant, where full speciated emissions data were provided by one of the operators for most of the time series.There is a significant decrease in HFC emissions in 1998/1999. This step-change in emissions is due to the installation of thermal oxider pollution abatement equipment at one of the UK manufacturing sites. Fugitive HFC emissions from both an HCFC22 plant and HFC manufacturing plant (run by the same operator) are treated using the same thermal oxidiser unit. Emissions also decrease in 2004, reflecting the installation of a thermal oxider at the second of the UK's HCFC22 manufacturing sites. This was installed in late 2003, and became fully operational in 2004.

Source: NIR 2009 unless stated otherwise

Table 4.54 shows that only two Member States report GHG emissions under 2E3 Other for the year 2007. Germany reports due to confidentiality reasons aggregated HFC emissions from 2E1 and 2E2 (HFC 134a and HFC 227ea production); The Netherlands include HFC emissions from handling activities, like repackage HFCs from large units (e.g. containers) into smaller units (e.g. Cylinders).

Table 4.54 2E3 Other: Overview of sources reported under this source category for 2007

Member State	2.E.3 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA	NA	NA	NA	-	0.0%
Belgium	Other non-specified	NA	NA	-	-	0.0%
Denmark	Other non-specified	NA,NO	NA,NO	NO	-	0.0%
Finland	Other non-specified	NO	NO	NO	-	0.0%
France	Other non-specified	NA,NO	NA,NO	NA	-	0.0%
Germany	Other non-specified	198.7	NO	C	198.7	89.1%
Greece	Other non-specified	NA,NO	NA,NO	NO	-	0.0%
Ireland	Other non-specified	NO	NO	NO	-	0.0%
Italy	NA	NA	NA	NA	-	0.0%
Luxembourg	NA	NA	NA	NA	-	-
Netherlands	Not specific attributable due to Confidential Bussiness Information	24.3	NO	NO	24.3	10.9%
Portugal	Other non-specified	NA,NO	NA,NO	NO	-	0.0%
Spain	NA	NA	NA	NA	-	0.0%
Sweden	Other non-specified	NA,NO	NA,NO	NO	-	0.0%
UK	Other non-specified	NA	NA	NA	-	0.0%
EU-15 Total		**223**	**0**	**-**	**223**	**100.0%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.55 summarizes the recommendations from the latest UNFCCC review of the inventory report in relation to the category 2E Production of Halocarbons. The overview shows that few recommendations were made and none could be implemented yet.

Table 4.55 2E Production of Halocarbons and SF_6: Findings of the latest UNFCCC review of the inventory report and responses in 2009 inventory submissions

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF6	
	Comment in the latest UNFCCC review report	**Status in 2009 submission**
Austria	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Belgium	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Denmark	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Finland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
France	France reports four subcategories under the category production of halocarbons and SF6: the production of chlorodifluoromethane (HCFC-22); other by-product emissions TFA; fugitive emissions; and other conversion of uranium. The estimates of emissions are based on reports from the relevant facilities. The ERT encourages France to report on the methods used by the facilities to estimate emissions in its next inventory submission. During the previous review, the ERT recommended that France investigate further whether or not fugitive emissions of PFCs occur in industry because these emissions have been reported as NO since 2003. The ERT noted that this recommendation has not been followed up by France and therefore the ERT reiterates its recommendation.	Not resolved; no description of the methods used by the facilities is included Not resolved; fugitive emissions are reported as NO in 2007.
Germany	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Greece	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Ireland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary

Member State	Review findings and responses related to 2.E. Production of halocarbons and SF6	
	Comment in the latest UNFCCC review report	Status in 2009 submission
Italy	The ERT noted that since 1996 hydrofluorocarbon-23 (HFC-23) emissions from HCFC-22 manufacture have been assumed to be zero because a thermal afterburner was installed and untreated leakage of HFC-23 was collected and sent to the thermal afterburner. However, a description of this operational situation was not provided in the NIR. In response to the ERT request, Italy provided additional information during the review, which explained that the thermal afterburner is fully operational. The ERT recommends that Italy explain this in its next annual submission.	Resolved; explanation of the operation of the thermal afterburner is included with reference to the EPER registry in the NIR 2009.
Luxembourg	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Netherlands	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Portugal	No recommendation for improvement for this source category in the report of the review of the initial report. [IRR]	No follow-up necessary
Spain	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Sweden	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
UK	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary

Sources: Review Report 2008 unless stated otherwise; NIR 2009 unless stated otherwise

4.2.5 Consumption of halocarbons and SF6 (CRF Source Category 2F) (EU-15)

Table 4.56 summarises information by Member State on emission trends of total GHG emissions and for the two key sources (HFCs and SF_6) from 2F Consumption of Halocarbons and SF_6.

Table 4.56 2F Consumption of Halocarbons and SF_6: Member States' contributions to total GHG, HFC and SF_6 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	HFC emissions in 1990 (Gg CO_2 equivalents)	HFC emissions in 2007 (Gg CO_2 equivalents)	SF_6 emissions in 1990 (Gg CO_2 equivalents)	SF6 emissions in 2007 (Gg CO_2 equivalents)
Austria	301	1,453	23	861	249	410
Belgium	542	1,846	439	1,765	103	81
Denmark	13	886	NA,NE,NO	840	13	30
Finland	94	935	0	904	94	23
France	1,441	14,983	23	13,822	1,076	761
Germany	4,511	14,122	40	10,892	4,333	2,895
Greece	3	675	NE,NO	666	3	10
Ireland	36	701	1	498	35	73
Italy	213	7,143	NO	6,681	213	374
Luxembourg	17	91	14	87	3	4
Netherlands	236	1,910	NO	1,471	217	214
Portugal	0	949	NE	941	NE	8
Spain	67	5,595	NA,NO	5,130	67	340
Sweden	87	894	4	855	84	37
United Kingdom	674	10,103	12	9,380	604	644
EU-15	**8,237**	**62,287**	**555**	**54,793**	**7,096**	**5,903**

Abbreviations explained in the Chapter 'Units and abbreviations'.

HFC emissions from 2F Consumption of Halocarbons and SF_6 account for 1.4 % of total EU-15 GHG emissions in 2007. HFC emissions in 2007 were 99 times higher than in 1990. The main reason for this is the phase-out of ozone-depleting substances such as chlorofluorocarbons under the Montreal Protocol and the replacement of these substances with HFCs (mainly in refrigeration, air conditioning, foam production and as aerosol propellants). France, Germany, UK and Italy had the most significant absolute increases from this source between 1990 and 2007.

SF_6 emissions from 2F Consumption of Halocarbons and SF_6 account for 0.1 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, SF_6 emissions from this source decreased by 17 %.

Germany, France and UK are responsible for 73 % of total EU-15 emissions from this source. In absolute terms, Germany had also the most significant decreases from this source between 1990 and 2007.

Table 4.57 provides information on the contribution of Member States to EC recalculations in HFC from 2F Consumption of Halocarbons for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 4.57 2F Consumption of halocarbons: Contribution of MS to EC recalculations in HFC for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	2.9	0.3	
Belgium	0.3	0.1	6.0	0.4	
Denmark	0.0	0.0	-20.0	-2.4	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	386.6	3.0	
Germany	0.0	0.0	701.7	7.4	
Greece	0.0	0.0	-1,761.0	-74.7	Method: All the time series have been recalculated according to the latest expert opinion.
Ireland	0.0	-	0.5	0.1	
Italy	0.0	0.0	24.0	0.4	
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	17.8	1.4	
Portugal	NE	0.0	1.6	0.2	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	2.4	0.3	
UK	10.2	610.5	643.3	7.2	Method: Revisions to the model; Update to F gas model following consultation with industry
EU-15	**10.5**	**1.9**	**5.8**	**0.0**	

Table 4.58 provides information on the contribution of Member States to EC recalculations in SF_6 from 2F Consumption of Halocarbons for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 4.58 2F Consumption of halocarbons and SF_6: Contribution of MS to EC recalculations in SF_6 for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	0.0	0.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	0.0	0.0	0.0	0.0	
Germany	0.1	0.0	130.7	5.7	Addition of source: For Transport Refrigeration the disposal emissions are implemented.
Greece	0.0	0.0	3.9	87.2	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	16.0	4.9	
Luxembourg	0.0	0.0	0.0	0.0	
Netherlands	0.0	0.0	-12.9	-6.0	
Portugal	0.0	0.0	-7.1	-45.7	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.5	1.4	
UK	0.0	0.0	-0.8	-0.1	
EU-15	**0.1**	**0.0**	**130.3**	**2.4**	

Table 4.59 shows the sub-categories of HFC emissions from 2F Consumption of Halocarbons and SF_6 by Member State. It shows that 2F1 Refrigeration and Air Conditioning Equipment is by far the largest sub-category accounting for 75 % of HFC emissions in this source category; 2F4 Aerosols/Metered Dose Inhalers and 2F2 Foam Blowing account for 14 % and 6 % respectively.

Table 4.59 2F Consumption of Halocarbons and SF_6: Member States' sub-categories of HFC emissions for 2007 (Gg CO_2 equivalents)

Member State	Consumption of Halocarbons and SF_6	Refrigeration and Air Conditioning Equipment	Foam Blowing	Fire Extinguishers	Aerosols/ Metered Dose Inhalers	Solvents	Other applications using ODS substitutes	Semiconductor Manufacture	Electrical Equipment	Other (please specify)
Austria	**861**	692	120	30	10	2	NO	7	NO	NA,NO
Belgium	**1,765**	1,446	129	12	179	NO	NE	NO	0	NA
Denmark	**840**	723	103	NO	11	NO	NO	NO	NO	3
Finland	**904**	819	8	C,NO	75	NO	NO	C,NA,NE,NO	NO	2
France	**13,822**	9,641	555	122	3,179	310	NO	16	NO	NA,NO
Germany	**10,892**	9,028	1,288	7	549	C,NO	NO	18	NO	2
Greece	**666**	665	NE	NE	1	NE	NO	NO	NO	NA,NO
Ireland	**498**	360	26	18	90	NO	NO	3	NO	NA,NO
Italy	**6,681**	5,995	259	115	308	NO	NO	5	NO	NA,NO
Luxembourg	**87**	77	6	NE	4	NE	NE	NE	NA	NA,NO
Netherlands	**1,471**	1,303	NO	NO	NO	NO	NO	NO	NO	168
Portugal	**941**	892	42	6	1	NO	NO	NO	NO	NA,NO
Spain	**5,130**	3,203	106	1,698	123	NO	NO	NO	NO	NA
Sweden	**855**	770	54	6	25	NO	NO	NO	NA	NA,NO
UK	**9,380**	5,563	410	198	3,014	70	NA	IE	IE	124
EU-15	**54,793**	**41,176**	**3,107**	**2,210**	**7,569**	**383**	**0**	**50**	**0**	**298**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.60 and 4.61 show MS contribution to EU-15 HFC emissions from the two most important sub-sources 2F1 and 2F4 and summarise information by Member State on emission trends, methodologies, activity data and emission factors.

Table 4.60 2F1 Refrigeration and Air conditioning: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	2	642	692	1.7%	50	8%	690	39211%	CS	Q	CS
Belgium	79	1,307	1,446	3.5%	138	11%	1,367	1732%	T2	Q/AS	CS/PS
Denmark	NA,NE	691	723	1.8%	32	5%	723	-	M/CS	CS	M/CS
Finland	0	659	819	2.0%	159	24%	819	6497352%	T2	Q	D
France	NO	8,795	9,641	23.4%	846	10%	9,641	-	M	Q	CS/ D
Germany	NA,NO	8,489	9,028	21.9%	539	6%	9,028	-	T2	(?)	D,CS
Greece	NE,NO	596	665	1.6%	69	12%	665	-	T2	AS	D
Ireland	IE,NO	361	360	0.9%	0	0%	360	-	T1, T3	NS	CS
Italy	NO	5,346	5,995	14.6%	648	12%	5,995	-	T2	AS	CS
Luxembourg	6	77	77	0.2%	0	0%	71	1131%	CS	Q	CS
Netherlands	NO	1,090	1,303	3.2%	212	19%	1,303	-	T2	AS	CS
Portugal	NE	807	892	2.2%	85	11%	892	-	T2	NS,PS	D,CS
Spain	NO	2,904	3,203	7.8%	299	10%	3,203	-	C	AS, Q	C
Sweden	3	721	770	1.9%	48	7%	767	30142%	T2, CS	PS,NS	D, CS
UK	NO	5,725	5,563	13.5%	-162	-3%	5,563	-	T3	Q,AS	CS
EU-15	**89**	**38,212**	**41,176**	**100.0%**	**2,964**	**8%**	**41,086**	**45914%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

In 2007, HFC emissions from 2F1 were more than 400 times higher than in 1990 (Figure 4.14). France, Germany, Italy and the UK are responsible for 73 % of total EU-15 emissions from this source. Between 2006 and 2007 EU-15 emissions increased by 8 %. The largest increase of HFC emissions from 2F1 between these years was in France. Only UK reported decreasing emissions from this source in the latest years.

Figure 4.14 2F1 Refrigeration and Air conditioning: EU-15 HFC emissions

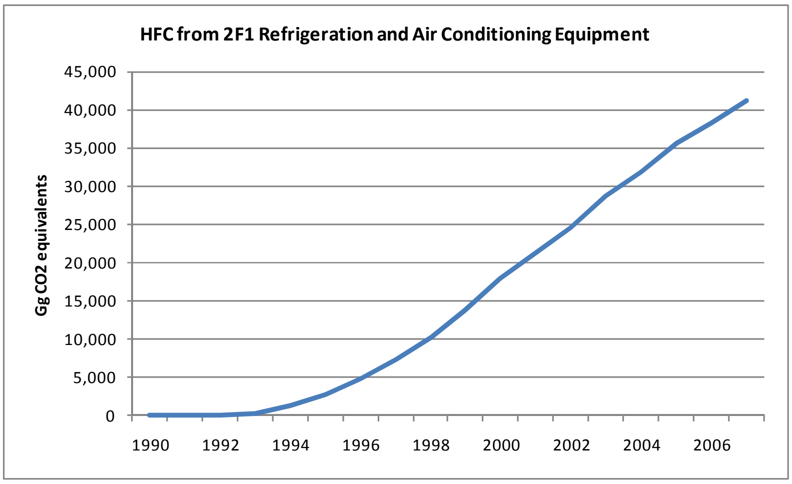


Table 4.61 2F4 Aerosols/ Metered Dose Inhalers: Member States' contributions to HFC emissions and information on method applied, activity data and emission factor

Member State	HFC (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	19	27	10	0.1%	-17	-62%	-9	-45%	CS	Q	D
Belgium	35	176	179	2.4%	3	2%	143	407%	T1	RS/NS	PS
Denmark	NA,NE	16	11	0.1%	-5	-32%	11	-	M/CS	CS	M/CS
Finland	NA,NO	77	75	1.0%	-2	-3%	75	-	T2	Q	D
France	NO	3,379	3,179	42.0%	-200	-6%	3,179	-	C/ T2	AS	CS
Germany	NO	611	549	7.3%	-62	-10%	549	-	CS	(?)	D,CS
Greece	NE,NO	0	1	-	-	-	-	-	CS	NS	D
Ireland	0	103	90	1.2%	-13	-13%	90	1396413%	T1, T2	NS	CS
Italy	NO	237	308	4.1%	70	30%	308	-	T2	AS	CS
Luxembourg	0	4	4	0.1%	0	0%	4	41340%	CS	Q	CS
Netherlands	NO	NO	NO	-	-	-	-	-	T2	AS	CS
Portugal	NE	1	1	0.0%	0	-14%	1	-	RA	NS	CS
Spain	NO	128	123	1.6%	-5	-4%	123	-	C	AS, Q	C
Sweden	1	24	25	0.3%	1	6%	24	1853%	T2, CS	PS,NS	D
UK	12	3,014	3,014	39.8%	0	0%	3,003	25405%	T3	AS	CS
EU-15	**67**	**7,798**	**7,569**	**100.0%**	**-229**	**-3%**	**7,502**	**11156%**			

In 2007, HFC emissions from 2F4 were more than 100 times higher than in 1990 (Figure 4.15). France and UK are responsible for 82 % of total EU-15 emissions from this source. Between 2006 and 2007 EU-15 emissions decreased by 3 %. The relative decrease between these years was largest in Austria and Denmark (Table 4.61).

Figure 4.15 2F4 Aerosols/Metered Dose Inhalers: EU-15 HFC emissions

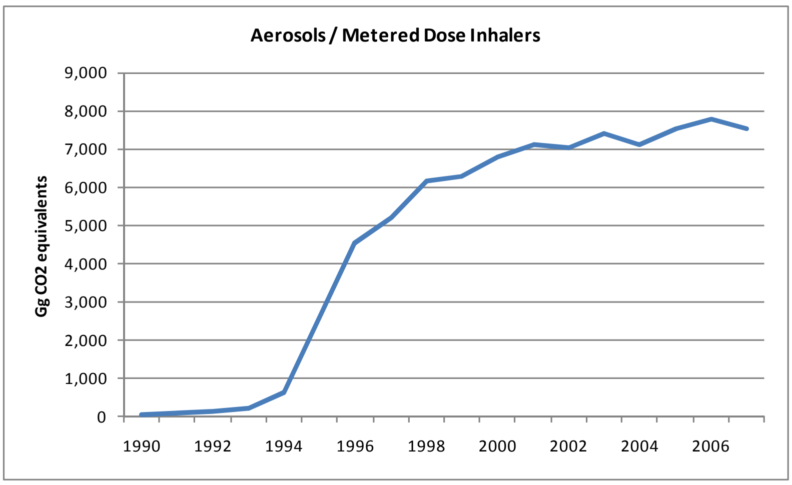


Table 4.62 provide descriptions on methods used for estimating HFC, PFC and SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.62 2F Consumption of halocarbons and SF_6: General description of national methods used for estimating emissions

Member States	Description of methods
Austria	A study has been contracted out to determine the consumption data and emissions from 1990-2000 for all uses of FCs (BICHLER ET AL. 2001). In this study, bottom up data for consumption per sector were compared with top-down data from importers and retailers of FCs as well as with data from the national statistics (import/export statistics). The study also included projections until 2010, these were used to estimate emissions from 2001-2005 for the subcategories *2 F 1 Refrigeration and Air conditioning equipment*, *2 F 3 Fire Extinguishers* and *2 F 9 Other sources of SF_6*. For the sub-categories *2 F 7 Semiconductor Manufacture* and *2 F 8 Electrical Equipment* data for these years were available due to the Austrian reporting obligation (see below). The sub-category *2 F 2 Foam blowing* was re-evaluated in a new contracted study (OBERNOSTERER et al 2004). Austrian estimates of emissions from the sources *2 F 4 Aerosols* and *2 F 5 Solvents* are based on a European evaluation of emissions from this sector (HARNISCH & SCHWARZ 2003), subsequently disaggregated to provide a top-down Austrian estimate. Data about consumption of HFC, PFC and SF_6 were determined from the following sources: • data from national statistics • data from associations of industry • direct information from importers and end users Since 2004 there is also a reporting obligation under the Austrian FC-regulation for users of FCs in the following applications: refrigeration and air-conditioning, foam blowing, semiconductor manufacture, electrical equipment, fire extinguishers and aerosols. Emissions for all subcategories were estimated using a country specific methodology, emission factors are based on information of experts from the respective industries. For most sources emissions are calculated from annual stocks using emission factors.
Belgium	Emissions of fluorinated greenhouse gases are mainly estimated on the basis of the consumption of the different substances for each application, the consumption of products containing such substances, figures on external trade in substances or products containing substances, as well as on emission modelling by application and assumptions on leakage rates.
Denmark	The data for emissions of HFCs, PFCs, and SF_6 has been obtained in continuation on work on inventories for previous years. The determination includes the quantification and determination of any import and export of HFCs, PFCs, and SF_6 contained in products and substances in stock form. This is in accordance with the IPCC-guideline (IPCC (1996), vol. 3, p. 2.43ff) as well as the relevant decision trees from the IPCC Good Practice Guidance (GPG, IPCC (1999) p. 3.53ff). For the Danish inventories of F-gases basically a Tier 2 bottom up approach is used. As for verification using import/export data a Tier 2 top down approach is applied. In an annex to the F-gas inventory report 2007 (DEPA, 2009), there is a specification of the approach applied for each sub-source category. The following sources of information have been used: • Importers, agency enterprises, wholesalers, and suppliers • Consuming enterprises, and trade and industry associations • Recycling enterprises and chemical waste recycling plants • Statistics Denmark • Danish Refrigeration Installers' Environmental Scheme (KMO) • Previous evaluations of HFCs, PFCs, and SF_6 Suppliers and/or producers provide consumption data of F-gases. Emission factors are primarily defaults from GPG, which are assessed to be applicable in a national context.
Finland	Detailed sector-specific approach. Emissions from each category are quantified using 2 or 3 different methods given in IPCC GPG (2000).
France	IPCC Tier 2
Germany	Detailed CS approach (Tier 2).
Greece	In order to obtain a reliable estimation of F-gases emissions, collection of detailed data for all activities mentioned above (e.g. number of refrigerators, type and amount of refrigerant used by each market label, substitutions of refrigerants that took place the late years etc.) is required. The availability of official data in Greece is limited and, therefore, the estimations presented hereafter cover only a part of the materials/equipments mentioned above. Specifically: (a) only HFC emissions from refrigerating (including transport refrigeration) and air conditioning (including mobile air conditioning) equipment and of metered dose inhalers are included, which, however, are considered to represent the basic source of the respective emissions (b) emissions from the use of SF_6 in electrical equipment.
Ireland	Emission calculation based on special studies by sub-contractors
Italy	Methodology used is IPCC Tier 2a, except for SF_6 emissions from electrical equipment (2F7), where it is IPCC Tier 3c. The IPCC Tier 1a method has been used to calculate potential emissions, using production, import, export and destruction data provided by the national producer (Solvay, several years; ST Microelectronics, several years; MICRON, several years). As regard PFC potential emissions, since no production occurs in Italy, export has been reasonably assumed negligible, whereas import correspond to consumption of PFCs by semiconductor manufactures, that use these substances.
Luxembourg	Emission estimates for the years 1996 to 1999, 2001 to 2004 and 2006 have been calculated with the respective trends 1995-2000, 2000-2005 and 2005-2010. The emissions from 1990 to 1994 are assumed to be equal to 1995 emissions since trend calculations are not possible for those years (it would actually lead to negative values). A re-evaluation of the emission sources and the emissions of HFCs, PFCs and SF_6, taking into account the 2000 IPCC-GPG Guidelines as well as country specific considerations, is ongoing. [NIR 2008]

Member States	Description of methods
Netherlands	To comply with the IPCC Good Practice Guidance (IPCC, 2001) IPCC Tier 2 methods are used to estimate emissions of the sub-sources Stationary refrigeration, Mobile airconditioning, Aerosols, Foams and Semiconductor manufacturing. The country-specific method for the source Electrical equipment is equivalent to the IPCC Tier 3 method and the country-specific methods for the sources Sound-proof windows and Electron microscopes are equivalent to IPCC Tier 2 methods.
Portugal	For those sources with sufficient available data, actual emissions where estimated with a Tier 2 (advanced or actual method) approach which is considered Good Practice in accordance with GPG. As a general rule, bottom-up methodologies were used, and thus overall methodology should be classified as Tier 2a. This approach departs from the knowledge of the number of equipments using Fluorinated compounds and estimates emissions to atmosphere from charge (amount of chemical used in the equipment), service life, emission rate during the various periods of the equipment life and possible recovery of emissions. Whenever possible emission estimates include assembly emissions - when equipment is first filled-, operation emissions - occurring during equipment lifetime or usage and resulting mainly from leaks -, disposal emissions - the remaining charge that is released to the atmosphere at end of equipment life and where the remaining charge is neither recycled or destroyed.
Spain	No general description, see sub-category specific descriptions
Sweden	In estimating the actual emissions, as far as possible, a Tier 2 approach has been used. A model is used for calculating the actual emissions. Changes in accumulated amounts each year resulting from additional amounts of HFC, PFC and SF_6 imported and used within the country, as well as the decline in accumulated stock caused by exports or emissions from operating systems, have been taken into consideration. Potential emissions: Data on bulk imports and exports are obtained from the Products register hosted by the Swedish Chemicals Inspectorate, which did not register these substances until 1995. Estimates of potential emissions for imports and exports were, however, made for all years in the time series, 1990-2004 in a special study in 2005. The method of estimating potential emissions for 2005 was made accordingly.
United Kingdom	No general description, see sub-category specific descriptions

Source: NIR 2009 unless stated otherwise

Table 4.63 provide descriptions on methods used for estimating HFC emissions from 2F1 Refrigeration and Air-Conditioning Equipment.

Table 4.63 2F1 Refrigeration and Air-conditioning equipment: Description of national methods used for estimating HFC emissions

Member States	Description of methods
Austria	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. Refrigeration and Air Conditioning: Consumption data was obtained directly from the most important importers of refrigerants. The stocks of the different subcategories were estimated using information from the most important refrigerant retailers/ importers and experts from the refrigeration branch.
Belgium	For the refrigeration sector, emissions have been estimated separately for the following source categories: industrial and commercial installations, household refrigerators, air conditioning of private cars, air conditioning of buses and coaches, and refrigerated transport. In accordance with the IPCC guidelines, the assembly emissions, the operation emissions and the disposal emissions are being determined separately. The assembly emissions are calculated as a function of the estimated amount charged into new systems and the percentage assembly losses, the operation emissions as a function of the amount stocked in existing systems and assumptions on annual leakage rates, and the disposal emissions in function of the amount in systems at time of disposal and the estimated recovered fraction. An annual inquiry is made on the consumption of the major F-gas containing product manufacturers, among which the 4 car manufacturers. These data are used for calculating the potential emissions as well as the assembly emissions. Industrial and commercial "installations" represent all on-site assembled systems for industrial & commercial refrigeration as well as stationary air-conditioning applications, which is the largest single source of F-gas emissions. The consumption and emission of refrigerants are modelled on the basis of an annual inquiry among refrigerant distributors on their national supply by refrigerant mixture, as well as on assumptions on average loss rates, from which the estimated supply for refilling vehicles is subtracted. No distinction is made between industrial refrigeration, commercial refrigeration and air conditioning installations, as it is not possible to disaggregate the consumption data between these sub-sectors, because of the presence of intermediary wholesalers, and the fact that no inventory of installations is available. The refrigerant consumption and emissions of the transportation sector are estimated by modelling the evolution of the vehicle stock, on the basis of the number of new vehicle registrations and of the percentage of new vehicles equipped with air conditioning., by category of vehicles (cars, buses and coaches). The emissions from refrigerated transport are calculated on the basis of the annual number of new registrations of refrigerated trucks and trailers by gross / net weight categories, the average quantity of refrigerant (by type of refrigerant) contained in each vehicle (by vehicle category) and emission factors taken from the literature.
Denmark	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. In case of commercial refrigerants and Mobile Air Condition (MAC), national emission factors are defined and used. Import/export data for sub-source categories where import/export is relevant (MAC, fridge/freezers for household) are quantified on estimates from import/export statistics of products + default values of the amount of gas in the product. The estimates are transparent and described in the annex to the report referred to above.
Finland	Refrigeration and air conditioning (CRF 2.F.1) Top-down Tier 2, Tier 1a, Tier 1b The Tier 2 top-down method is used for all sources in this category, both stationary and mobile. Data are not collected for separate subcategories because such statistics are either not available or the preparation of such statistics would entail a very high reporting burden on companies. There is also some evidence that simpler questionnaires lead to better response activity. HFC-23 emissions from this source are not reported separately due to confidentiality.

Member States	Description of methods
France	IPCC Tier 2. Les émissions de HFC sont déterminées à l'aide du modèle « RIEP » développé par l'Ecole des Mines de Paris qui utilise une méthode de rang 2 du GIEC avancée.
Germany	IPCC Tier 2a. This category is divided into the sub-categories of household refrigeration, commercial refrigeration, transport refrigeration, industrial refrigeration, stationary air-conditioning systems and room air-conditioners, and mobile air-conditioning systems. In Germany, the leading pure-HFC refrigerants are HFC-134a and the mixtures 404A and 507A. For calculation of HFC emissions from the sub-categories of refrigeration and stationary airconditioning systems, individual data are collected, or refrigerant models used. Any refrigerant models used are described in connection with the relevant method. The emission factors used are the result of surveys of experts. The emission factors for waste disposal are the standard values from the IPCC Guidelines of 1996. For some sub - source categories, disposal emissions occurred for the first time in 2003.
Greece	Refrigeration and air-conditioning: F-gases emissions are estimated according to the Tier 2a methodology described in the IPCC Good Practice Guidance. It is a bottom-up approach based on detailed equipment data and emission factors representing various types of leakage per equipment category. It should be noted that the application of the Tier 1 methodology (calculation of potential emissions based on imports, exports and domestic consumption of each gas) and Tier 2b is not possible, as the available information is not reported in the way required by these methodologies. Total emissions are calculated as the sum of assembly emissions, operation emissions that include annual leakage from equipment stock in use as well as servicing emissions and disposal emissions that include the amount of refrigerant released from scrapped systems.
Ireland	In terms of stationary refrigeration data on the quantities of industrial gases supplied to the refrigeration sector is obtained from chemical suppliers and manufacturers of refrigeration units. Sales data is provided for a range of HFCs and blends corresponding to the individual HFC species. A bottom-up approach is not feasible for estimating actual emissions from stationary refrigeration and air conditioning in Ireland due to the lack of data available on equipment types and HFC sales data into equipment sub-categories. Therefore emissions are estimated using a top-down approach based on reported sales data and information on market shares, which are applied to calculate estimates of total HFC sales into the Irish stationary refrigeration and air-conditioning sectors. Emissions of HFCs from sub-category 2.IIA.F.1.6 Mobile Air-Conditioning are estimated using a Tier 3b bottom-up analysis which utilises national vehicle fleet statistics from the Department of the Environment, Heritage and Local Government and assumed rates of airconditioning unit penetration in the national vehicle fleet. The methodology used takes account of vehicle lifetime, the percentage of vehicles having HFC in their air-conditioning systems, average charge per unit, product manufacturing emissions, effective lifetime leakage rates (incorporating emissions from normal operating losses and accidental releases arising from collision damage) and decommissioning losses.
Italy	Refrigeration and air-conditioning: IPCC Tier 2a Basic data and have been supplied by industry: specifically, for the mobile air conditioning equipment the national motor company and the agent's union of foreign motor-cars vehicles have provided the yearly consumptions; for the other air conditioning equipment the producer supply detailed table of consumption data by gas. Losses rates have been checked with industry and they are distinguished by domestic equipment, small and large commercial equipment, industrial chillers, mobile air conditioning equipment. Refrigeration activities, such as commercial, transport, industrial and other stationary, are all reported under domestic refrigeration because no detailed information is available to split consumptions and emissions in the different sectors. Anyway appropriate losses rates have been applied for each gas taking in account the equipment where refrigerants are generally used. Therefore implied product life factors, especially for HFC 134a, result from the weighted average of different losses rates, from 0.7% for domestic refrigeration to 10% for large chillers.
Luxembourg	The stationary refrigeration and the mobile air conditioning are estimated using reported emissions by Germany expressed per capita with the relative population in Luxembourg. [NIR 2008]
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Portugal	CFC, HCFC and F-Gases emissions from operation and disposal of Domestic Refrigeration Equipments, Commercial Refrigeration (non domestic Refrigeration Equipments), transport refrigeration equipments, Stationary and Industrial Air conditioning equipments and Mobile Air Conditioning were estimated using the bottom-up approach (Tier 2a or actual method) as proposed in chapter 3.7.4 of the GPG. F-Gases emissions for each particular compound were estimated from total Refrigeration Fluid emissions and considering the percentage of F-Gas use in total Refrigeration Fluid use in each year. The stock of domestic refrigeration equipments was estimated from the number of households and from the percentage of households with refrigeration equipments, available for years 1990, 1995 and 2000, according to an unpublished report from INE.From year 2000 onward the percentage of equipments per household was forecasted by APA based on gross domestic product behaviour. The number of households refers to INE-Family Survey based on 1991 and 2001 Census values. There are no available national statistics concerning the number and dimension of non-domestic refrigeration equipments used in commerce, industry, tourism, services and institutional activities. A survey to Hotels, Hostels and Camping Parks was conducted with the support of "Turismo de Portugal, ip" and "AHP – Associação da Hotelaria de Portugal", in order to obtain real data concerning the number and dimension of non-domestic refrigeration equipments. Data pertaining to other commerce and services activities was estimated with the technical support of APIRAC, Importers and DGE (Enterprise and Industry General Directorate). Calculations for Hypermarkets were made separately. Estimates for Road Transportation and Railways were made separately. The number of light vehicles with MAC was estimated from the total number of light vehicles sold each year, using the same information used to establish the time series of car sales and fleet in chapter 1A3, and the percentage of new cars sold with MAC at each yearwas estimated according to data provided by manufacturers.
Spain	En cuanto a la refrigeración y el aire acondicionado se ha contado con información suministrada para algunos años por las asociaciones empresariales del frío y climatización y, por lo que respecta a su uso en la industria de automoción, con información obtenida vía cuestionario a las plantas de fabricación de automóviles. En el primer

Member States	Description of methods
	caso, es decir para los equipos estacionarios de refrigeración y climatización, el equipo de trabajo del inventario ha extendido las tasas de variación interanual para completar los últimos años de la serie al no haberse podido disponer de otra información en esta edición del inventario. Los factores de emisión son por lo que respecta a la producción nacional de automóviles datos derivados de la información de cuestionarios a las plantas fabricantes, y para los demás sub-sectores se han tomado de las guías de IPCC. La metodología de estimación de las emisiones se ha basado en la expuesta en la Sección 2.17.4.2 del Manual de Referencia 1996 IPCC y en las secciones 3.7.4 y 3.7.5 de la Guía de Buenas Prácticas 2000 IPCC. Según estas referencias las emisiones se pueden originar en las fases de montaje, funcionamiento y retirada de los equipos. A cada una de estas fases corresponde un algoritmo de cálculo de las emisiones. La emisión total será la suma de las emisiones generadas en cada una de las tres fases.
Sweden	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6. Refrigeration and air conditioning equipment: Input data for the calculation of actual emissions consists of information from various sources. For heat pumps, air conditioning, mobile air conditioning, refrigeration and freezing equipment, the equipment producers and importers were contacted and have provided information of varying quality. Estimates have been checked with trade associations (KYS and SVEP) and with experts at the Swedish EPA (Ujfalusi, Bernekorn, Björsell). The information on refrigerant-related imported amounts of fluorinated gases from the Products register is compared to calculations made in the model, based on assumptions and information from other sources.
United Kingdom	The calculation methodology within the model is considered to provide a relatively conservative approach to the estimation of emissions.The bank of fluid is estimated by considering the consumption of fluid in each sector, together with corrections for imports, exports, disposal and emissions.Once the size of the bank in a given year is known, the emission can be estimated by application of a suitable emission factor.Emissions are also estimated from the production stage of the equipment and during disposal.The methodology corresponds to the IPCC Tier 2 -'bottom-up'- approach.Data are available on the speciation of the fluids used in these applications; hence estimates were made of the global warming potential of each fluid category. Emissions from the domestic refrigeration sector were estimated based on a bottom-up approach using UK stock estimates of refrigerators, fridge-freezers, chest-freezers and upright freezers from the UK Market Transformation Programme (MTP, 2002).For the commercial refrigeration sub-sectors, emissions for these sectors were based on the activity data supplied by industry and used in previous emission estimates by March (1999) and WS Atkins (2000).Consultation with a range of stakeholders was used to determine appropriate country-specific emission factors; these generally fell within the ranges given in IPCC guidance (IPCC 2000). As part of the recent update to the F-gas inventory and projections (AEA, 2008), a range of stakeholders were re-contacted to review the parameters in the model, including emission factors and typical refrigerant blends in use.This has led to some changes in the GWP weighted emissions totals. Emissions of HFCs from mobile air conditioning systems were also derived based on a bottom-up analysis using UK vehicle statistics obtained from the UK Society of Motor Manufacturers and Traders, and emission factors determined in consultation with a range of stakeholders.A full account of the assumptions and data used to derive emission estimates for the MAC sub-sector is in AEAT (2004) and AEA (2008).

Source: NIR 2009 unless stated otherwise

Table 4.64 provides an overview of all sources reported under 2F9 Other by EU-15 Member States for the year 2007. The largest contributor to emissions is Germany with 51 %. Most Member States report emissions from double glaze windows in this source category.

Table 4.64 2F9 Other: Overview of sources reported under this source category for 2007

Member State	2.F.9 Other	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO_2 equivalents]	Share in EU-15 Total
Austria	Double glaze windows, Research and other use	NA,NO	NA,NO	0.0113	269.8	6.4%
Belgium	Double glaze windows	NA	NA	0.0029	70.3	1.7%
Denmark	Double glaze windows, Laboratories, Fibre optics	2.8	4.8	0.0006	22.9	0.5%
Finland	Grouped confidential data	1.8	0.5	0.0006	17.5	0.4%
France	Shoes application, Closed application, Open application	NA,NO	189.0	NO	189.0	4.5%
Germany	Car Tyres, Shoes, Trace gas, Double glaze windows, Coating, AWACS maintenance, Optical Glass Fibre, Solar Technology, Welding	1.7	19.6	0.0894	2,157.5	51.3%
Greece	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Ireland	Medical Applications, Tracer in Leak Detection, Double glaze windows, Sporting goods	NA,NO	NA,NO	0.0006	13.2	0.3%
Italy	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Luxembourg	Noise reduction windows	NA,NO	NA,NO	0.0001	2.9	909.8
Netherlands	No specific allocation due to confidentiality of data	167.9	225.6	0.0090	607.4	14.4%
Portugal	NA,NO	NA,NO	NA,NO	NO	-	0.0%
Spain	NA	NA	NA	NA	-	0.0%
Sweden	Shoes, Double glaze windows	NA,NO	NA,NE,NO	0.0004	9.1	0.2%
UK	Semiconductors, Electrical and production of trainers, One Component Foams, Gibraltar F Gas Emissions	123.9	79.4	0.0269	847.3	20.1%
EU-15 Total		**298**	**519**	**0.1418**	**4,207**	**100.0%**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Figure 4.16 and Table 4.64 summarise information by Member State on emission trends, methodologies, emission factors and activity data for the key source SF_6 from 2F9 Other sources of SF_6. The emission trend is mainly driven by the emission trend in Germany.

Figure 4.16 2F9 Other: EU-15 SF_6 emissions

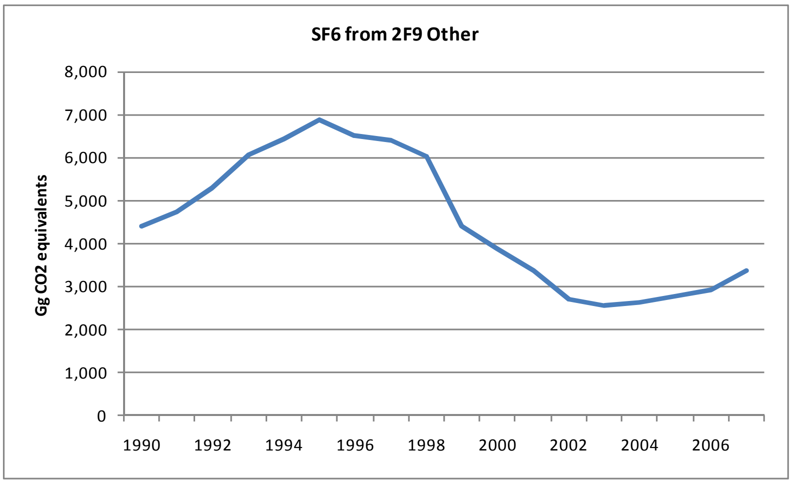


Table 4.65 2F9 Other: Member States' contributions to SF_6 emissions and information on method applied, activity data and emission factor

Member State	SF_6 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	127	274	270	8.0%	-4	-2%	143	113%	CS	Q	CS
Belgium	84	64	70	2.1%	6	9%	-13	-16%	NA	NA	NA
Denmark	12	23	15	0.5%	-8	-34%	3	28%	M/CS	CS	M/CS
Finland	8	30	15	0.4%	-14	-49%	7	94%	T1	Q	D
France	118	NO	NO	-	-	-	-118	-	0.0	0.0	0.0
Germany	3,211	1,647	2,136	63.0%	490	30%	-1,075	-33%	CS	(?)	CS
Greece	NO	NO	NO	-	-	-	-	-	0.0	0.0	0.0
Ireland	13	13	13	0.4%	0	2%	0	-2%	NO	NO	NO
Italy	NO	NO	NO	-	-	-	-	-	NA	NA	NA
Luxembourg	2	3	3	0.1%	0	2%	1	26%	CS	Q	CS
Netherlands	217	202	214	6.3%	12	6%	-3	-2%	T2, CS	PS	D, PS
Portugal	NE	NO	NO	-	-	-	-	-	NA	NA	NA
Spain	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Sweden	2	12	9	0.3%	-3	-23%	7	271%	CS	PS	D, PS
United Kingdom	604	694	644	19.0%	-50	-7%	40	7%	T1, T2	Q, AS	CS
EU-15	**4,398**	**2,961**	**3,390**	**100.0%**	**429**	**14%**	**-1,008**	**-23%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.66 provide descriptions on methods used for estimating SF_6 emissions from 2F Consumption of Halocarbons and SF_6.

Table 4.66 2F Consumption of halocarbons and SF_6: Description of national methods used for estimating SF_6 emissions

Member States	Description of methods
Austria	Semiconductors: All consumption data and data about actual emissions from semiconductor manufacture are based on direct information from industry. Because of the confidentiality claimed for consumption data in this industry emissions are reported in the CRF only for the sum of HFC and PFC. Emissions are calculated according to the formula presented below: *Emissions = Consumption*(1-emission control technology) * efficiency factor * uptime* Typical ranges of these parameters are: for emission control technology 0.01 – 0.95, for efficiency factor 0.75-0.95, and for uptime 0.9. The emission control technology applied is high temperature combustion and elution of HF with typical efficiencies of 65-95% for latest years.. Electrical Equipment: Information on SF_6 stocks in electrical equipment in 2003-2006 were obtained from energy suppliers and industrial facilities. SF_6 emissions were calculated based on the assumption that there are no emissions during first filling on site (furthermore, smaller equipment is already filled during manufacture); based on information from experts from industry, it was thus estimated that emissions during service and leakage are 1% of annual stocks.

Member States	Description of methods
	Noise insulating windows: Activity data were estimated based upon information from experts from industry. The actual emissions are the sum of emissions during production and leakage, which is estimated to be 1% of the original SF_6 filling. Emissions at disposal became relevant in 2006, because the average life time is estimated to be 25 years and the first SF_6 filled windows were introduced in Austria in 1980. They are calculated by assuming that the remaining quantity of SF_6 in windows produced in 1980 is emitted this year. Tyres: Information on the amount of SF_6 used for filling tyres was obtained from SF_6 retailers. Emissions were calculated as one third per year for the three years following consumption. Shoes: Emissions from the imported amount of shoes with SF_6 filling was obtained from the producer. It was assumed that all SF_6 is emitted at the end of the lifetime of these shoes, which was estimated to be 3 years. Research: SF_6 is used in research in electron microscope and other equipment, the annual consumption was estimated to be 100 kg per year until the total estimated stock of 500 kg was reached (1996), emissions are estimated to be 20 kg per year (after 1996 consumption = emissions).
Belgium	The SF_6 emissions originating from the production and the stock of soundproof double-glazing are calculated from the SF_6 consumption data, which have been obtained from the main manufacturers. The stock of SF_6 contained in existing glazing in Belgium is evaluated on the basis of a balance between production, import and export of this glazing , as well as emissions from the stock, over the years. From information obtained from the double glazing producers we assessed a specific export rate for each of them. The import of acoustic double glazing was estimated to be around 10% of the Belgian consumption. The emission rate of glazing from the bank is assumed to be 1% /year, as previously. The emission from production of acoustic double glazing is assumed to be 33% of the SF_6 consumption. The disposal emissions are based on an assumed unique lifetime of 25 years. SF_6 emissons from the electricity sector are based on stock and emission factor data obtained from the SYNERGRID association.
Denmark	See also General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Finland	Electrical equipment (CRF 2.F. 8) Tier 3c (country-level mass-balance), Tier 1b Tier 1a estimates can not be calculated for this source because of lack of historical data. Tier 1b estimates have been calculated, however, based on survey and emissions data, cf. section 3.1 of Oinonen (2003). Running shoes (CRF 2.F. 9) Method for adiabatic property applications, Tier 1b Tier 1a is not applicable to this category because all SF_6 used is imported not in bulk, but in products (i.e. shoes). Emissions from this source are not reported separately due to confidentiality.
France	IPCC Tier 2. Fabrication de semi-conducteurs (2F7) : Les émissions de PFC, HFC-23 et SF_6 sont calculées selon la méthode de rang 2c du GIEC à partir des consommations de gaz déclarées par les sites. Equipements électriques (2F8) : La méthode de calcul distingue les émissions à la charge des équipements à l'usine selon les quantités déclarées par les industriels à leur syndicat et les émissions du parc installé estimées par EDF qui distingue les fuites à l'usage, la maintenance et la fin de vie.
Germany	Semiconductor manufacture: The emissions cannot be determined solely on the basis of input quantities (sales by gas vendors), because the difference between consumption and emissions depends on a number of factors, including only partial chemical transformation in plasma reactors and the effects of downstream exhaust-gas-scrubbing systems. Furthermore, a residue of approximately 10 % per gas bottle must be taken into account as non-consumption. During the etching process, only about 15 % of the added CF4 react chemically. The emission factor, an inverse reaction quota, thus amounts to 85 % of the CF4 consumption. Electrical equipment: The emissions figures are based largely on a mass balance. Increasingly, they are also being combined with emission factors for sub-areas in which the technical measurement limits for mass-balancing have been reached or in which mass-balancing would necessitate unreasonably high costs. The methods used are based on the new "2006 IPCC Guidelines for National Greenhouse Gas Inventories; Volume 3", Chapter 8. For further information, the reader is referred to "Tier 3, Hybrid Life-Cycle Approach" in sub-chapter 8.2. Noise insulating windows: The EF production is 33 %, with respect to new annual consumption. The emission factor Euse of 1 % with respect to the average SF_6 stocks that have accumulated since 1975 and that are in place in year n. Disposal losses are incurred at the end of windows' service lifetimes (utilization periods), or an average of 25 years after being filled. Tyres and Shoes: The emissions are calculated using equation 3.23 of IPCC-GPG (2000).
Greece	Electrical equipment The available information is not sufficient in order to apply the methodologies suggested by the IPCC Good Practice Guidance. In the context of the present inventory emissions are estimated on the basis of information provided by PPC regarding losses in the transmission and in the distribution system. The data provided cover the period 1995 – 2007. Emissions estimates are being performed on the basis of the quantity of SF_6 consumed during the year, by the Directorate of Strategy and Planning of the PPC. Emissions for the period 1990 – 1994 are estimated (by the inventory team) by mean of a linear extrapolation.
Ireland	Semiconductor manufacture: There are two main semiconductor manufacturers in Ireland, both of which provide data on the annual use and estimated emissions of HFCs, PFCs and SF_6 in their plants over the full time series 1990-2007. Electrical equipment: The Electricity Supply Board (ESB) is the owner of both the high and low voltage distribution systems and the owner and operator of the medium and lower voltage distribution systems in Ireland. The company has supplied an estimate of SF_6 emissions from their equipment using a Tier 1 approach based on an analysis of opening and closing stocks of SF_6. Other Emission Sources (2.F.9): This category includes emissions of SF_6 from minor uses within Ireland including emissions from double glazed windows, medical applications, sporting goods and as a gas-air tracer in leak detection.
Italy	SF_6 emissions from electrical equipment have been estimated according to the IPCC Tier 2a approach from 1990 to 1994, and IPCC Tier 3c from 1995. SF_6 leaks from installed equipment have been estimated on the basis of the total amount of sulphur hexafluoride accumulated and average leakage rates; leakage data published in environmental reports have also been used for major electricity producers (ANIE, several years). Additional data on SF_6 used in high voltage gasinsulated transmission lines have been supplied by the main energy distribution companies.

Member States	Description of methods
Luxembourg	F7 – Electrical Equipment: A country specific methodology is applied: Emissions= EF● AR; The activity rate (AR) is the estimated installed capacity with the total nameplate capacity from the largest operator in Luxembourg. The yearly emissions are assumed to be 1% of the activity rate, i.e. EF=0.01. F8 – Noise reduction windows: A country specific methodology is applied: Emissions= EF● AR; The activity rate (AR) is the calculated SF_6 stock on the basis of the estimated installed noise reduction windows. The yearly emissions are assumed to be 1% of the activity rate, i.e. EF=0.01. [NIR 2008]
Netherlands	See General description of national methods used for estimating emissions from Consumption of halocarbons and SF_6.
Portugal	SF_6 emissions from electrical equipment: different estimates methodologies for electricity distribution at: (a) Very High Voltage (>110 kV): a methodology based on "Correspondent States Principle" was used (b) distribution at Low (≤1 kV), Medium (>1 kV and ≤45 kV) and High Voltage (>45 kV and ≤110 kV): estimated with a tier T3b, based on data provided by "EDP Distribuição", excluding the details in life-cycle and using a country-specific emission factor. Separate estimates were made for Gas Circuit Breakers; Outdoor Gas Insulated Switchgears; Gas Insulated Switchgears; High and Medium Voltage Sectioning Posts;
Spain	Tier 2. Category 2F8 includes the SF_6 emissions from electrical equipment. In the case of Spain, this is the only source generating emissions of this gas. De una forma general, las emisiones se pueden generar en cada uno de los siguientes puntos del ciclo de vida de los equipos eléctricos que incorporan SF_6 como aislante: 1) En la fase de fabricación del equipo (lo que incluye las operaciones de prueba y la carga de los equipos). 2) Durante la instalación en el lugar de funcionamiento del equipo. 3) Durante la fase de funcionamiento del equipo. 4) En la retirada de funcionamiento del equipo. Estos cuatro puntos o fases del ciclo vida que dan origen a las emisiones se corresponden con los respectivos cuatro términos que figuran en el segundo miembro de la ecuación siguiente, y que es la trascripción de la Ecuación 3.16 de la Guía de Buenas Prácticas de IPCC correspondiente al método de nivel 2a, que es el que se ha adoptado para la estimación de las emisiones de esta actividad: ET = EF + EI + EO + ERdonde: ET = Emisiones totales; EF = Emisiones en fabricación; EI = Emisiones en instalación; EO = Emisiones en operación de los equipos; ER = Emisiones en la retirada de los equipos
Sweden	Semiconductor manufacture: Information concerning the annually used amounts of various fluorinated substances has been provided by the company, and as far as possible been compared to information from the Products register at the Swedish Chemicals Inspectorate. Emissions are calculated by using the IPCC Good practice Guidance Tier 1 method. Electrical equipment: The SF_6 emissions from production have decreased in later years due to measures taken at the production facility. These estimates, obtained from industry, are of medium to high quality, with better quality in later years. Emissions from installed amounts of SF_6 for insulation purposes in operating systems have previously contributed less to the actual annual emissions. In 2001-2002, a questionnaire was sent out to power companies from the trade association Swedenergy (Svensk Energi) asking for the installed amounts of SF_6 in operating equipment, and the replaced amounts of SF_6 during service. The results showed an installed accumulated amount of approximately 80 Mg and an annual leakage rate of 0.6% (equals the amount replaced from the questionnaire) and these were used as input data in the inventory. For later years, data on replaced amounts of SF_6 in operating systems results in a calculated annual leakage rate of 0.5% (Swedenergy and power distribution companies). For jogging shoes, a more or less rough estimate has been made. It has not been possible to obtain any national data, so a Norwegian estimate was scaled to the Swedish population. According to the results from a study performed in early 2004 a phasing out of SF_6 and replacement with PFC-218 was started in 2003. Manufacturers of windows have provided data on the amount of SF_6 used in the manufacture of barrier gas windows. The manufacturers have also provided estimates of the share of SF_6 emitted in production. These estimates vary considerably between manufacturers, from 5-50%. Calculating a weighted average of the emission factor at production results in a national figure in the order of 30%, which is in line with the point estimate of 33% given in the IPCC Good Practice Guidance.
United Kingdom	Emissions of SF_6 from semiconductor manufacturing and from electrical equipment are combined with emissions from training shoes in source category 2F8b for reasons of commercial confidentiality. SF_6 emission from electrical transmission and distribution were based on industry data from BEAMA (for equipment manufacturers) and the Electricity Association (for electricity transmission and distribution), who provided emission estimates based on Tier 3b, but only for recent years. Tier 3a estimates were available for the electricity distribution and transmission industry for 1995. In order to estimate a historical time series and projections, these emission estimates together with fluid bank estimates provided by the utilities were extrapolated using the March study methodology (March, 1999).This involved estimating leakage factors based on the collected data and using the March model to estimate the time series.Emissions prior to 1995 used the March SF_6 consumption data to extrapolate backwards to 1990 from the 1995 estimates. Emissions of PFC and SF_6 emissions from electronics are based on data supplied by UK MEAC – the UK Microelectronics Environmental Advisory Committee.UK MEAC gave total PFC consumption for the UK electronics sector based on purchases of PFCs as reported by individual companies.Emissions were then calculated using the IPCC Tier 1 methodology, which subtracts the amount of gas left in the shipping container (10%), the amount converted to other products (between 20% and 80% depending on the gas) and the amount removed by abatement (currently assumed to be zero).Emissions for previous years were extrapolated backwards assuming an annual 15% growth in the production of semiconductors in the UK up until 1999.

Source: NIR 2009 unless stated otherwise

Table 4.67 summarizes the recommendations from the latest UNFCCC review of the inventory report in relation to the category 2F Consumption of Halocarbons. The overview shows that some recommendations have been implemented.

Table 4.67 2F Consumption of halocarbons and SF_6: Findings of the latest UNFCCC review of the inventory report and responses in 2009 inventory submissions

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF6	
	Comment in the latest UNFCCC review report	Status in 2009 submission
Austria	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Belgium	The ERT found that the method used to estimate emissions appears to be comprehensive. However, the ERT could not confirm this, as the NIR does not provide sufficiently detailed information on the method used (e.g. in the case of refrigeration and air conditioning equipment, the NIR does not state whether or not all of the phases of the life cycle are covered for all activities). The ERT recommends that Belgium further improve the transparency of the methods used by providing detailed methodological information and the assumptions used in the NIR. In addition, the ERT recommends that Belgium improve the reporting of background data and quantitative explanations in the CRF.	Partly resolved; Description on phases of life cycle included in NIR. Background data are provided at aggregated level in the CRF.
Denmark	The ERT encourages Denmark to further analyse the cause of the overall trend and inter-annual changes in emissions from each subcategory in this category, and to provide further explanation of this in the NIR in its next annual submission. According to the NIR, a comparison of potential and actual emissions was only carried out in 1995–1997 and, for all three years, the potential emissions are approximately higher than actual emissions by a factor of 3. However, there is no further explanation in the NIR of the difference between potential and actual emissions. The ERT encourages Denmark to compare potential and actual emissions for the whole time series and to analyse the reason for any differences, with a view to improving its determination of EFs over time.	Partly resolved; trend description is included for the major sources. No further comparison and analysis of potential vs. Actual emissions is provided.
Finland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
France	Potential emissions of F-gases are reported as not estimated. During previous stages of the review, the ERT was informed that France planned to report potential emissions of F-gases in its next inventory submission, if possible. The ERT recommends that France implement this plan in order to improve the completeness of its reporting in line with the UNFCCC reporting guidelines. During the review, the ERT raised several questions regarding the parameters that were considered as outliers, such as the product life factor for 1, 1, 1, 2-tetrafluoroethane, pentafluoroethane and 1, 1, 1-trifluoroethane. The Party clarified that the inventory is based on a model developed and updated by the Ecole des Mines de Paris, and that surveys are carried out for commercial refrigeration. The Party also clarified that the Ecole des Mines de Paris intends to examine cross-country comparisons. The ERT encourages the Party to carry out these comparisons as a QA/QC procedure, report the results and provide more detailed documentation of the methodology used in its next inventory submission.	Not resolved; potential emissions are not calculated in the 2009 submission. Not resolved; No information included in the NIR 2009.
Germany	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Greece	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Ireland	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Italy	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Luxembourg	At the time of the review, the ERT noted that a consultant was carrying out a study on the estimation of HFC, PHF and SF6 emissions (Econotec, 2008). The ERT recommends that Luxembourg ensure that the study is in line with the IPCC good practice guidance, that assumptions are transparent and correspond to circumstances in Luxembourg, and that the Party allow for further improvements based on country-specific data. The ERT recommends that estimates should be based primarily on data collected in the country rather than data or studies carried out in neighbouring countries (these should be used mainly as QA/QC tools). The ERT recommends that Luxembourg continue to implement procedures that make it possible to track the flow and amount of HFCs, PFCs and SF6 (in bulk and equipment) in the country, leading to more accurate emission estimates.	Not resolved; NIR 2009 not available yet.

Member State	Review findings and responses related to 2.F. Consumption of halocarbons and SF6	
	Comment in the latest UNFCCC review report	Status in 2009 submission
Netherlands	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
Portugal	No recommendation for improvement for this source category in the report of the review of the initial report. [IRR]	No follow-up necessary
Spain	Spain is planning to improve its emission estimates by reviewing the AD and parameters used to estimate emissions with a focus on the refrigeration and air conditioning equipment category. Spain is encouraged to continue with its planned improvements by looking for other possible sources of information, involving other ministries and industry contacts, for its next annual inventory submission.	Not resolved; part of the planned improvements.
Sweden	No recommendation for improvement for this source category in the latest review report.	No follow-up necessary
UK	The United Kingdom has reported emissions of HFCs, PFCs and SF6 as “unspecified mixes”. The ERT welcomes the Party’s plan to comply with the UNFCCC reporting guidelines by reporting emissions of these gases in a more disaggregated way in its 2010 submission. As part of this work, the ERT recommends that the United Kingdom report emissions of F-gases by species in metric tonnes, the unit used in the sectoral background data tables. The Party also supplied the ERT with a new model and stated that it intends to report emissions using the new model in its 2009 submission. The ERT welcomes this new model, which was developed with the assistance of industry representatives, and recommends that the United Kingdom document the recalculation transparently in its next annual submission. The ERT also recommends, since the new model suggests slightly higher emission estimates for the recent years, that the United Kingdom assess the effect of the change in methodology on the overall pattern of consumption of HFCs in different applications in the country.	Partly resolved; HFC, PFC and SF6 emissions are still reported as unspecified mix. Documentation on source specific recalculations is included in NIR 2009.

Sources: Review Report 2008 unless stated otherwise; NIR 2009 unless stated otherwise

4.2.6 Other (CRF Source Category 2G) (EU-15)

Table 4.68 shows that only three Member States reports GHG emissions under 2G Other for the year 2007. The Netherlands include CO_2, CH_4 and N_2O emissions from fireworks and candles, degassing drinkwater from groundwater and process emissions in other economic sectors; Germany reports due to confidentiality reasons aggregated SF_6 emissions from shoes, AWACS maintainance and welding; and Denmark include CO_2 emissions from lubricants in this category.

Table 4.68 2G Other: Overview of sources reported under this source category for 2007

Member State	2.G Other	CO_2 emissions [Gg]	CH_4 emissions [Gg]	N_2O emissions [Gg]	HFC emissions [Gg CO_2 equivalents]	PFC emissions [Gg CO_2 equivalents]	SF_6 emissions [Gg]	Total emissions [Gg CO2 equivalents]	Share in EU-15 Total
Austria	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Belgium	NA,NE	NA,NE	NA	NA	NA	NA	NA	-	0.0%
Denmark	Lubricants	37.9	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	37.9	5.6%
Finland	NA	NA	NA	NA	NA	NA	NA	-	0.0%
France	NA,NO	NO	NO	NO	NA,NO	NO	NO	-	0.0%
Germany	Other non-specified	NO	NO	NO	NA,NO	NO	0.0132	316	46.8%
Greece	NA,NO	NO	NO	NO	NA,NO	NO	NO	-	0.0%
Ireland	NA,NO	NO	NO	NO	NA,NO	NO	NO	-	0.0%
Italy	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Luxembourg	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Netherlands	Fireworks and candles, Degassing drinkwater from groundwater, Process emissions in other economic sectors	277.8	1.8	0.02	NA,NO	NO	NO	321	47.5%
Portugal	NA,NO	NO	NO	NO	NA,NO	NO	NO	-	0.0%
Spain	NA	NA	NA	NA	NA	NA	NA	-	0.0%
Sweden	NA	NO	NO	NO	NA,NO	NO	NO	-	0.0%
UK	NA	NA	NA	NA	NA	NA	NA	-	0.0%
EU-15 Total		**316**	**2**	**0**	**0**	**0**	**0.0132**	**675**	**100.0%**

Abbreviations explained in the Chapter ‘Units and abbreviations’.

4.3 Methodological issues and uncertainties (EU-15)

The previous section presented for each EU-15 key source in CRF Sector 2 an overview of the Member States' contributions to the key source in terms of level and trend, information on methodologies, emission factors, completeness and qualitative uncertainty estimates. Detailed information on national methods and circumstances is available in the Member States' national inventory reports.

Table 4.69 shows the total EU-15 uncertainty estimates for the sector 'Industrial processes' and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for CO_2 from 2A6 and the lowest for SF_6 from 2E. With regard to trend CO_2 from 2A6 shows the highest uncertainty estimates, CO_2 from 2D and 2G the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 4.69 Sector 2 Industrial processes: Uncertainty estimates for the EU-15

Source category	Gas	Emissions 1990	Emissions 2007	Emission trends 1990-2007	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
2.A.1 Cement production	CO_2	80 357	87 106	8%	2.6%	8
2.A.2 Lime production	CO_2	17 350	17 942	3%	9.0%	1
2.A.3 Limestone and dolomite use	CO_2	5 869	7 392	26%	6.8%	244
2.A.4 Soda ash production and use	CO_2	1 702	1 983	16%	14.8%	6
2.A.5 Asphalt roofing	CO_2	0.019	0.005	-74%	25.5%	19
2.A.6 Road paving with asphalt	CO_2	25	11	-57%	4869.3%	1793
2.A.7 Other	CO_2	4 401	4 865	11%	12.2%	257
2.B Chemical industry	CO_2	27 820	32 307	16%	11.6%	2
2.C Metal production	CO_2	77 420	73 837	-5%	5.1%	1
2.D Other Production	CO_2	73	29	-60%	100.0%	0
2.G Other	CO_2	282	316	12%	20.6%	0
2.A Mineral products	CH_4	24	20	-16%	92.7%	21
2.B Chemical industry	CH_4	554	438	-21%	26.0%	15
2.C Metal production	CH_4	105	162	55%	8.6%	1
2.G Other	CH_4	42	37	-13%	51.0%	1
2.B Chemical industry	N_2O	100 579	36 584	-64%	16.4%	901
2.C Metal production	N_2O	13	10	-22%	20.1%	3
2.G Other	N_2O	3	6	121%	70.7%	85
2.C Metal production	HFC	0	10	-	30.0%	-
2.E Production of halocarbons and SF_6	HFC	27 459	1 832	-93%	9.7%	12
2.F Consumption of halocarbons and SF_6	HFC	555	54 793	9773%	22.8%	66
2.C Metal production	PFC	13 341	1 430	-89%	7.0%	5
2.E Production of halocarbons and SF_6	PFC	2 898	322	-89%	20.4%	10.9
2.F Consumption of halocarbons and SF_6	PFC	585	1 591	172%	6.3%	5
2.C Metal production	SF_6	1 732	2 990	73%	26.3%	122
2.E Production of halocarbons and SF_6	SF_6	1 815	0	-100%	0.1%	24
2.F Consumption of halocarbons and SF_6	SF_6	7 096	5 903	-17%	8.0%	24
Total	**all**	**372 437**	**332 326**	**-11%**	**3.9%**	**4**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories; uncertainty estimates include for Spain 2006 data.

4.4 Sector-specific quality assurance and quality control (EU-15)

There are two main activities for improving the quality of GHG emissions from industrial processes: (1) Before and during the compilation of the EC GHG inventory several checks are made of the Member States data in particular for time series consistency of emissions and implied emission factors, comparisons of implied emission factors across Member States and checks of internal consistency. (2) In the second half of the year the EC internal review is carried out for selected source categories. In 2006 the following source categories have been reviewed by Member States experts: 2A Mineral Products, 2B Chemical Industry, 2C Iron and Steel Production and Fluorinated Gases, 2E Production of Halocarbons and SF_6 and 2F Consumption of Halocarbons and SF_6. In 2008, completeness and allocation issues have been reviewed by Member States experts for all source categories in Industrial Processes.

For the inventory 2005 for the first time plant-specific data was available from the EU Emission Trading Scheme (EU ETS). This information has been used by EC Member States for quality checks and as input for calculating total CO_2 emissions for the sectors Energy and Industrial Processes in this report (see Section 1.4.2).

In addition, Eurostat has started a project for evaluating the quality of Eurostat activity data (industrial production data) for the use in the EC GHG inventory.

4.5 Sector-specific recalculations (EU-15)

Table 4.70 shows that in the industrial processes sector the largest recalculations in absolute terms were made for CO_2 in 1990 and 2006.

Table 4.70 Sector 2 Industrial processes: Recalculations of total GHG emissions and recalculations of GHG emissions for 1990 and 2006 by gas (Gg CO_2 equivalents) and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	52,613	1.7%	-3,524	-0.8%	-12,777	-3.2%	11	0.0%	-680	-3.9%	0	0.0%
Industrial Processes	-310	-0.1%	40	5.7%	390	0.4%	11	0.0%	-680	-3.9%	0	0.0%
2006												
Total emissions and removals	48,924	1.6%	293	0.1%	-16,310	-5.2%	58	0.1%	-299	-6.9%	165	1.9%
Industrial Processes	-477	-0.2%	23	3.8%	-198	-0.5%	499	1.0%	-94	-1.8%	73	0.8%

Table 4.71 provides an overview of Member States' contributions to EU-15 recalculations.

Table 4.71 Sector 2 Industrial processes: Contribution of Member States to EU-15 recalculations for 1990 and 2006 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2006					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	0	0	0	105	0	0	0	0	0
Belgium	-5	0	0	0	-680	0	-35	0	-1	4	0	0
Denmark	50	0	0	0	0	0	38	0	0	0	0	0
Finland	-59	-4	0	0	0	0	-27	-7	0	0	0	0
France	-8	0	0	0	0	0	18	0	0	385	-86	0
Germany	27	0	-6	0	0	0	-71	0	-6	555	-10	74
Greece	-186	0	396	0	0	0	317	-1	-191	-1,431	0	0
Ireland	1	0	0	0	0	0	0	0	0	0	0	0
Italy	-78	0	0	0	0	0	-907	0	0	0	-2	11
Luxembourg	0	0	0	0	-	0	39	0	0	0	-	0
Netherlands	-44	0	0	0	0	0	-45	0	0	-4	0	-5
Portugal	0	0	0	0	0	0	334	0	0	3	0	-5
Spain	-10	11	0	0	0	0	-88	1	0	0	0	0
Sweden	0	0	0	0	0	0	518	0	0	0	0	0
UK	0	33	0	10	0	0	-673	29	0	987	5	-1
EU-15	**-310**	**40**	**390**	**11**	**-680**	**0**	**-477**	**23**	**-198**	**499**	**-94**	**73**

4.6 Industrial processes for EU-27

4.6.1 Overview of sector (EU-27)

Figure 4.17 CRF Sector 2 Industrial Processes: EU-27 GHG emissions for 1990–2007 in CO_2 equivalents (Tg)

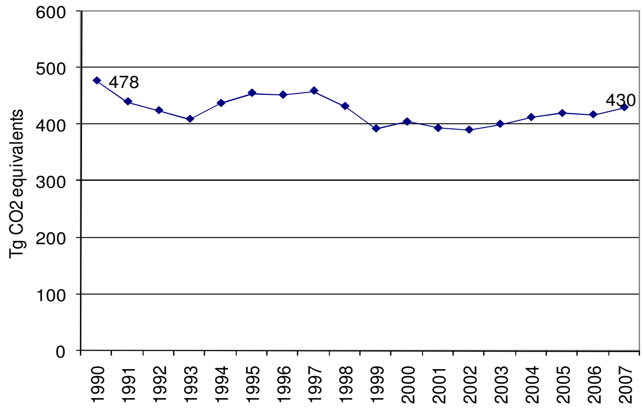
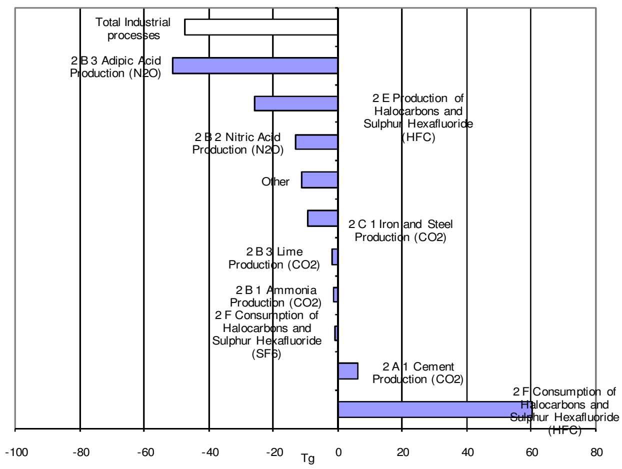
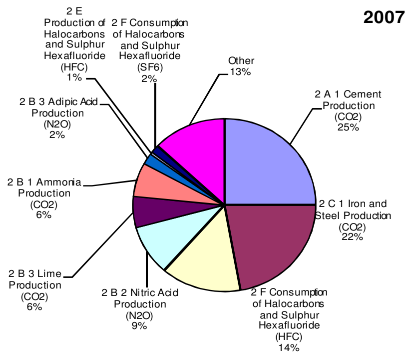


Figure 4.18 CRF Sector 2 Industrial processes: Absolute change of GHG emissions by large key source categories 1990–2007 in CO_2 equivalents (Tg) and share of largest key source categories in 2007





4.6.2 Source categories (EU-27)

4.6.2.1 Mineral products (CRF Source Category 2A) (EU-27)

Table 4.72 2A1 Cement production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	80.357	85.150	87.106	81,0%	1.956	2%	6.748	8%			
Bulgaria	2.070	1.488	1.897	1,8%	409	27%	-173	-8%	T2	NS	D
Cyprus	614	821	812	0,8%	-9	-1%	199	32%	T2	PS	D
Czech Republic	2.489	1.748	2.043	1,9%	295	17%	-446	-18%	T2	NS	CS
Estonia	483	414	597	0,6%	183	44%	114	24%	CS	PS	CS
Hungary	1.673	1.295	1.328	1,2%	33	3%	-344	-21%	D,T2,T3	PS	PS
Latvia	366	133	172	0,2%	38	29%	-194	-53%	T2	PS	PS
Lithuania	1.668	516	524	0,5%	8	2%	-1.144	-69%	T2	NS	PS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	5.453	5.984	7.050	6,6%	1.067	18%	1.597	29%	T1	NS	CS
Romania	4.416	3.631	4.027	3,7%	396	11%	-389	-9%	T2, CS	AS, Q, NS	PS
Slovakia	1.438	1.364	1.458	1,4%	94	7%	20	1%	T2	PS	CS
Slovenia	482	523	556	0,5%	33	6%	74	15%	T2	PS	PS
EU-27	**101.509**	**103.068**	**107.570**	**100,0%**	**4.502**	**4%**	**6.061**	**6%**			

Table 4.73 2A2 Lime Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	17.350	17.733	17.942	69,9%	208	1%	592	3%			
Bulgaria	1.222	1.038	1.061	4,1%	23	2%	-161	-13%	T1	NS	D
Cyprus	4	10	10	0,0%	-1	-5%	6	161%	T1	Q, NS	D
Czech Republic	1.337	758	794	3,1%	36	5%	-543	-41%	D	NS	CS
Estonia	145	31	34	0,1%	3	10%	-111	-76%	T1	PS	CS
Hungary	653	304	301	1,2%	-3	-1%	-352	-54%	D, T2	PS	D
Latvia	121	1	1	0,0%	0	-15%	-120	-99%	T2	PS	PS
Lithuania	216	49	42	0,2%	-7	-14%	-174	-80%	T1	NS	D
Malta	NE	NO	NO	-	-	-	-	-	D	NS	PS
Poland	2.512	1.520	1.682	6,6%	162	11%	-830	-33%	0,0	0,0	0,0
Romania	3.080	1.975	2.767	10,8%	793	40%	-312	-10%	D	NS	D
Slovakia	770	854	897	3,5%	43	5%	127	16%	T2	PS	CS
Slovenia	206	134	123	0,5%	-11	-8%	-83	-40%	T2	PS	PS
EU-27	**27.617**	**24.408**	**25.655**	**100,0%**	**1.247**	**5%**	**-1.962**	**-7%**			

Abbreviations explained in the Chapter ‘Units and abbreviations’.

Table 4.74 2A3 Limestone and Dolomite Use: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	5.869	7.835	7.392	67,3%	-443	-6%	1.522	26%			
Bulgaria	482	329	141	1,3%	-189	-57%	-341	-71%	D	NS	D
Cyprus	NA	NA	NA	-	-	-	-	-	NO	NO	NO
Czech Republic	678	1.069	1.106	10,1%	37	3%	428	63%	CS	NS	CS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Hungary	202	321	329	3,0%	8	2%	126	62%	D, T2	PS	D
Latvia	0	31	33	0,3%	2	6%	33	9265%	T1	PS	D
Lithuania	4	0,4	0,5	0,0%	0	13%	-4	-89%	NA	NE	NA
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	IE	618	594	5,4%	-24	-4%	594	-	0,0	0,0	0,0
Romania	1.221	946	946	8,6%	0	0%	-275	-23%	OTH 1	Q, PS	D
Slovakia	302	455	429	3,9%	-26	-6%	127	42%	T2	PS	CS
Slovenia	2	6	6	0,1%	0	3%	4	153%	T1	PS	D
EU-27	**8.762**	**11.610**	**10.976**	**100,0%**	**-634**	**-5%**	**2.214**	**25%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.6.2.2 Chemical industry (CRF Source Category 2B) (EU-27)

Table 4.75 2B1 Ammonia Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	17.023	15.659	16.553	60,2%	894	6%	-470	-3%			
Bulgaria	1.620	467	532	1,9%	65	14%	-1.088	-67%	T1	NS	CS
Cyprus	NO	NO	NO	-	-	-	-	-	IE	IE	IE
Czech Republic	807	581	544	2,0%	-37	-6%	-262	-33%	T1	NS	CS
Estonia	317	135	124	0,5%	-10	-8%	-193	-61%	T1a,T1b	PS	CS
Hungary	1.416	773	844	3,1%	71	9%	-571	-40%	T3	PS	D, PS
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	1.190	1.129	2.329	8,5%	1.200	106%	1.139	96%	T2	PS	PS
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	2.811	4.230	4.209	15,3%	-22	-1%	1.397	50%	T2	NS	CS
Romania	3.267	2.370	2.057	7,5%	-314	-13%	-1.211	-37%	T1b	NS	D
Slovakia	356	351	327	1,2%	-24	-7%	-29	-8%	T2	PS	PS
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**28.806**	**25.695**	**27.519**	**100,0%**	**1.824**	**7%**	**-1.288**	**-4%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.76 2B5 Other: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	9.951	15.126	15.538	100,0%	412	3%	5.586	56%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	0	0	0	-	-	-	-	-
Czech Republic	IE,NA	IE,NA	IE,NA	-	-	-	-	-
Estonia	NA	NA	NA	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Poland	0	0	0	-	-	-	-	-
Romania	NE	NE,NO	NE,NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-27	**9.951**	**15.126**	**15.538**	**100,0%**	**412**	**3%**	**5.586**	**56%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.77 2B2 Nitric acid production: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	37.145	27.610	25.925	64,4%	-1.684	-6%	-11.220	-30%			
Bulgaria	2.255	900	1.324	3,3%	424	47%	-931	-41%	D	NS	D
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	1.127	915	773	1,9%	-143	-16%	-354	-31%	T2	NS, PS	PS
Estonia	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Hungary	3.214	1.430	906	2,3%	-524	-37%	-2.308	-72%	T3	PS	PS,D
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	771	2.006	2.579	6,4%	574	29%	1.808	234%	T1	PS	D
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	3.163	4.414	4.553	11,3%	139	3%	1.389	44%	T1	NS	CS
Romania	4.402	2.507	2.769	6,9%	262	10%	-1.633	-37%	D	Q , PS	D,C
Slovakia	1.149	1.565	1.412	3,5%	-153	-10%	263	23%	T2	PS	PS
Slovenia	NO	NO	NO	-	-	#WERT!	-	-	NO	NO	NO
EU-27	**53.227**	**41.346**	**40.241**	**100,0%**	**-1.105**	**-3%**	**-12.986**	**-24%**			

Table 4.78 2B3 Adipic Acid Production: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	58.927	6.568	8.965	100,0%	2.397	37%	-49.962	-85%			
Bulgaria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Cyprus	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Czech Republic	NO	NO	NO	-	-	-	-	-	0,0	0,0	0,0
Estonia	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Hungary	NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	372	NO	NO	-	-	-	-372	-100%	0,0	0,0	0,0
Romania	574	NO	NO	-	-	-	-574	-100%	NA	NO3	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**59.872**	**6.568**	**8.965**	**100,0%**	**2.397**	**37%**	**-50.907**	**-85%**			

Table 4.79 2B5 Other: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4.508	1.973	1.694	83,9%	-279	-14%	-2.814	-62%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	0	0	0	-	-	-	-	-
Czech Republic	84	94	94	4,7%	0	0%	11	13%
Estonia	NA	NA	NA	-	-	-	-	-
Hungary	NO	NO	NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NO	NO	-	-	-	-	-
Malta	NO	NO	NO	-	-	-	-	-
Poland	143	235	232	11,5%	-3	-1%	89	62%
Romania	NE	NE,NO	NE,NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-27	**4.734**	**2.302**	**2.020**	**100,0%**	**-283**	**-12%**	**-2.715**	**-57%**

4.6.2.3 Metal production (CRF Source Category 2C) (EU-27)

Table 4.80 2C1 Iron and Steel Production: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	71.751	66.558	68.506	71,6%	1.948	3%	-3.245	-5%			
Bulgaria	1.793	1.548	1.440	1,5%	-108	-7%	-353	-20%	D	NS	CS
Cyprus	NA	NA	NA	-	-	-	-	-	T2	NS	C
Czech Republic	12.533	8.425	8.030	8,4%	-396	-5%	-4.503	-36%	T1	NS	D
Estonia	NA,NE	NA,NE	NA,NE	-	-	-	-	-	NA	NO	NA
Hungary	380	270	290	0,3%	20	8%	-90	-24%	CS	IS	D
Latvia	13	13	13	0,0%	0	2%	0	0%	T2	PS	PS
Lithuania	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Poland	7.627	8.367	8.342	8,7%	-25	0%	714	9%	/T2/T3/CS	NS/ /Q /PS	CS/PS
Romania	10.291	8.129	8.441	8,8%	312	4%	-1.851	-18%	T2	PS, Q	D,CS
Slovakia	420	564	535	0,6%	-28	-5%	115	27%	T2	PS	CS
Slovenia	30	29	28	0,0%	-1	-2%	-2	-5%	T2	PS	PS
EU-27	**104.838**	**93.901**	**95.625**	**100,0%**	**1.723**	**2%**	**-9.214**	**-9%**			

Table 4.81 2C3 Aluminium Production: PFC emissions of EU-27

Member State	PFC emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	13.341	1.568	1.430	58,8%	-139	-9%	-11.911	-89%			
Bulgaria	NA,NE,NO	NA,NO	NA,NO	-	-	-	-	-	NO	NO	NO
Cyprus	NO	NO	NO	-	-	-	-	-	T3b	PS	PS
Czech Republic	NO	NO	NO	-	-	-	-	-	0,0	0,0	0,0
Estonia	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Hungary	271	NO	NO	-	-	-	-271	-100%	D, T2	PS	D, PS
Latvia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	NO	NO	NO	-	-	-	-	-	0,0	0,0	0,0
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	NA	253	261	10,7%	8	3%	261	-	0,0	0,0	0,0
Romania	2.116	610	626	25,7%	16	3%	-1.490	-70%	T3	PS, Q	PS
Slovakia	271	36	25	1,0%	-11	-31%	-246	-91%	T1	PS	D
Slovenia	257	116	92	3,8%	-24	-21%	-166	-64%	T3	PS	PS
EU-27	**16.257**	**2.583**	**2.433**	**100,0%**	**-150**	**-6%**	**-13.824**	**-85%**			

4.6.2.4 Production of halocarbons and SF6 (CRF Source Category 2E) (EU-27)

Table 4.82 2E1 By-Product Emissions: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents	(%)	(Gg CO_2 equivalents	(%)
EU-15	21.158	1.767	1.245	100,0%	-522	-30%	-19.913	-94%
Bulgaria	NO	NO	NA,NO	-	-	-	-	-
Cyprus	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Czech Republic	NO	NA,NO	NA,NO	-	-	-	-	-
Estonia	NO	NO	NO	-	-	-	-	-
Hungary	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Latvia	NO	NO	NO	-	-	-	-	-
Lithuania	NO	NA,NO	NA,NO	-	-	-	-	-
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	-
Poland	NE	NE,NO	NA,NE,NO	-	-	-	-	-
Romania	NO	NO	NO	-	-	-	-	-
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	NA,NO	NA,NO	NA,NO	-	-	-	-	-
EU-27	**21.158**	**1.767**	**1.245**	**100,0%**	**-522**	**-30%**	**-19.913**	**-94%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

4.6.2.5 Consumption of halocarbons and SF6 (CRF Source Category 2F) (EU-27)

Table 4.83 2F1 Refrigeration and Air conditioning: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	89	38.212	41.176	88,5%	2.964	8%	41.086	45914%			
Bulgaria	NE	NE	NE	-	-	-	-	-	NE	NE	NE
Cyprus	0	53	21	0,0%	-32	-61%	21	-	T2a	Q, IS	D
Czech Republic	NO	805	1.518	3,3%	713	89%	1.518	-	T2	Q	D
Estonia	NO	93	108	0,2%	15	16%	108	-	T2	Q	CS
Hungary	NO	595	598	1,3%	3	1%	598	-	CS	Q	CS
Latvia	IE,NA,NE	18	34	0,1%	16	90%	34	-	PS	PS	PS
Lithuania	NA	19	24	0,1%	5	25%	24	-	0,0	0,0	0,0
Malta	0,001	NE,NO	NE,NO	-	-	-	-0,001	-100%	D	AS	D
Poland	NE,NO	2.196	2.676	5,8%	480	22%	2.676	-	0,0	0,0	0,0
Romania	NO	6	14	0,0%	8	139%	14	-	T2	PS, Q	D
Slovakia	NO	196	223	0,5%	27	14%	223	-	D	AS	CS
Slovenia	NO	111	130	0,3%	19	17%	130	-	T2	NS, PS, Q	D
EU-27	**89**	**42.305**	**46.522**	**100,0%**	**4.218**	**10%**	**46.433**	**51888%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 4.84 2F4 Aerosols/Meterd Dose Inhalers: HFC emissions of EU-27

Member State	HFC (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	67	7.798	7.569	94,8%	-229	-3%	7.502	11156%			
Bulgaria	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NE	NE	NE
Cyprus	0	0	0	0,0%	-	-	0	-	NA	NA	NA
Czech Republic	NO	42	51	0,6%	9	21%	51	-	D	Q	D
Estonia	NO	3	3	0,04%	0	-	3	-	T2	Q	CS
Hungary	NO	6	9	0,1%	4	66%	9	-	D, T1	PS	CS
Latvia	NE,NO	2	3	0,03%	0,5	22%	3	-	PS	PS	PS
Lithuania	NA	NE	NE	-	-	-	-	-	0,0	0,0	0,0
Malta	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NE	NE	NE
Poland	NA,NO	346	346	4,3%	-1	0%	346	-	0,0	0,0	0,0
Romania	NO	NO	NO	-	-	-	-	-	NA	NE	NA
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**67**	**8.197**	**7.981**	**100,0%**	**-217**	**-3%**	**7.913**	**11768%**			

**Table 4.85	2F9 Other: SF_6 emissions of EU-27**

Member State	SF_6 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	4.398	2.961	3.390	98,0%	429	14%	-1.008	-23%			
Bulgaria	NE	NE	NE	-	-	-	-	-	NO	NO	NO
Cyprus	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Czech Republic	NO	12	9	0,3%	-3	-22%	9	-	T2	Q	D
Estonia	NO	0	0,03	-	-	-	0,03	-	T2	Q	CS
Hungary	NO	83	57	1,6%	-26	-31%	57	-	---	---	---
Latvia	NO	NO	NO	-	-	-	-	-	PS	PS	PS
Lithuania	NA	NO	NO	-	-	-	-	-	0,0	0,0	0,0
Malta	NA	NA	NA	-	-	-	-	-	NA	NA	NA
Poland	NA	NA	NA	-	-	-	-	-	0,0	0,0	0,0
Romania	NO	NO	3	0,1%	3	-	3	-	T2	PS, Q	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NA	NA	NA	-	-	-	-	-	T2	AS	PS
EU-27	**4.398**	**3.056**	**3.459**	**100,0%**	**403**	**13%**	**-939**	**-21%**			

Abbreviations explained in the Chapter ‘Units and abbreviations’.

5 Solvent and other product use (CRF Sector 3)

This chapter provides sections on emission trends, methods and on recalculations in CRF Sector 3 Solvent and Other Product Use. In response to the UNFCCC review findings this report for the first time includes more detailed descriptions of methods used by Member States.

The use of solvents manufactured using fossil fuels as feedstocks can lead to evaporative emissions of various non-methane volatile organic compounds (NMVOC), which are subsequently further oxidised in the atmosphere. Fossil fuels used as solvent are notably white spirit and kerosene (paraffin oil). White spirit is used as an extraction solvent, as a cleaning solvent, as a degreasing solvent and as a solvent in aerosols, paints, wood preservatives, lacquers, varnishes and asphalt products. White spirit is the most widely used solvent in the paint industry.

The following sources are covered by sector Solvent and other procut use:

CRF	SNAP	Description	CRF	SNAP	Description
3 A	0601	Paint application	**3 B**	0602	Degreasing, dry cleaning and electronics
	060101	Paint application : manufacture of automobiles		060201	Metal degreasing
	060102	Paint application : car repairing		060202	Dry cleaning
	060103	Paint application : construction and buildings		060203	Electronic components manufacturing
	060104	Paint application : domestic use (except 060107)		060204	Other industrial cleaning
	060105	Paint application : coil coating			
	060106	Paint application : boat building			
	060107	Paint application : wood			
	060108	Other industrial paint application			
	060109	Other non industrial paint application			
3 C	0603	Chemical products manufacturing or processing	**3 D**	0604	Other use of solvents and related activities
	060301	Polyester processing		060401	Glass wool enduction
	060302	Polyvinylchloride processing		060402	Mineral wool enduction
	060303	Polyurethane processing		060403	Printing industry
	060304	Polystyrene foam processing		060404	Fat, edible and non edible oil extraction
	060305	Rubber processing		060405	Application of glues and adhesives
	060306	Pharmaceutical products manufacturing		060406	Preservation of wood
	060307	Paints manufacturing		060407	Underseal treatment and conservation of vehicles
	060308	Inks manufacturing		060408	Domestic solvent use (other than paint application)
	060309	Glues manufacturing		060409	Vehicles dewaxing
	060310	Asphalt blowing		060411	Domestic use of pharmaceutical products
	060311	Adhesive, magnetic tapes, films and photographs		060412	Other (preservation of seeds,...)
	060312	Textile finishing	**3 D**	0605	Use of HFC, N_2O, NH_3, PFC and SF6
	060313	Leather tanning		060501	Anaesthesia
	060314	Other		060505	Fire extinguishers
				060506	Aerosol cans
				060508	Other
			NOT included in this sector		
			2 F 1	060502	Refrigeration and air conditioning equipments
			2 G	060503	Refrigeration and air conditioning equipments using other products than halocarbons
			2 F 2	060504	Foam blowing (except 060304)
			2 F 6	060507	Electrical equipments (except 060203)

5.1 Overview of sector (EU-15)

CRF Sector 3 Solvent and Other Product Use contributes 0.2 % to the total EU-15 GHG emissions (Table. 5.5). The EU-15 Member states jointly achieved a emissions reduction of about 24 % from 13.7 Tg in 1990 to 10.5 Tg in 2007 (Figure 5.1 and Table 5.1).

As it is shown in Table 5.1 and Figure 5.2, in the period 1990 to 2007 an emission reduction in this sector could be archieved by

- Germany (2,080 Gg CO_2eq; -39 %),
- France (701 Gg CO_2eq; -34 %),
- The Netherlands (336 Gg CO_2eq; -62 %),
- Italy (262 Gg CO_2eq; -11 %)
- Austria, Finland, Denmark, Sweden, Greece, Ireland, and Luxembourg (together 292 Gg CO_2eq; -8 %)

The Member States with the highest increase in emission in this sector are Portugal with 127 Gg CO_2eq (58 %) and Spain with (286 Gg CO_2eq; 21 %).

Figure 5.1 Sector 3 Solvent and Other Product Use: EU-15 GHG emissions for 1990–2007 in CO_2 equivalents (Tg)

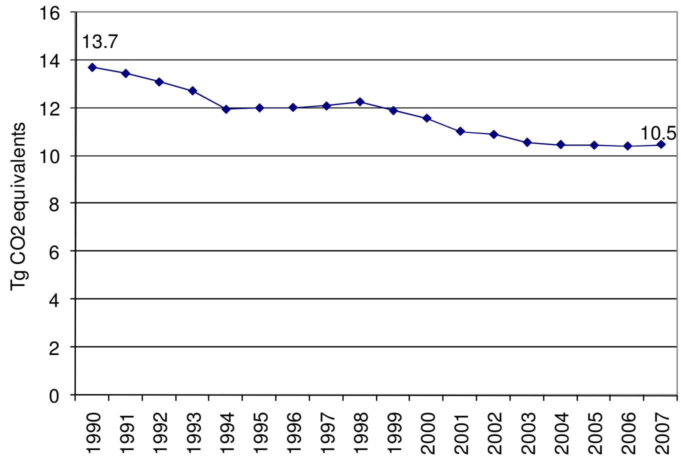
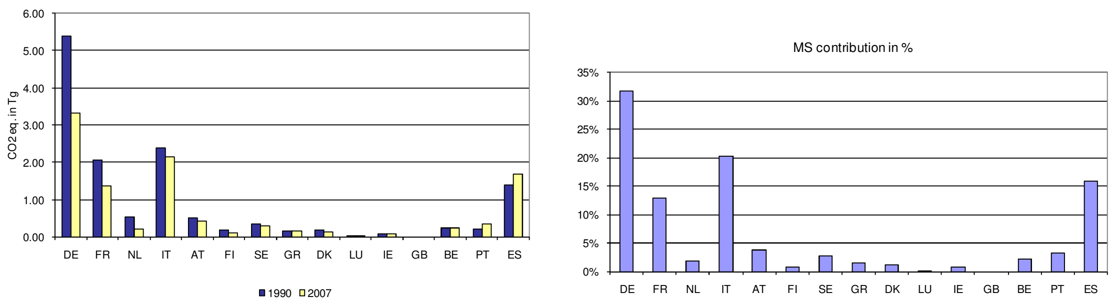


Figure 5.2 Sector 3 Solvent and Other Product Use: GHG emissions of EU-15 MS for 1990 and 2006 as well as Member States' contributions to GHG emissions for 2006 in percentage



In 2007, the emissions increased by 0.7 % compared to 2006 (Table 5.1). In this period the highest emission reduction in absolute terms was achieved by France (-32 Gg CO_2eq; -2 %).

The Member States with the highest emission increases in this sector is Spain (157 Gg CO_2eq; 10 %) and Portugal (7 Gg CO_2eq; 2 %). In the Member States Irland, Greece and Luxembourg, a slight increase could be noted.

As it is shown in Table 5.1 the Member States Germany and Italy are jointly responsible for 52 % of the total EU-15 GHG emissions in this sector and Spain and France are jointly responsible for 29 % of the total EU-15 GHG emissions in this sector. The remaining 19 % of GHG emissions of this sector emanate from all other EU-15 Member States each with shares of 4 % or even less.

Table 5.1 Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emissions

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	512	412	409	3.9%	-3	-1%	-103	-20%
Belgium	246	247	247	2.4%	0	0%	0	0%
Denmark	179	130	124	1.2%	-6	-5%	-55	-31%
Finland	178	100	97	0.9%	-3	-3%	-81	-46%
France	2,062	1,393	1,361	13.0%	-32	-2%	-701	-34%
Germany	5,396	3,345	3,316	31.7%	-29	-1%	-2,080	-39%
Greece	170	160	160	1.5%	1	0%	-9	-6%
Ireland	79	81	83	0.8%	2	2%	4	5%
Italy	2,394	2,147	2,133	20.4%	-14	-1%	-262	-11%
Luxembourg	24	18	19	0.2%	0.9	5%	-5	-21%
Netherlands	541	216	205	2.0%	-11	-5%	-336	-62%
Portugal	220	339	346	3.3%	7	2%	127	58%
Spain	1,388	1,517	1,674	16.0%	157	10%	286	21%
Sweden	332	294	294	2.8%	0	0%	-38	-12%
United Kingdom	0	0	0	0.0%	0	-	0	-
EU-15	**13,723**	**10,399**	**10,469**	**100.0%**	**69**	**0.7%**	**-3,254**	**-24%**

In the following table the emission of CO_2, N_2O and NMVOC as well as the Total GHG emission for the EU 15 and for all EU15 Member States are listed as recommended in IRR 2007 (para 78).

Table. 5.2 Sector 3 Solvent and Other Product Use: EU-15 emissions of CO_2, N_2O, NMVOC and GHG

		CO_2	N_2O	NMVOC	Total emissions		CO_2	N_2O	NMVOC	Total emissions
		Gg			Gg CO_2 eq		Gg			Gg CO_2 eq
A. Paint Application	***EU15***	***3163.25***	***0.00***	***1180.01***	***3163.25***	**B. Degreasing and Dry Cleaning**	***390.73***	***0.00***	***165.65***	***390.73***
	AT	77.70	0.00	29.22	77.70		37.80	NA	14.30	37.80
	BE	NA	0.00	21.95	0.00		NA	NA	2.63	0.00
	DK	35.52	0.00	11.40	35.52		15.08	NA	4.84	15.08
	FI	31.69	0.00	14.41	31.69		1.28	NO	0.58	1.28
	FR	547.88	0.00	175.79	547.88		30.39	NA	9.75	30.39
	DE	892.51	0.00	297.50	892.51		128.58	NO	42.86	128.58
	GR	35.29	0.00	11.32	35.29		8.82	NE	2.83	8.82
	IE	31.68	0.00	10.16	31.68		3.99	NA	1.28	3.99
	IT	698.72	0.00	224.16	698.72		68.33	NA	21.92	68.33
	LU	3.04	0.00	1.38	3.04		3.68	NE	1.23	3.68
	NL	59.45	0.00	22.55	59.45		1.97	NO	3.72	1.97
	PT	104.49	0.00	33.55	104.49		9.40	NO	3.02	9.40
	ES	602.71	0.00	193.38	602.71		81.26	NA	26.07	81.26
	SE	42.56	0.00	15.09	42.56		0.15	NA	0.15	0.15
	GB	NE	0.00	118.13	0.00		NE	NE	30.47	0.00
C. Chemical Products, Manufacture and	***EU15***	***450.34***	***0.00***	***354.68***	***450.34***	**D. Other**	***3277.33***	***10.28***	***1377.74***	***6464.22***
	AT	16.66	0.00	8.83	16.66		116.37	0.52	51.74	276.64
	BE	NA	0.00	3.09	0.00		NA	0.80	31.54	246.74
	DK	6.79	0.00	2.18	6.79		29.68	0.12	9.52	66.60
	FI	8.09	0.00	3.68	8.09		19.59	0.12	8.90	56.01
	FR	110.88	0.00	35.58	110.88		588.71	0.27	188.89	671.44
	DE	144.36	0.00	48.12	144.36		976.95	3.79	325.65	2150.96
	GR	NA	0.00	IE	0.00		116.22	NA,NE	39.75	116.22
	IE	7.28	0.00	2.33	7.28		40.25	NA,NE	12.91	40.25
	IT	NA	0.00	78.53	0.00		593.56	2.49	190.43	1365.76
	LU	1.68	0.00	0.64	1.68		4.58	0.02	2.13	10.41
	NL	NA	0.00	IE	0.00		66.97	0.25	27.60	143.70
	PT	152.76	0.00	51.72	152.76		79.61	NE	29.00	79.61
	ES	NA	0.00	104.33	0.00		526.47	1.50	168.92	990.23

		CO_2	N_2O	NMVOC	Total emissions		CO_2	N_2O	NMVOC	Total emissions
		Gg			Gg CO_2 eq		Gg			Gg CO_2 eq
	SE	1.83	0.00	0.71	1.83		118.35	0.42	56.30	249.63
	GB	NE	0.00	14.94	0.00		NE	NE,NO	234.46	0.00
Total Solvent and Other Product Use	***EU15***	***7281.64***	***10.28***	***3078.07***	***10468.53***					
	AT	248.53	0.52	104.09	408.80					
	BE	NA	0.80	59.21	246.74					
	DK	87.08	0.12	27.94	124.00					
	FI	60.65	0.12	27.57	97.07					
	FR	1277.87	0.27	410.01	1360.60					
	DE	2142.40	3.79	714.13	3316.41					
	GR	160.34	NA,NE	53.90	160.34					
	IE	83.19	NA,NE	26.69	83.19					
	IT	1360.61	2.49	515.04	2132.81					
	LU	12.98	0.02	5.38	18.81					
	NL	128.39	0.25	53.87	205.12					
	PT	346.26	NE,NO	117.29	346.26					
	ES	1210.44	1.50	492.70	1674.20					
	SE	162.89	0.42	72.25	294.18					
	GB	NE	NE,NO	397.99	0.00					

This sector does not contain a key source.

In the Sector 3 Solvent and Other Product Use in addition to CO_2 emission NMVOC and N_2O emission are identified. The most important GHG from Solvent and Other Product Use is CO_2. In 2007 the CO_2 emissions have a share of 0.18 % of the 'Total EU-15 CO_2 Emissions and Removals' and a share of 0.21 % of the 'Total EU-15 GHG emissions' (Table 5.3). In 2007 the N_2O emissions have a share of 1.09 % of the 'Total EU-15 N_2O emissions' and a share of 0.08 % of the 'Total EU-15 GHG emissions' (Table 5.4).

Table. 5.3 Sector 3 Solvent and Other Product Use: EU-15 CO_2 emissions as well as their share

	Unit	1990	2007
CO_2 emission in Solvent and Other Product Use	[Gg]	9,531	7,282
Total EU-15 GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13,723	10,469
Share of CO_2 emission in Total EU-15 GHG in 'Solvent and Other Product Use'		*69%*	*70%*
Total EU-15 CO_2 Emissions and Removals	[Gg]	3,360,324	3,391,122
Share of CO_2 emission from 'Solvent and Other Product Use' in Total EU-15 CO_2 Emissions and Removals		*0.28%*	*0.21%*
Total EU-15 GHG Emissions and Removals	[Gg CO_2 eq]	4,232,927	4,052,084
Share of CO_2 emission from 'Solvent and Other Product Use' in Total EU-15GHG Emissions and Removals		*0.23%*	*0.18%*

Table. 5.4 Sector 3 Solvent and Other Product Use: EU-15 N_2O emissions as well as their share

	Unit	1990	2007
N_2O emission in Solvent and Other Product Use	[Gg]	14	10
Total EU-15 GHG emission in Solvent and Other Product Use	[Gg CO_2 eq]	13,723	10,469
Share of N_2O emission in Total EU-15 GHG in 'Solvent and Other Product Use'		*31%*	*30%*
Total EU-15 N_2O Emissions and Removals	[Gg]	1,250	944
Share of N_2O emission from 'Solvent and Other Product Use' in Total EU-15N_2O Emissions and Removals		*1.08%*	*1.09%*

Total EU-15 GHG Emissions and Removals	[Gg CO_2 eq]	4,232,927	4,052,084
Share of N_2O emission from 'Solvent and Other Product Use' in Total EU-15 GHG Emissions and Removals		*0.10%*	*0.08%*

Table. 5.5 Sector 3 Solvent and Other Product Use: EU-15 GHG emissions as well as their share

	Unit	1990	2007
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	13,723	10,469
Total EU-15 GHG Emissions and Removals	[Gg CO_2 eq]	4,232,927	4,052,084
Share of GHG emission from 'Solvent and Other Product Use' in Total EU-15 GHG Emissions and Removals		*0.32%*	*0.26%*

5.2 Methodological issues and uncertainties (EU-15)

This sector does not contain any key source. An overview information on methodologies used by the Member States is given in Table. 5.6. For estimation the emission in this sector the methodologies used by the Member States are very different and based on:

- Methodology provided by IPPC Guidelines and CORINAIR Guidebook;
- Bottom up and top down approach / consumption-based emissions estimating;
- Chemical approach
- mass balance for single substances or groups of substances
- plant specific surveys / expert judgment.

No additional overview information on qualitative uncertainty estimates is provided. Alltogether it can be noted that very high uncertainties are reported because of lack of information and rough assumptions.

Table. 5.6 Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Austria (NIR AT 2009)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** CO_2 ***Completness:*** yes ***Uncertainties:*** CO_2: 11 %, N_2O: 20 %

Time series consistency: *yes* ***Sectorspecific QA/QC and verification:*** provided ***Recalulation:*** yes ***Planned improvements:*** no

Methodology (CO_2 emissions):

CO_2 emissions from solvent use were calculated from NMVOC emissions of this sector. As a first step the quantity of solvents used and the solvent emissions were calculated. To determine the quantity of solvents used in Austria in the various applications, a bottom up and a top down approach were combined. The top down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors have been calculated on the basis of the bottom up approach. By linking the results of bottom up and top down approach, quantities of solvents annually used and solvent emissions for the different applications were obtained. Emission estimates only based on the top down approach overestimated emissions because a large amount of solvent substances is used for "non-solvent-applications" (applications where substances usually are used as feed stock in chemical, pharmaceutical or petrochemical industry). However, there might be emissions from the use of the produced products, such as ETBE or MTBE which are used as fuel additive and finally combusted, these emissions for example are considered in the transport sector.

Activity:

The top-down approach is based on (A) import-export statistics, (B) production statistics on solvents in Austria, (C) survey on non-solvent-applications in companies, (D) survey on the solvent content in products and preparations at producers & retailers. The bottom up approach is based on an extensive survey on the use of solvents in the year 2000 and 2008. In this survey data about the solvent content of paints, cleaning agents etc. and on solvents used (both substances and substance categories) like acetone or alcohols were collected. Information about the type of application of the solvents was gathered, divided into the three categories 'final application', 'cleaner' and 'product preparation' as well as the actual type of waste gas treatment, which was divided into the categories 'open application', 'waste gas collection' and 'waste gas treatment'.

Emission factor:

For every category of application and waste gas treatment an emission factor was estimated to calculate solvent emissions in the year 2000. In a second step a survey in 1800 households was made for estimating the domestic solvent use. Also, solvent use in the context of moonlighting besides commercial work and do-it-yourself was calculated.

Methodology, Activity & Emission factor (N_2O Emissions):

N_2O Emissions in CRF 3: 3 D 1 Use of N_2O for anaesthesia and 3 D 3 Use of N_2O in aerosol cans: A specific methodology for these activities has not been prepared yet. 100 % of N_2O used for anaesthesia/ aerosol cans is released into atmosphere, which means that activity data = emission (1.00 Mg N_2O / Mg product use)

Belgium (NIR BE 2009)

GHG & pollutant: NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainties:*** high

Time series consistency: *yes* ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** yes ***Planned improvements:*** yes

Methodology (CO_2 emissions):

In Belgium the emissions of NMVOC in this source category include paint application, production of medicines, paints, inks and glues, domestic use of other products, coating processes, printing industry, wood conservation, treatment of rubber, storage and handling of products, recuperation of solvents and extraction of oil, cleaning and degreasing and dry cleaning. No estimation of the CO_2 equi. emissions of the solvent consumption is carried out in Belgium; except in the Flemish region (from non-energy use of lubricants and solvents wich are reported under category 2.G).

The regions in Belgium are using comparable methodologies to estimate the emissions of solvent and other product use in their region.

The emissions of NMVOC in Flanders are estimated by using the results of a study started by the University of Gent in 1998 and continued by the Flemish Environment Agency (VMM). In Wallonia, the calculation is based on a methodology established by Econotec.

In the Brussels region, the emissions are calculated by using the results of research projects.

Because of the less importance of these emissions in the greenhouse gas story, only a general view of how these emissions are calculated in Belgium is given below.

- All emissions of category 3A (NMVOC emissions for Paint Application…) as well as some of category 3.D (other domestic use, wood coating, wood conservation, recovery of solvents, treatment of rubber, coating of synthetic material and paper) are estimated based on production figures that are given by the specific industry or professional federations. The emission factors used are mainly the solvent content of the product.
- The remaining emissions of categories 3C (production of paints, inks and glues) and 3D (storage and handling of products and assembly of automobiles, extraction of oil seeds, textile coating and printing industry) are estimated based on information gathered in the industrial databases mainly originating from the yearly reporting obligations of the industrial companies.
- There is no estimation carried out in Belgium of the CO_2 equivalents calculated out of the emissions of NMVOC of the solvent consumption because of the unreliability of this factors proposed in literature.

Methodology, Activity & Emission factor (N_2O Emissions):

The emission calculation for the emission of N_2O from anaesthesia (3D) is based on the number of hospital beds in Belgium and the average consumption of anaesthetics per bed. The emission factor is 10,3 kg N_2O/bed/year. This factor was determined by inquiries carried out in 1995 by an independent consultant agency Econotec. It has been assumed that all of the nitrous oxide used for anaesthetics will eventually be released to the atmosphere. The number of beds used for the emissions calculations was obtained from the DGASS (General Directorate for Health and Social Action) and from the Health Public Federal Service.

Denmark (NIR DK 2009)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainties:*** *AD:50%; EF325%*
Time series consistency: yes ***Sectorspecific QA/QC and verification:*** yes ***Recalulation:*** yes ***Planned improvements:*** yes

Methodology (CO_2 emissions):

The emissions of Non-Methane Volatile Organic Compounds (NMVOC) from industrial use and production processes and household use in Denmark have been assessed. Until 2002 the NMVOC inventory in Denmark was based on questionnaires and interviews with different industries, regarding emissions from specific activities, such as lacquering, painting impregnation etc. However, this approach implies large uncertainties due to the diverse nature of many solvent-using processes. For example, it is inaccurate to use emission factors derived from one printwork in an analogue printwork, since the type and combination of inks may vary considerably. Furthermore the employment of abatement techniques will result in loss of validity of estimated emission factors. A new approach has been introduced, focusing on single chemicals instead of activities. This will lead to a clearer picture of the influence from each specific chemical, which will enable a more detailed differentiation on products and the influence of product use on emissions. The procedure is to quantify the use of the chemicals and estimate the fraction of the chemicals that is emitted as a consequence of use. Mass balances are simple and functional methods for calculating the use and emissions of chemicals

Eq. (1) Use = production + import – export – destruction/disposal – hold up *and* Eq. (2) Emission = use * emission factor

where "hold up" is the difference in the amount in stock in the beginning and at the end of the year of inventory. A mass balance can be made for single substances or groups of substances, and the total amount of emitted chemical is obtained by summing up the individual contributions. It is important to perform an indepth investigation in order to include all relevant emissions from the large amount of chemicals The method is based on a chemical approach, and this implies that the SNAP category system is not directly applicable. Instead emissions will be related to specific chemicals, products, industrial sectors and households and to the CRF sectors mentioned.

The tasks in a chemical focused approach are (I) Definition of chemicals to be included, (II) Quantification of use amounts from Eq. (1) and (III) Quantification of emission factors for each chemical.

In principle all chemicals that can be classified as NMVOC must be included in the analysis, which implies that it is essential to have an explicit definition of NMVOC. The definition in solvent directive (1999/13/EC) of VOCs is as follows: "Volatile organic compound shall mean any organic compound having at 293,15 K a vapour pressure of 0,01 kPa or more, or having a corresponding volatility under the particular condition of use". A list of 650 single chemicals and a few chemical groups described in "National Atmospheric Emission Inventory", cf. Annex 3.F, is used. Probably the major part will be insignificant in a mass balance, but a detailed investigation must be made before any chemicals can be excluded. It is important to be aware that some chemicals are comprised in products and will not be found as separate chemicals in databases, which is the predominant softener in PVC. In order to include these chemicals the product use must be found and the amount of chemicals in the product must be estimated. It is important to distinguish the amount of chemicals that enters the mass balance as pure chemical and the amount that is associated to a product, in order not to double-count.

Activity: Production, import and export figures are extracted from Statistics Denmark, from which a list of 427 single chemicals, a few groups and products is generated. For each of these a *use* amount in tonnes pr yr (from 1995 to 2006) is calculated. It is found that 34 different NMVOCs comprise over 95 % of the total use, and it is these 34 chemicals that are investigated further. In the Nordic SPIN database (Substances in Preparations in Nordic Countries) information for industrial use categories and products specified for individual chemicals, according to the NACE and UCN coding systems is available. This information is used to distribute the *use* amounts of individual chemicals to specific products and activities. The product amounts are then distributed to the CRF sectors 3A – 3D.

Emission factor: Emission factors, cf. Eq. 2, are obtained from regulators or the industry and can be provided on a site by site basis or as a single total for whole sectors. Emission factors can be related to production processes and to use. In production processes the emissions of solvents typically are low and in use it is often the case that the entire fraction of chemical in the product will be emitted to the atmosphere. Each chemical will be associated with four emission factors; 1) chemical industry (lowest EF), 2) other industry, 3) non-industrial activities, 4) domestic and other diffuse use (highest EF). This implies that high emission factors are applicable for use of solvent containing products and lower emission factors are applicable for use in industrial processes.

Methodology, Activity & Emission factor (N_2O Emissions):

Five companies sell N_2O in Denmark and only one company produces N_2O. N_2O is primarily used in anaesthesia by dentists, veterinarians and in hospitals and in minor use as propellant in spray cans and in the production of electronics. Due to confidentiality no data on produced amount are available and thus the emissions related to N_2O production are unknown. An emission factor of 1 is assumed for all uses, which equals the sold amount to the emitted amount.

Finland (NIR FI 2009)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:***NMVOC: -32% - +34%, N_2O:-34%- +39%. ***Time series consistency:*** *yes* ***Sectorspecific QA/QC and verification:*** yes ***Recalulation:*** no ***Planned improvements:*** no

Methodology (CO_2 emissions):

3.A – 3.D.: Indirect CO_2 emissions from solvents and other product use have been calculated from NMVOC emissions for the time series 1990-2007. Indirect CO_2 emissions were calculated using the equation below. It was assumed that the average carbon content is 60% by mass for all categories under the sector of solvents and other products use. Used fossil carbon content fraction of NMVOC is based on limited published national analyses of speciation profile. (Netherlands NIR 2005, EPA 2002).

$Emissions_{CO2} = Emissions_{NMVOC}$ * Percent carbon in NMVOCs by mass * 44 /12

Paint application is the biggest source of NMVOC emissions of this sector. Emissions have been calculated from the use of paint and varnish in industry and households. Most Finnish paint producers or importers are members of the Association of Finnish Paint Industry and the use of paint is calculated in the Association using amount and solvent content of sold paint and varnish. The rest of emissions from use of paint and varnish have been estimated using a questionnaire sent to non-members of this association and emission data from the VAHTI system (detailed information in Annex 2). Detailed data of these calculations are included in the report to the UNECE: Air pollutant emissions in Finland 1990-2006, Informative Inventory Report (Finnish Environment Institute, 2008) Degreasing and dry cleaning is a minor source of NMVOCs. Chlorinated organic solvents are used in the metal and electronics industries to clean surfaces of different components and in dry cleaners and emissions are based on import statistics of pure chlorinated solvents, amount of products containing chlorinated organic solvents and amounts of solvent waste processed in the hazardous waste treatment plant. The NMVOC emissions are also emitted from the use of solvents in different industrial processes. In Finland there are these kinds of processes in the pharmaceutical industry, leather industry, plastic industry, textile industry, rubber conversion and manufacture of paints and inks. The emissions are foremost from the emission data of the VAHTI system. Questionnaires are also sent to companies in the textile, plastic and paint industry in which they report either the amount of used solvent or the emissions of their production processes.

Methodology (N_2O Emissions):

The N_2O emissions are calculated by Statistics Finland. The country-specific calculation method is consistent with a Tier 2 method. In the estimation of the N_2O emissions sales data are obtained from the companies delivering N_2O for medical use and other applications in Finland. For the years 1990 to 1999 the emissions have been assumed constant based on activity data obtained for the years 1990 and 1998. Since 2000 annual and more precise data have been received from the companies. The emission estimation is based on the assumption that all used N_2O is emitted to the atmosphere in the same year it is produced or imported to Finland. A very small part of emissions is estimated due to non-response.

Activity data

For the estimation of N_2O emissions production or importation data are obtained from companies for the years 1990, 1998 and all years starting from 2000. In 2007 one company reported that they have continued to export and that has been also taken into account in the calculations.

France (NIR FR 2009)

GHG & pollutant: NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:*** 3A: 54%, 3D: 102%

Time series consistency: yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** yes ***Planned improvements:*** yes

Methodology (CO_2 emissions):

Cette catégorie regroupe l'ensemble des activités consommatrices de solvants que sont l'application de peinture (dans l'industrie, le bâtiment, à usage domestique, …), le dégraissage des métaux et le nettoyage à sec. Ces activités sont des sources importantes de COVNM qui selon les règles de notification des émissions, sont convertis en émissions de CO_2 en considérant leur oxydation ultime.

The activities (*Paint application, Degreasing and dry cleaning, Chemical products, manufacture and processing, Other)* of this category are important sources of NMVOC emissions. The procedure to calculate the emisions from solvent use is based on statistics of paint and varnish consumption, adhesive consumption, tabac consumption, number of fireworks, capita data, national emission factors. The content of solvents is given by the industries, national studies and associations. Also a bottom up approach is used.

Methodology, Activity & Emission factor (N_2O Emissions):

Le N_2O est également, du fait de son usage comme gaz analgésique, émis par ce secteur.

The emission calculation for the emission of N_2O from anaesthesia (3D) is based on the number of population and the use of N_20 from anaesthesia in Europe.

Germany (NIR DE 2009)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no***Completness:*** yes ***Uncertainty:*** *N_2O: 67.1%; CO_2: 12.5%*

Time series consistency: *yes* ***Sectorspecific QA/QC and verification:*** provided ***Recalulation:*** yes ***Planned improvements:*** yes

Methodology (CO_2 emissions):

NMVOC emissions are calculated in keeping with a product-consumption-oriented approach. In this approach, the NMVOC input quantities allocated to these source categories, via solvents or solvent-containing products, are determined and then the relevant NMVOC emissions (for each source category) are calculated from those quantities via specific EFs. This method is explicitly listed, under "consumption-based emissions estimating", as one of two methods that are to be used for emissions calculation for this source category. Use of this method is possible only with valid input figures – differentiated by source categories – in the following areas:

1. Quantities of VOC-containing (pre-) products and agents used in the report year,
2. The VOC concentrations in these products (substances and preparations),
3. The relevant application and emission conditions (or the resulting specific EF).
4. To take account of the highly diverse structures throughout the sub-categories 3A – 3D, these input figures are determined on the level of 37 differentiated source categories, and the calculated NMVOC emissions are then aggregated. The product / substance quantities used are determined at the product-group level with the help of production and foreign-trade statistics. Where possible, the so-determined domestic-consumption quantities are then further verified via cross-checking with industry statistics.
5. The values used for the average VOC concentrations of the input substances, and the EFs used, are based on experts' assessments (expert opinions and industry dialog) relative to the various source categories and source-category areas. Not all of the necessary basic statistical data required for calculation of NMVOC emissions for the most current relevant year are available in final form; as a result, the data determined for the previous year are used as an initial basis for a forecast for the current report. The forecast for NMVOC emissions from solvent use for the relevant most current year is calculated on the basis of specific activity trends. As soon as the relevant basic statistical data are available for the relevant most current year, in their final form, the inventory data for NMVOC emissions from solvent use will be recalculated.
6. Since 1990, so the data, NMVOC emissions from use of solvents and solvent-containing products have decreased by nearly 38 %. The main emissions reductions have been achieved in the years since 1999. This successful reduction has occurred especially as a result of regulatory provisions such as the 31st Ordinance on the execution of the Federal Immissions Control Act, the 2nd such ordinance *(*and the TA Luft. The German "Blauer Engel" ("Blue Angel") environmental quality seal, which is used to certify a range of products, including low-solvent paints, lacquers and glues, has also played an important role in this development.
7. While product sales increased in some areas – even over periods of several years –thereby adding to emissions, the above-described measures offset this trend. These successes, which have occurred especially in recent years, are reflected in the updated emissions calculations – which, thanks to methods optimisation, now feature greater differentiation of VOC concentrations and EFs.

For the 2009 report, indirect CO_2 emissions from NMVOC have been calculated for the first time. The following relationship was used for pertinent conversion: $EM_{indirect\ CO2} = EM_{NMVOC}$ * molar mass CO_2 / molar mass C * 75%

Methodology, Activity & Emission factor (N_2O Emissions):

N_2O in medical application, N_2O use in the food industry, N_2O in technical applications: With regard to development of N_2O-emissions time series for product use, to date only N_2O emissions from medical applications have actually been determined. At the same time, this approach is justified, since this sector is the main source of N_2O emissions in the area of product use, accounting for 90 % of such emissions (SCHÖN et al., 1993). The remaining 10 % can be broken down into technical applications (less than 10 %) and foodtechnology applications (less than 5 %). From this information, the pertinent share for the food-technology industry is estimated at 3 %, and thus the corresponding share for the "technical applications" area is estimated at 7 %, the difference between the total remaining share (10 %) and the 3 % for foods. The N_2O-applications distribution in 2001 is 90 % for medical applications and 10 % for food technology and technical applications. In the time-series trend, a constant N_2O-emissions level is assumed in the "other" area, since no detailed figures on trends in this sector are available. In product use (medical and other applications), the input nitrous oxide escapes into the air directly and completely. As a result, the emission factor for this sector is 1 t/t, for all years in question.

N_2O formation in detonation of explosives with ammonium nitrate: According to the Federal Office for Material Research and Testing (BAM), levels of explosives use in Germany remained constant from 1990 to 2005. The N_2O-emissions amount estimated above represents only the theoretically maximum emittable amount. No information is available as to distribution, i.e. as to the number of detonations that would be required to emit this maximum amount of N_2O. For this reason, it is also assumed here that detonations are carried out primarily as

"controlled" detonations, and that thus the maximum N_2O-emissions levels are seldom attained. No figures are available to permit determination of the amounts of N_2O emissions actually emitted upon detonations. The above figure (68 g N_2O per kg AN) is a theoretical one, and it could be far off the actual value. When a 5 % emissions rate is assumed the N_2O amount is 3.4 g. This figure is of the same order as the maximum emissions rate (2 g) given by BENNDORF (1999, page 4), a figure that corresponds to about 3 % of the above-determined theoretical maximum N_2O emissions level. For a "worst-case scenario", the time-series trend in this project is calculated using the higher value (3.4 g). To determine the relevant emission factors in kg/t, the explosives amounts involved are used.

Greece(NIR GR 2009)

GHG & pollutant: CO_2, NMVOC ***GHG Key Category:*** no ***Completness:*** no ***Uncertainty:*** no
Time series consistency: yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** no ***Planned improvements:*** yes

Methodology (NMVOC, CO_2 emissions):

The calculation of NMVOC emissions requires a very detailed analysis of the use of solvents and other products containing volatile organic compounds. There are two basic approaches for the estimation of emissions from Solvent and Other Product Use, which depend on the availability of data on the activities producing emissions and the emission factors.

- Production-based. In cases that solvent or coating use is associated with centralised industrial production activities (e.g. automobile and ship production), it is generally possible to develop NMVOC emission factors based on unit of product output. Next, annual emissions are estimated on the basis of production data.
- Consumption-based. In many applications of paints, solvents and similar products, the end uses are too small-scale, diverse, and dispersed to be tracked directly. Therefore, emission estimates are generally based on total consumption (i.e. sales) of the solvents, paints, etc. Used in these applications. The assumption is that once these products are sold to end users, they are applied and emissions generate relatively rapidly. Emission factors developed on the basis of this assumption can then be applied to data from sales for the specific solvent or paint products.

The application of both approaches needs detailed activity data, concerning either e.g. the amount of pure solvent consumed or the amount of solvent containing products consumed. The availability of such activity data in Greece is limited and as a result the default CORINAIR methodology is applied for the estimation of NMVOC emissions. It should be mentioned that evaporative emissions of GHG arising from other types of product use (e.g. N_2O emissions from medical use), are not estimated since appropriate methodologies have not been developed yet. Carbon dioxide emissions are calculated from NMVOC emissions, assuming that the carbon content of NMVOC is 85%.

Paint application: Data availability concerning the use of products containing solvents for "Vehicle manufacture and Vehicle refinishing" is limited and as a result the respective emissions are not estimated. Emissions from "Domestic use and construction" are estimated on the basis of population figures and default emission factors from CORINAIR (0.5 kg / capita).

Metal Degreasing and Dry Cleaning: Emission estimates are given only for the dry cleaning sector. These estimates are based on population figures and default emission factors from CORINAIR (0.25 kg /capita) that is applicable to all types of dry cleaning equipment.

Other Use of Solvents and Related Activities: The emission factors used for some of the activities defined in CORINAIR and for which it was possible to obtain the corresponding activity data from the National Statistical Service of Greece, are: (a) Production and processing of PVC: 40 kg / t of product produced or processed. (b) Production of pharmaceutical products: 14 g /capita. (c) Ink production: 30 kg / t of product. (d) Glue production, applied emission factor: 20 kg /t of product (e) For the wood preservation: 24 kg / t of wood preserved (f) For fat edible and non edible oil extraction: 14 kg NMVOC/ t of seed processed (g) For domestic solvent use (except paint application): 2.6 kg NMVOC/capita/year.

In the case of printing industry, the estimation of emissions was based on the consumption of ink. Printing ink is mostly used for the publishing of newspapers, books and various leaflets. According to the estimations of one publishing organisation, the amount of ink used for the printing of a daily newspaper is approximately 3.7 g of ink. The quantity of ink used for printing books etc. Was calculated by subtracting the total quantity used for the newspapers from the total ink consumed. The emission factor applied (260 kg / t ink) is the average of emission factors for newspaper printing (54 kg /t ink) and for books and other leaflets printing (132-800 kg / t ink).

Ireland(NIR IE 2009)

GHG & pollutant: CO_2, NMVOC ***GHG Key Category:*** no ***Completness:*** *yes* ***Uncertainty:*** CO_2: 30 %
Time series consistency:yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:yes*** ***Planned improvements:*** no

Methodology Activity data, emission factor (CO_2 emissions):

The inventory agency commissioned a project to carry out in-depth analysis of the specified NMVOC source categories (CTC, 2005) in order to compile the best possible estimates of emissions in 2004 as a follow-up to the earlier commissioned work and to revise the inventories for the years 1998-2003 as necessary in the light of new information. The revised estimates for these target years indicated lower NMVOC emissions than had been previously reported and used as the basis for CO_2 in the sector Solvent and Other Product Use.

A bottom-up approach was possible for activities subject to IPC licensing in the four source categories. Relevant data on emissions and solvent use were extracted from their electronic or paper Annual Environmental Reports (AERs) or Pollution Emissions Registers (PERs). Where such information was not available, European PERs were assessed. Top-down methods were used for activities not covered by the IPC licensing system. These included the use of paints and the use of domestic solvents, the two principal source categories. Input, usage and emissions data for each individual activity was collated into IPC and non-IPC spreadsheets and emissions were estimated by applying EMEP/CORINAIR methods, default emission factors and general guidance as appropriate. Scaling up to national level was applied where necessary.

The largest contributor to overall emissions is the domestic solvent use sub-category. It is also to be noted that emissions from this sub-category have increased while those from the majority of sub-categories are decreasing. The main drivers are considered to be the increased number of vehicles, growth in the number of individual households, and higher per-capita consumption of non-aerosol automotive products, cosmetics, toiletries, and household products. It should be noted that UK emission factors together with Irish statistics for number of vehicles, persons and households were used in the absence of any other data. One of the only two other significant sub-categories for which emissions are increasing is industrial application of paint in the wood products sector. This is as a result of an expansion in activity in the sub-category as well as the continued use of conventional high solvent content coatings. The vast majority of these companies are small operations outside the remit of IPC.

Emissions from architectural paint use are decreasing (even while paint sales are increasing) as a result of an increased market share for water-based paints and a reduction in the VOC content of water based paints (VOC content of solvent based paints remains more or less static). From discussions with industry, one of the key drivers for the decrease in solvent use in architectural paint has been as a result of pressure from some of the larger retailers. The decrease in VOC emissions from architectural painting should be set to continue with the advent of the deco-paints Directive (EP and CEU, 2004b) and can only benefit from continued and expanded retailer/consumer pressure. There have been significant drops in both printing and wood impregnation. The decrease in printing is principally due to the installation of abatement equipment in the plant, which is the largest user of solvents. The decrease in the use of wood preservatives can be attributed to several site closures and to the switch from solvent-borne to water-borne wood preservatives. Other industrial paint application and other manufacturing taken together show a decrease in emissions between 1998 and 2007. The diversity within these sectors is very large in terms of the type of process, the products made, and the scale involved. There have been closures, particularly of a few of the large emitters, which have decreased emissions, but there has also been some new processes licensed. In addition there is a large degree of uncertainty associated with the non-IPC element of the emissions estimates for these sources. However, the study found that there are specific instances of IPC licensed sites reducing VOC emissions through prevention at source or through abatement.

Activity data

The activity data used for computing estimates of CO_2 emissions in Solvent and Other Product Use are the mass emissions of NMVOC computed for the relevant source categories (3.A Paint Application, 3.B Degreasing and Dry Cleaning, 3.C Chemical Products and 3.D Other Solvent Uses). The Irish data used for this purpose are the VOC emissions compiled according to the CORINAIR methodology for reporting to UNECE under the Convention on Long Range Transboundary Air Pollution (CLRTAP) (UNECE, 1999).

As part of the work on recalculations for the 2002 submission, Ireland produced a revised and consistent timeseries of such NMVOC emissions estimates based on the results of detailed analysis and investigations for 1998 (Finn et al, 2001).

Emission factor

The CO_2 emissions are derived by assuming that 85 percent of the mass emissions of NMVOC in the four categories is converted to CO_2. .

Italy (NIR IT 2009)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** yes ***Completness:*** *yes*

Uncertainty: CO_2: 58% - AD 30%, EF 50%; N_2O: 51% - AD 50%, EF 10%

Time series consistency:yes ***Sectorspecific QA/QC and verification:*** provided ***Recalulation:*** yes ***Planned improvements:*** yes

Methodology, Activity data & Emission factor (CO_2 emissions):

Emissions of NMVOC from solvent use have been estimated according to the methodology reported in the EMEP/CORINAIR guidebook, applying both national and international emission factors (Vetrella, 1994; EMEP/CORINAIR, 2005). Country specific emission factors provided by several accredited sources have been used extensively, together with data from the national EPER Registry; in particular, for paint application (Offredi, several years; FIAT, several years), solvent use in dry cleaning (ENEA/USLRMA, 1995), solvent use in textile finishing and in the tanning industries (TECHNE, 1998; Regione Toscana, 2001; Regione Campania, 2005; GIADA 2006). Basic information from industry on percentage reduction of solvent content in paints and other products has been applied to EMEP/CORINAIR emission factors in order to evaluate the reduction in emissions during the considered period. Emissions from domestic solvent use have been calculated using a detailed methodology, based on VOC content per type of consumer product. As regards household and car care products, information on VOC content and activity data has been supplied by the Sectoral Association of the Italian Federation of the Chemical Industry (Assocasa, several years) and by the Italian Association of Aerosol Producers (AIA, several years). As regards cosmetics and toiletries, basic data have been supplied by the Italian Association of Aerosol Producers too (AIA, several years) and by the national Institute of Statistics and industrial associations (ISTAT, several years; UNIPRO, several years); emission factors time series have been reconstructed on the basis of the information provided by the European Commission (EC, 2002). The conversion of NMVOC emissions into CO_2 emissions has been carried out considering that carbon content is equal to 85% as indicated by the European Environmental Agency for the CORINAIR project (EEA, 1997), except for CO_2 emissions from the 3C sub-sector which are not calculated to avoid double-counting. These emissions are, in fact, already accounted for in sectors 1A2c and 2B.

Methodology, Activity data & Emission factor (N_2O emissions):

Emissions of N_2O have been estimated taking into account information available by industrial associations. Specifically, the manufacturers and distributors association of N_2O products has supplied data on the use of N_2O for anaesthesia from 1994 to 2008 (Assogastecnici, several years). For previous years, data have been estimated by the number of surgical beds published by national statistics (ISTAT, several years). Moreover, the Italian Association of Aerosol Producers (AIA, several years) has provided data on the annual production of aerosol cans. It is assumed that all N_2O used will eventually be released to the atmosphere, therefore the emission factor for anaesthesia is 1 Mg N_2O/Mg product use, while the emission factor used for aerosol cans is 0.025 Mg N_2O/Mg product use, because the N_2O content in aerosol cans is assumed to be 2.5% on average (Co.Da.P., 2005). N_2O emissions have been calculated multiplying activity data, total quantity of N_2O used for anaesthesia and total aerosol cans, by the related emission factors.

Luxembourg(NIR LU 2008)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness: yes*** ***Uncertainty:****no*

Time series consistency:yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** yes ***Planned improvements:*** yes

Methodology, Activity data & Emission factor (CO_2 emissions):

The total amount of NMVOC emissions from solvents and other product use has been taken as a basis to calculate resulting CO_2 emissions. The following VOC emission estimates from this source categroy were done for 1990. Part of these data are based on estimations of various solvent application activities in Luxembourg as they were at the beginning of the 1990ies. In some sub-sectors, no statistical data on consumption of solvent containing products were available. Therefore part of the estimations are based on typical consumption estimates of products containing solvents for the neighbour countries of Luxembourg and/or for Europe. An update of these estimations of VOC emissions from solvents could lead to an improvement of the emission data.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions

Netherlands (NIR NL 2009)

GHG & pollutant: CO_2, NMVOC, N_2O ***GHG Key Category:*** no ***Completness: yes*** ***Uncertainty:***CO_2: 27 %, N_2O: 50% ***Time series consistency:***yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** no ***Planned improvements:*** no

Methodology (CO_2 emissions):

3A, 3B & 3D: Country-specific carbon contents of the NMVOC emissions from 3A Paint application, 3B Degreasing and dry cleaning and 3D Other product use are used to calculate indirect CO_2 emissions. The monitoring of NMVOC emissions from these sources differs per source. Most of the emissions are reported by branch organizations (e.g paints, detergents and cosmetics). The indirect CO_2 emissions from NMVOCs are calculated from the average carbon contents of the NMVOC in the solvents: C-content NMVOC 3A: 0.72, 3B: 0.16 3D: 0.69

The carbon content of degreasing and dry cleaning is very low due to the high share of chlorinated solvents (mainly tetrachloroethylene used for dry cleaning). The emissions are then calculated as follows:

CO_2 (in Gg) = Σ{NMVOC emission in subcategory i (in Gg) x C-fraction subcategory i} x 44/12

The fraction of organic carbon (i.e. of natural origin) in the NMVOC emissions is assumed to be negligible.

Activity data: consumption data and NMVOC contents of products are mainly provided by trade associations, such as the VVVF (for paints), the NCV (for cosmetics) and the NVZ (for detergents). The consumption of almost all solventcontaining products has increased since 1990. However, the general NMVOC content of products (especially paints) has decreased over the past years, resulting in a steady decline in NMVOC emissions since 1990 (see Section 2.4). Due to the increased sales of hairspray and deodorant sprays NMVOC emissions have increased slightly in recent years. It is assumed that the NMVOC contents of these products have remained stable.

Emission factors: It is assumed that all NMVOC in the product is emitted (with the exception of some cleaning products and methylated spirit, which are partly broken down in sewerage treatment plants after use, or used as fuel in BBQs or fondue sets (methylated spirit).

Methodology (N_2O emissions):

Country-specific methodologies are used for the N_2O sources in Sector 3. Since the emissions in this source category are from non-key sources for N_2O, the present methodology complies with the IPCC Good Practice Guidance (IPCC, 2001).

Activity data: The major hospital supplier of N_2O for anesthetic use reports the consumption data of anesthetic gas in the Netherlands annually. The Dutch Association of Aerosol Producers (NAV) reports data on the annual sales of N_2O-containing spray cans. Missing years are then extrapolated on the basis of this data. Domestic sales of cream in aerosol cans have shown a strong increase since 2000. The increase is reflected in the increased emissions in these years.

Emission factors: The emission factor used for N_2O in anesthesia is 1 kg/kg. Sales and consumption of N_2O for anesthesia are assumed to be equal each year. The emission factor for N_2O from aerosol cans is estimated to be 7.6 g/can (based on data provided by one producer), and is assumed to be constant over time.

Portugal (NIR PT 2009)

GHG & pollutant: CO_2,NMVOC, N_2O ***GHG Key Category:*** 3A, 3B 3D ***Completness:*** yes ***Uncertainty:*** 3A: 262%; 3B: 100% %; 3C 141%; 3D: 408% ***Time series consistency:*** yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** no

Planned improvements: yes

Methodology, Activity data & Emission factor (CO_2 emissions):

NMVOC emissions estimates must be converted in CO_2 emissions whenever the carbon that is present in organic compounds has fossil fue origin (originated from feed-stocks from petroleum, coal or natural gas), and being assumed that NMVOC compounds are fully oxidized in air to carbon dioxide contributing thence to the atmospheric pool. Therefore, in general terms in except for the cases where a specific methodology is presented, emission of ultimate CO_2 were calculated assuming that 85 percent of the mass emissions of NMVOC is carbon and it is converted to carbon dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory as CO_2e. With U_{CO2}=44/12 * NMVOC*0.85, where U_{CO2}-Ultimate CO_2 (ton/yr); NMVOC-emissions of NMVOC (ton/yr).

Paint Application (CRF 3A): *Methodology:*

NMVOC emissions from use of coating materials are estimated in a simple manner using the following formulation:

$Emi_{NMVOC(a,p,y)}$ =ΣaΣp[EF(p) * $Coating_{CONS(a,p,y)}$] * 10^{-3}; Where $Emi_{NMVOC(y)}$ – NMVOC emissions resulting from use/application of coating substances during year y; $Coating_{CONS(a,p,y)}$ – Use of coating substance p in economic activity a during year y; $EF_{(p)}$ – NMVOV EF (solvent content) resulting from application of substance p.

Emission factors for NMVOC were made equal to solvent content of paints, which were established as expert guess from information collected from two of the biggest paint sellers in Portugal. These specific EFs were applied to the total consumption of paint, irrespective of the application where it is used, and average EFs were hence determined for water based paint, solvent based paint and other paints.

Activity data: For most activities there is no available and reliable statistical information concerning the use of paints. From IAIT and IAPI industrial surveys, from INE, it is only possible to determine consumption of paint in industrial activities, but the remaining, and larger part of consumption, is not known. Therefore total consume of paint and varnish in Portugal had first to be estimated from internal production, importation and exportation according to: $Total_{Cons(y,p)}$=$Production_{(y,p)}$+$Imports_{(y,p)}$–$Exports_{(y,p)}$; Where: $Total_{Cons(y)}$- Consumed paint and varnish of type p in year y; $Production_{(y,p)}$ - National Produced paint and varnish of type p in year y; $Imports_{(y,p)}$ - Imported paint and varnish of type p in year y; $Exports_{(y,p)}$ - Exported paint and varnish of type p in year y. The most detailed level desegregation per paint type that was possible to achieve was dependent, however on the fact that the statistical classes available for production data were dissimilar from the classes that are used for external trade. Information of annual production of paints by paint type are collected in IAIT and IAPI surveys.

Degreasing and dry cleaning (CRF 3B) - *Methodology:* Assuming that all solvents consumed during degreasing and dry-cleaning evaporate, NMVOC emission will be equal to the amount of solvents used. If it is considered that annual consumption of solvents in an economic activity is used to replenish the quantity of solvent that was lost, then annual NMVOC emissions may be estimated from the annual consumption of solvent. This methodology overcomes the need of being aware of the portion of solvent that is recovered. In the case of the dry-cleaning activity it was assumed that either the solvent is lost directly to atmosphere, or if it is conveyed to water or retained in clothes, but it will eventually reach atmosphere by evaporation. For the dry cleaning sector other methodologies, based on quantities of washed cloths, are recommended by several sources (USEPA, 1981; EMEP/CORINAIR). However, in Portugal there is no sufficient information to use this other approach. CO_2 emissions are derived by assuming that 85 percent of the mass emissions of NMVOC is carbon (see above).

Activity data: Statistical information concerning total solvent use, from the National Statistics Institute (INE), was used to estimate VOC emissions. Consumption of solvents was based on consumption of volatile organic materials in the metal and plastic industries, from IAIT statistical survey. Statistical information concerning total solvent use, from the National Statistics Institute (INE), was used to estimate VOC emissions. Consumption of solvents was based on consumption of volatile organic materials in the metal and plastic industries, from IAIT statistical survey. There is no available statistical information concerning consumption of solvents and other materials in dry-cleaning activity, because this activity is not included under IAIT and IAPI industrial surveys. Therefore, it was assumed that all PERimported to Portugal is used in dry-cleaning activity and that all PER that is used is imported (no national production). Annual importation, which is available from INE's statistical databases on external trade from 1990 to 2002, was therefore assumed as equal to solvent use. The full time series is forecasted for the years after 2002.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Chemical products, manufacture and processing (CRF 3C): *Methodology:* Emissions were estimated by the use of EF that are multiplied by the quantity of material produced: $Emi_{NMVOC}=EF*Activity_{Rate}*10^{-3}$ Where Emi_{NMVOC} - annual emission of NMVOC; $Activity_{Rate}$ - Indicator of activity in the production process. Quantity of product produced per year as a general rule for this emission source. It was assumed that NMVOC result mostly from solvents with fossil origin, therefore contributing fully to ultimate carbon dioxide emissions. Ultimate carbon dioxide emissions are calculated assuming that emitted VOC have on average 85% of carbon (see above). *Processing of polymers-Activity data:* Information about activity data for this sector is scarce and limited to year 1990, from INE. However, because some polymers and fibbers are produced in a restricted number of industrial units, confidentiality constraints avoid their. *Emission factors* applied to polymer processing and fibber production were set from AP42 (US-EPA), and from CORINAIR/EMEP. *Rubber Processing-Methodology:* Assuming that all solvents consumed during rubber processing evaporate, NMVOC emission will be equal to the amount of solvents used. This procedure could be used to estimate emissions for years 1990 and 1991. However, because statistical data on solvent consumption in this sector is not available beyond year 1992, NMVOC emissions had to be estimated from quantity of rubber processed according to: $Emi_{NMVOC(y)}=Solvent(y)=\Sigma_p[S_{Fac(p)}*Proc_{RUBBER(p,y)}]*10^{-3}$; Where: $Emi_{NMVOC(y)}$ – NMVOC total emissions from rubber processing; Solvent (y)–Total solvent use in rubber processing; $S_{Fac(p)}$–Quantity of solvent used to produce product p; $Prod_{RUBBER(p,y)}$–Production of rubber product p in year y. *Emission factor* or solvent use factor, that was used to estimate solvent consumption after 1992 was derived from the statistical information available from IAIT for this sector for years 1989 to 1991. From the several materials that were consumed in this activity only Benzene and Gasoline were considered solvents and prone to evaporation. *Activity data:* Production data of rubber artefacts, incl. tires and tire reconstruction, was available from the IAIT and IAPI industrial surveys. *Paints Manufacturing- Activity data:* Production of paints and varnish as described in Paint Application. *Emission factor:* The USEPA (1983) EF was used - 15 kg for each tone of paint or varnish manufactured, that includes emissions during cleaning of installations and applies to production of all coating materials. This EF was applied to the total value of paint and varnish produced in Portugal irrespective of type. *Inks Manufacturing- Activity data:* Statistical data of annual production of inks in Portugal is available from IAIT and IAPI industrial surveys (INE), for years 1990 through 2000. Linear forecast values were considered for subsequent years. Use of pigments in ink production was also available from INE's database. *Emission factor:* The NMVOC EF that was used, 60 kg for each tone of ink manufactured, refers to vehicle coking and applies to general ink type, is from USEPA (1983). *Glues Manufacturing-Activity data:* Production of glues and adhesives in Portugal is available in Portugal for years 1990 and 1991 from INE. Average values were considered for subsequent years. Production of glues and adhesives is reported in chapter 5.5. *Emission factor:* The CORINAIR EF was adopted - 20 kg for each tone of glues and adhesives manufactured, which is applied to all kind of glues and adhesives, with or without solvents in their composition, and includes the cleaning of industrial installations. **Other use of solvents and related activities (CRF 3D) -** In this sector are included emission calculations for different activities, such as: 1) printing; 2) edible and non edible oil extraction; 3) use of glue and adhesives; 4) preservation of wood; 5) other solvents use; 6) use of perfume; 7) use of waxes and polishing products; 8) use of soaps and detergents. *Printing-Methodology:* With $Emi_{NMVOC(a,p,y)} = \Sigma_p\Sigma_t\Sigma_i[EF_{(i)} * INK_{CONS(p,i,t,y)}] * 10^{-3}$. Where $Emi_{NMVOC(y)}$ – NMVOC emissions resulting from printing activities during year y; $Ink_{CONS(p,i,t,y)}$–Use of ink i for printing product p using technology t during year y; $EF_{(p)}$–$EF_{(solvent\ content)}$ of ink i. *Emission factor:* NMVOC EFs reflect solvent content of ink, assuming that all solvents contribute to volatile organic compounds, and that control equipment for emissions are not widespread and representative. *Activity data:* Consumption of inks in printing industry according to printing product is available from IAPI industrial survey, for years 1995 to 2000, from the INE's statistical database. Original data allows that total consumption of inks – but not its type – be divided by printing products. Data printing activities in other economic activities – metallic industry, plastic industry, ceramic and - is also included. Some assumptions were made concerning what technology was used for each press product, i.e.: a) newspapers are printed using web letterpress or web offset lithography, according to national sales of ink; b) books printing uses lithography; c)Magazines and other publications use rotogravure; d) Packages and metallic, plastic and other artefacts use flexography; e) serigraphy technology is used in textile processes. For years in the period from 1990-1994, consumption of inks had to be estimated from national production and external trade and according to: $Total_{Cons(y)} = Production_{(y)} + Imports_{(y)} – Exports_{(y)}$ Where: $Total_{Cons(y)}$- Total consumption of inks in year y; $Production_{(y,p)}$ - National Produced inks in year y; $Imports_{(y,p)}$ - Imported inks in year y; $Exports_{(y,p)}$ - Exported quantity of inks in year y. Because external trade classifies inks in a single class, the more detailed desegregation of inks, available for production of inks, could not be used, and only total ink consumption could be assessed. The same proportion of technologies/products in 1995 was used to separate total inks consumption for the years 1990-1994. *Edible and non edible oil extraction* **-** *Methodology:* Emissions of NMVOC were estimated considering that the annual hexane consumption by the industrial plant, hexane make-up, is due to losses to the air, and hence: $Emi_{NMVOC}(y) = MakeUp_{Solvents(y)}$Where: $Emi_{NMVOC}(y)$ - Emissions of NMVOC; $MakeUp_{Solvents(y)}$ - annual consumption ofsolvent in edible and non-edible oil industry, to replenish looses. Ultimate CO_2 emissions are calculated assuming that 85.71 percent of the mass emissions of NMVOC is carbon and is converted to carbon dioxide in the atmosphere. All solvents are assumed to have fossil origin and hence all ultimate CO_2 emissions are included in the inventory. $U_{CO2} = 44/12 * NMVOC * 0.8571$Where: U_{CO2} - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC. *Emission factor:* The national EF for NMVOC was calculated as the ratio of the amount of solvents consumed during manufacture processes to the quantities of edible and non edible oil manufactured. However, from the available data from INE, this EF could be only estimated from IAIT industrial survey because solvent consumption is not available from IAPI survey. Because in IAPI survey (1992-2000) it was not possible to distinguish production of edible oils from production of non-edible soils, it was decided just to use a global EF. *Activity data:* Oil production data was available from INE's industrial surveys: IAIT for 1990 and 1991 and IAPI thereafter until 2000. Production data for 2001-2006 was forecasted by APA from previous years. All annual values are reported in Table 5.23, together with olive oil production, although that product does not cause NMVOC emissions. *Glues and adhesives - Methodology*: $NMVOC = Cons_{Nat} \times FE_{Nat} + Imp \times FE_{imp}$ Where: NMVOC = Global emissions of NMVOC (ton); $Cons_{Nat}$ = Consumption of Glues and Adhesives produced in Portugal (ton); FE_{Nat} = EF for Glues and Adhesives produced in Portugal; Imp = Importation of Glues and Adhesives (ton); FE_{imp} = EF associated to the use of imported Glues and Adhesives. And $Cons_{Nat} = Prod_{Nat} –$ ExpWhere: $Cons_{Nat}$ = Consumed Glues and Adhesives produced in Portugal (ton); $Prod_{Nat}$= National Produced Glues and Adhesives (ton); Exp = Exported Glues and Adhesives (ton) *Emission factor:* To estimate the EF applied for the use of national glues and adhesives, the ratio of the amount of solvents consumedduring manufacture processes with the amount of glues and adhesives manufactured was computed, and an average EF obtained. The EF for VOC emission from the manufacture of glue and adhesives was subtracted from this value to obtain the EFs for use of national produced glue and adhesives. For non-natural imported glues and adhesives the CORINAIR90 Default EF was used: 600 kg/ton. It is considered that natural based glue does not contribute to NMVOC emission. *Wood Preservation - Methodology*: $Emi_{NMVOC\ (y)} = Consumption(y)* FE_{Consumption}$where: $Emi_{NMVOC(y)}$ - Emissions of NMVOC associated to consumption of wood preservation products (ton); Consumption(y) - Consumption of wood preservation products (ton); $FE_{Consumption}$ - EF

associated to the consumption of wood preservation products.
Emission factor: CORINAIR90 EF Handbook proposes three EFs for VOC emission from wood preservation, depending on the type of product used. The EF is 100 kg/ton of product applied for creosote; 900 kg/ton for solvent based products and 0 for water based products. The available data do not discriminate the share of the several types of preservation products, therefore, it was assumed that the main product used in Portugal is creosote.
Perfumes and Cosmetics Use - Methodology: Perfumes, personal hygiene and cosmetic products. Lipsticks, brilliantine, beauty creams and milks, depilatories, deodorants, hair sprays, sun lotions, tanner products, shampoos, tooth-cleaning, hair coloration and nail varnishes, among others, were considered in perfume, personal hygiene or cosmetic product. Emissions are estimated from:NMVOC = Use * $FE_{Prod+use}$where: NMVOC - Emissions of NMVOC associated to the production and use of perfumes (ton); use - Use of perfumes (ton); $FE_{Prod+use}$ - EF associated to the production and use of perfumes (ton)
Emission factor: Since there are no available VOC EF for this activity an EF for VOC emission during the production and the use of these products was calculated. It was estimated by the ratio of the amount of solvents consumed during the manufacture process with the amount of perfumes, personal hygiene and cosmetic products manufactured.With $FE_{Prod+use}$ = Solvents / National Production where: $FE_{Prod+use}$ = Emissions of NMVOC associated to consumption of perfume and cosmetics use (ton); Solvents = Solvent content of perfumes (ton); National Production = National production values of perfumes (ton)
*Waxes and polishing products / Soaps and Detergent***s:** The Methodology is similar to the one that was used for Perfume Use.
*Uses of solvents from biomass***:** There are two organic substances used as solvents: ethanol and rosin derivatives that may be emitted to atmosphere when used. Emissions may be estimated from consumption of these substances. However, in some activities, such as beverage and food industry, use of alcohol does not contribute to air emissions because it is ingested, and it is not included in emissions.
Methodology: Emissions are therefore estimated from: NMVOC = TotalConsumption – $Cons_{NONEMI}$Where NMVOC – Emission; TotalConsumption – Total consumption of biological solvent in all activities; $Cons_{NONEMI}$ – Consumption of biological solvents in activities where solvents are not emitted to atmosphere. For rosin derivatives total consumption is obtained from industrial production corrected from imports and exports: TotalConsumption = IndustrialProduction + Imports – Exports. Because these two compounds have a biological origin NMVOC emissions are not added to ultimate carbon dioxide emissions accounting.
Other uses of synthetic solvents from fossil fuels - Methodology: NMVOC = Produced Solventswhere: NMVOC = Emissions of NMVOC (ton); Consumed Solvents = quantity of produced solvents(ton). The calculation of Global CO_2 emissions is made according to:U_{CO2} = 44/12 * NMVOC * 0.85where: U_{CO2} - Ultimate CO_2 (ton/yr); NMVOC - Global emissions of NMVOC (ton/yr).

Spain (NIR ES 2009)

GHG & pollutant: CO_2,NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:***CO_2: 25 %
Time series consistency:yes ***Sectorspecific QA/QC and verification:*** yes ***Recalulation:*** yes ***Planned improvements:*** yes
Methodology, Activity data & Emission factor (CO_2 emissions):

For NMVOCs, the methodology applied for the estimation of emissions is essentially that of EMEP/CORINAIR, supplemented by contributions and inquiries made to the IIASA and EGTEI1. With respect to specific issues, it should be noted that for some particularly relevant emission sources, the information has been obtained and processed at individual plant level (as in the case of vehicle manufacturing plants). For the remaining emission sources, a vast proportion of the data on activity variables comes from the corresponding business associations: ASEFAPI, FEIQUE, ANAIP, ATEPA, COFACO, AFOEX. Likewise, in the case of some activities, general statistical information such as population was obtained from the Spanish National Statistics Institute (INE), the Industrial Survey (INE) or the publication entitled “The Chemical Industry in Spain” from the Ministry of Industry, Tourism and Trade (MITYC).
As for emission factors, the methodology used attempts to quantify the NMVOC content in solvents and other products containing these substances. Where appropriate, the corresponding reduction factors are incorporated for the different applications and emissions abatement techniques used. More specifically, in the case of paint application, the differentiation between the different types of paint (waterbased, solvent-based, etc.) is particularly relevant. As and when information on the development of these techniques over time is available, the factors are shown on an annualized basis. The case of vehicle manufacturing plants deserves special mention, as each manufacturing plant received individualized treatment through the gathering of information on the amounts of concentrate and solvent used, their VOC content during the different phases of the paint lines and production process, as well as during the recovery and disposal processes installed at each centre, so that the emissions are estimated by mass balance.
Emission of CO_2 has been calculated with the following equation:$emission_{CO2} = emission_{NMVOC} * 0.85 * 44/12$
Methodology, Activity data & Emission factor (N_2O emissions):
As far as N_2O is concerned, the emissions considered in the inventory are limited to the use of this gas for anaesthetic purposes, as mentioned above. Nitrous oxide, with its characteristically greater solubility in fats than in water, is transported in gaseous form by the blood to the central nervous system through the fluids contained in the latter, where it produces a state of complete unconsciousness or narcosis. Like many other volatile anaesthetic products, N_2O leaves the organism unchanged, that is to say, it is resistant to catabolism through biological processes. As a result of this peculiar quality, N_2O emissions are considered to be equal to its consumption for such uses. This consumption has been estimated on the basis of the information furnished by one of the sector's firms.

Sweden (NIR SE 2009)

GHG & pollutant: CO_2,NMVOC, N_2O ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:***CO_2 25 %
Time series consistency:yes ***Sectorspecific QA/QC and verification:*** provided ***Recalulation:*** yes ***Planned improvements:*** no
Methodology, Activity data & Emission factor (CO_2 emissions):

A new method was developed during 2005 in order to obtain all activity data concerning solvent and other product use from the Products register hosted by the Swedish Chemicals Inspectorate. Reliably activity data, for this purpose, can only be obtained from 1995. The Products register is a register over chemical products imported to or manufactured in Sweden. A list of substances defined as NMVOCs, and found in the Products register in quantities over 100 tonnes, has been compiled. The following definition of NMVOC has been used:
Volatile organic compound (VOC) mean any organic compound having a vapour pressure of 0.01 kPa or more at 293.15 K, or having a corresponding volatility under the particular conditions of use. The fraction of creosote which exceeds this value of vapour pressure at 293.15K shall be considered a VOC. The list includes 365 substances (Cas-nr, name, carbon contents for each substance) and was used for extracting quantities of NMVOC and C in substances found in the Products register. Data extractions have been made for each year from 1995 to 2004. The extractions show for each year “The intended use of the product, the type of product (product code)”, “Industry to which the product is sold (industry category)”, “Quantity NMVOC”, “Quantity C”
Using the information concerning "product code" and "industry category" in combination, the quantities of NMVOC and C for each year and CRF code were compiled. The quantities of NMVOC used as raw material in processes were identified for each CRF code. Country specific emission factors for solvents used as raw material and for remaining solvents were developed for each CRF code. The emission factors for raw material are set very low, since most of the solvents will not be emitted during production, but will end up in the product. The sold amount of solvent is not always identical to the amount of solvent used.

Sector 3 Solvent and Other product use: Methodological issues for estimation of emissions
Since accurate data for compiling time series for NMVOC and CO_2 from "Solvents and other product use" only can be found in the Products register from 1995, reported emissions for CRF codes 3A-D for 1990 until 1994 were taken from the old time series and in some cases emission data for 1990 - 1994 has been interpolated. Activity data for the latest year, 2007, is not yet official and hence Sweden has chosen to report data from 2006. Data for 2007 will be updated in the next submission. Emission of CO_2 has been calculated with the following equation:emission$_{CO2}$ = C$_{quantity}$*emission factor*44/12 C quantity is the carbon quantity of the solvents. 44 and 12 are the molecular weights of CO_2 and C, respectively. Since the method for calculating CO_2 emissions have been changed compared to the method used in previous submissions, the reported emissions of NMVOC for 1990-94 have been related to the NMVOC emissions for 1995. The ratio has been used to calculate the emissions of CO_2 for each CFR code (3A-D). ***Methodology, Activity data & Emission factor (N_2O emissions):*** There are two companies in Sweden selling N_2O in gas cylinders. Information on sold amounts was obtained from one of the companies (1990 - 1991) and from the Products register at the Swedish Chemicals Inspectorate (1992 - 2005). The time series of use of N_2O in Sweden are reported in "Other use of N_2O" (3D4) since no background data is available to separate between the source categories "Use of N_2O for Anaesthesia" (3D1) and "N_2O from Aerosol cans" (3D3). Consequently CRF codes 3D1 and 3D3 are both reported as IE. Activity data for the latest year, 2007, is not yet official and hence Sweden has chosen to report data from 2006. Data for 2007 will be updated in the next submission.
United Kingdom (NIR GB 2009) ***GHG & pollutant:*** - ***GHG Key Category:*** no ***Completness:*** yes ***Uncertainty:*** no ***Time series consistency:***yes ***Sectorspecific QA/QC and verification:*** not provided ***Recalulation:*** yes ***Planned improvements:*** yes ***Methodology, Activity data & Emission factor (CO_2 emissions):*** 3.A.:Emission estimates for most types of coatings are based on annual consumption data and emission factors provided by the British Coatings Federation (BCF, 2005; BCF, 2006; BCF, 2007; BCF, 2008). Emission estimates for drum coatings, metal packaging and OEM coatings are estimated instead using a combination of consumption data and emission factors and estimates made on a plant by plant basis using information supplied by the Metal Packaging Manufacturers Association (MPMA, 2000) and the regulators of individual sites. 3.B.: Emission estimates for surface cleaning processes are based on estimates of annual consumption and emission factors. Consumption estimates are based on data from UK industry sources and UK and European trade associations, together with some published data. Some extrapolation of data is necessary, using Index of Output data produced annually by the Office for National Statistics (ONS, 2008), although this is not expected to introduce significant uncertainty into the estimates. Emission factors assume that all hydrocarbon and oxygenated solvent is emitted, while emission factors for chlorinated solvents are lower, reflecting the fact that some solvent is sent for disposal rather than emitted. Emission estimates for dry cleaning are based on estimates of solvent consumption by the sector. Industry-sourced data are available for some years and estimates for the remaining years are based on a model of the sector, which takes account of changes in the UK population and the numbers of machines of different types and with different emission levels. Emission estimates for leather degreasing are based on a single estimate of solvent use extrapolated to all years using the Index of Output for the leather industry, which is produced annually by the ONS. 3.C.: Emission estimates for coating of film, leather, and textiles as well as estimates for tyre manufacture are based on plant-by-plant emission estimates, made on the basis of information available from regulators. Emissions from coating manufacture are calculated from the solvent contained in coatings produced in the UK, by assuming that an additional 2.5% of solvent was lost during manufacture. Emissions from the manufacture of rubber goods other than tyres are based on solvent consumption estimates provided by the British Rubber Manufacturers Association (BRMA, 2001), which are extrapolated to other years on the basis of the Index of Output figures for the rubber industry which are published each year by the ONS. 3.D.: Emission estimates are based on one of three approaches: (1) Estimates are made based on activity data and emission factors supplied by industry sources (printing processes, consumer products, wood preservation); (2) Estimates are made for each process in a sector based on information provided by regulators or process operators (seed oil extraction, pressure sensitive tapes, paper coating); (3) Estimates are based on estimates of solvent consumption supplied by industry sources (adhesives, aerosols, agrochemicals, miscellaneous solvent use).

5.3 Sector-specific quality assurance and quality control (EU-15)

There are no sector-specific QA/QC procedures for this sector.

5.4 Sector-specific recalculations (EU-15)

Table 5.7 shows that in the solvent sector significant recalculations were made for CO_2 and only minor recalculations for N_2O.

Table 5.7 Sector 3 Solvent and Other Product Use: Recalculations of total GHG emissions and recalculations of GHG emission for 1990 and 2006 by gas ($GgCO_2$-equivalents and %)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
		percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	52,613	1.7%	-3,524	-0.8%	-12,777	-3.2%	11	0.0%	-680	-3.9%	0	0.0%
Solvent and other product use	3,545	59.2%	0	0.0%	0	0.0%	NO	NO	NO	NO	NO	NO
2006												
Total emissions and removals	48,924	1.6%	293	0.1%	-16,310	-5.2%	58	0.1%	-299	-6.9%	165	1.9%
Solvent and other product use	2,291	45.4%	0	0.0%	-7	-0.2%	NO	NO	NO	NO	NO	NO

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 5.8 provides an overview of Member States' contributions to EU-15 recalculations. Besides Austria, France and Danmark, which recalculations are small, Germany contributed most to recalculations for CO_2 emissions in 1990 and 2006.

Table 5.8 **Sector 3 Solvent and Other Product Use: Contribution of Member States to EU-15 recalculations for 1990 and 2006 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)**

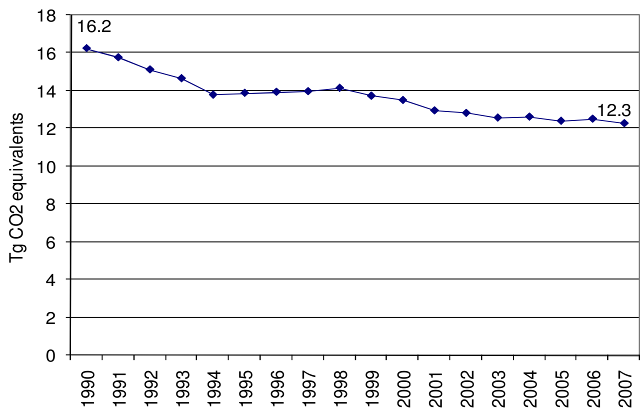
	1990						2006					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	-3	0	0	NO	NO	NO	27	0	0	NO	NO	NO
Belgium	NE	0	0	NO	NO	NO	NE	0	-2	NO	NO	NO
Denmark	31	0	0	NO	NO	NO	-10	0	1	NO	NO	NO
Finland	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
France	205	0	0	NO	NO	NO	100	0	0	NO	NO	NO
Germany	3,308	0	0	NO	NO	NO	2,171	0	0	NO	NO	NO
Greece	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Ireland	-2	0	0	NO	NO	NO	1	0	0	NO	NO	NO
Italy	0	0	0	NO	NO	NO	-2	0	0	NO	NO	NO
Luxembourg	6	0	0	NO	NO	NO	3	0	0	NO	NO	NO
Netherlands	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Portugal	0	0	0	NO	NO	NO	0	0	0	NO	NO	NO
Spain	0	0	0	NO	NO	NO	4	0	0	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	-4	0	-5	NO	NO	NO
UK	NE	0	0	NO	NO	NO	NE	0	0	NO	NO	NO
EU-15	**3,545**	**0**	**0**	**NO**	**NO**	**NO**	**2,291**	**0**	**-7**	**NO**	**NO**	**NO**

Abbreviations explained in the Chapter 'Units and abbreviations'.

5.5 Solvent and other product use for EU-27

CRF Sector 3 Solvent and Other Product Use contributes 0.26 % to the total EU-27 GHG emissions (Table. 5.12). The EU-27 Member States jointly achieved emission reductions of about 24 % from 16.2 Tg in 1990 to 12.3 Tg in 2007 (Figure 5.3 and Table 5.9).

Figure 5.3 **Sector 3 Solvent and Other Product Use: EU-27 GHG emissions for 1990–2007 in CO_2 equivalents (Tg)**



In 2007, the emissions decreased by 1.9 % compared to 2006 (Table 5.9).

Table 5.9 Sector 3 Solvent and Other Product Use: Member States' contributions to GHG emission

Member State	Greenhouse gas emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	13.723	10.399	10.469	85,2%	69	1%	-3.254	-24%
Bulgaria	73	55	54	0,4%	-1	-2%	-19	-26%
Cyprus	2	3	3	0,0%	0	1%	1	31%
Czech Republic	765	513	432	3,5%	-81	-16%	-333	-44%
Estonia	0	0	0	0,0%	-	-	-	-
Hungary	290	344	158	1,3%	-186	-54%	-132	-46%
Latvia	56	64	55	0,4%	-9	-14%	-1	-1%
Lithuania	101	92	92	0,7%	-1	-1%	-9	-9%
Malta	2	2	3	0,02%	1	34%	0	9%
Poland	629	706	733	6,0%	27	4%	104	16%
Romania	541	208	161	1,3%	-47	-23%	-379	-70%
Slovakia	17	82	80	0,7%	-2	-3%	63	369%
Slovenia	43	44	42	0,3%	-2	-5%	-1	-3%
EU-27	**16.242**	**12.513**	**12.281**	**100,0%**	**-232**	**-1,9%**	**-3.961**	**-24%**

In the following table the emission of CO_2, N_2O and NMVOC as well as the Total GHG emission for the EU-12 and for all EU-12 Member States are listed as recommended in IRR 2007 (para 78).

Table. 5.10 Sector 3 Solvent and Other Product Use: EU-12 emissions of CO_2, N_2O, NMVOC and GHG

		CO_2	N_2O	NMVOC	Total emissions		CO_2	N_2O	NMVOC	Total emissions
		Gg			Gg CO_2 eq		Gg			Gg CO_2 eq
A. Paint Application	BG	NE	0.00	2.94	0.00	B. Degreasing and Dry Cleaning	NE	NA	0.00	0.00
	CY	2.39	0.00	2.43	2.39		0.60	NE	0.11	0.60
	CZ	118.40	0.00	37.67	118.40		53.49	NA	17.02	53.49
	EE	NA	0.00	NA	0.00		NA	NA	NA	0.00
	HU	71.57	0.00	25.33	71.57		0.01	NO	0.01	0.01
	LV	23.27	0.00	7.46	23.27		6.05	NO	1.94	6.05
	MT	NA	0.00	NE	0.00		NA	NA	NE	0.00
	PL	271.79	0.00	0.00	271.79		105.55	NE	IE	105.55
	RO	139.01	0.00	44.60	139.01		16.82	NE	5.40	16.82
	SI	NO	0.00	10.71	0.00		NE	NE	0.20	0.00
	SK	NE	0.00	20.00	0.00		NE	NE	5.06	0.00
	LT	47.34	0.00	15.19	47.34		12.24	NE	3.93	12.24
C. Chemical Products, Manufacture and Processing	BG	NO	0.00	0.06	0.00	D. Other	8.98	0.15	5.03	54.10
	CY	NE	0.00	NE	0.00		NE	NE	0.22	0.00
	CZ	44.16	0.00	14.05	44.16		81.60	0.69	25.96	296.12
	EE	NA	0.00	NA	0.00		NA	NA	NA	0.00
	HU	IE	0.00	IE	0.00		NO	0.28	NO	86.52
	LV	NE	0.00	0.07	0.00		21.71	0.01	6.96	25.74
	MT	NA	0.00	NE	0.00		NA	0.01	1.79	2.71
	PL	67.21	0.00	IE	67.21		164.48	0.40	NA,NE	288.48
	RO	NA	0.00	14.22	0.00		5.24	NE	1.68	5.24
	SI	NE	0.00	3.86	0.00		NA	0.14	NA	42.16
	SK	NE	0.00	8.37	0.00		NO	0.26	0.15	79.95
	LT	NE	0.00	NE	0.00		32.09	NA,NE	10.30	32.09
Total Solvent and Other Product Use	BG	8.98	0.15	8.03	54.10					
	CY	2.99	NE	2.76	2.99					
	CZ	297.65	0.69	94.71	512.17					
	EE	NA	NA	NA	0.00					
	HU	71.57	0.28	25.34	158.09					
	LV	51.03	0.01	16.43	55.06					
	MT	NA	0.01	1.79	2.71					
	PL	609.04	0.40	IE,NA,NE	733.04					
	RO	161.07	NE	65.90	161.07					

SI	NA,NE,NO	0.14	14.77	42.16
SK	NE.NO	0.26	33.58	79.95
LT	91.67	NA,NE	29.41	91.67

Table. 5.11 Sector 3 Solvent and Other Product Use: EU-27 CO_2 emissions as well as their share

	Unit	1990	2007
CO_2 emission in Solvent and Other Product Use	[Gg]	11,403	8,495
Total EU-27 GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	16,242	12,281
Share of CO_2 emission in Total EU-27 GHG in 'Solvent and Other Product Use'		*70%*	*69%*
Total EU-27 CO_2 Emissions and Removals	[Gg]	4,399,146	4,188,016
Share of CO_2 emission from 'Solvent and Other Product Use' in Total EU-27 CO_2 Emissions and Removals		*0.26%*	*0.20%*
Total EU-27 GHG Emissions and Removals	[Gg CO_2 eq]	5,558,427	5,046,963
Share of CO_2 emission from 'Solvent and Other Product Use' in Total EU-27GHG Emissions and Removals		*0.21%*	*0.17%*

Table. 5.12 Sector 3 Solvent and Other Product Use: EU-27 N_2O emissions as well as their share

	Unit	1990	2007
N_2O emission in Solvent and Other Product Use	[Gg]	15.6	12.2
Total EU-27 GHG emission in Solvent and Other Product Use	[Gg CO_2 eq]	16,242	12,281
Share of N_2O emission in Total EU-27 GHG in 'Solvent and Other Product Use'		*30%*	*31%*
Total EU-27 N_2O Emissions and Removals	[Gg]	1,653	1,205
Share of N_2O emission from 'Solvent and Other Product Use' in Total EU-27N_2O Emissions and Removals		*0.94%*	*1.01%*
Total EU-27 GHG Emissions and Removals	[Gg CO_2 eq]	5,558,427	5,046,963
Share of N_2O emission from 'Solvent and Other Product Use' in Total EU-27 GHG Emissions and Removals		*0.09%*	*0.08%*

Table. 5.13 Sector 3 Solvent and Other Product Use: EU-27 GHG emissions as well as their share

	Unit	1990	2007
GHG emission in 'Solvent and Other Product Use'	[Gg CO_2 eq]	16,242	12,281
Total EU-27 GHG Emissions and Removals	[Gg CO_2 eq]	5,558,427	5,046,963
Share of GHG emission from 'Solvent and Other Product Use' in Total EU-27 GHG Emissions and Removals		*0.29%*	*0.24%*

6 Agriculture (CRF Sector 4)

Half of the European Union's land is farmed. This fact alone highlights the importance of farming for the EU's natural environment. Farming and nature exercise a profound influence over each other. Farming has contributed over the centuries to creating and maintaining a variety of valuable semi-natural habitats. Today these shape the majority of the EU's landscapes and are home to many of the EU's richest wildlife. Farming also supports a diverse rural community that is not only a fundamental asset of European culture, but also plays an essential role in maintaining the environment in a healthy state[29].

The links between the richness of the natural environment and farming practices are complex. While many valuable habitats in Europe are maintained by extensive farming, and a wide range of wild species rely on this for their survival, agricultural practices can also have an adverse impact on natural resources. Pollution of soil, water and air, fragmentation of habitats and loss of wildlife can be the result of inappropriate agricultural practices and land use.

Agriculture in Europe is determined by the Common Agricultural Policy (CAP) of the European Union. The CAP dates from 1957, and its foundations are entrenched in the Treaty of Rome. Initially, the emphasis of the CAP was to increase agricultural productivity, partly for food security reasons, but also to ensure that the EC had a viable agricultural sector and that consumers had a stable supply of affordable food (Gay et al., 2005). With the MacSharry reform of 1992 several steps were taken by the EC to shift CAP subsidies away from price and market support towards direct support for farmers. This was further pursued with the Agenda 2000 reform, as signified by the shift in focus towards the maintenance and enhancement of the rural environment and the growing recognition of agriculture as a multifunctional activity. In environmental terms, the focus is on

(i) less-favoured areas and areas with environmental restrictions, and

(ii) on agricultural production methods designed to protect the environment and to maintain the countryside.

However price support and income payments, together with milk quotas, remained the dominant support measures. The 2003 CAP reform made further progress in the direction initiated by the Agenda 2000 reform, by aiming to make European agriculture more market oriented and giving a stronger focus to environmental protection. With the CAP reform, cross-compliance became an obligatory element of the CAP. Cross-compliance establishes a link between the granting of income support to the farmers and the compliance by the beneficiary with specified requirements of public interest (Oenema, 2008). These are given in

(i) "Statutory management requirements" (SMR, (Annex III of Regulation (EC) No 1782/2003) which are set in 19 community legislative acts on environment, food safety, animal health and welfare, as well as

(ii) the obligation to maintaining land in good agricultural and environmental conditions (GAECs) and maintaining permanent pasture at level at 1.5.2004. Definitions of GAEC are specified at national or regional level and should warrant appropriate soil protection, ensure a minimum level of maintenance of soil organic matter and soil structure and avoid the deterioration of habitats.

An important driver of GHG emissions from agriculture were the milk quota. For example in the Netherlands, total milk production is determined mainly by EC policy on milk quota, which remained unchanged. Therefore, the effect of increasek milk production per cow needed to be counteracted by decreasing the animal number of adult dairy cattle.

The *Nitrates Directive* (Council Directive 91/676/EEC) is the SMR with the largest impact on

[29] http://europa.eu.int/comm/agriculture/envir/index_en.htm

greenhouse gas emissions from agriculture. The directive aims at reducing and preventing water pollution caused by nitrates from agricultural sources with the goal that nitrate concentrations in groundwater will not exceed 50 mg NO_3 L^{-1} and listing codes of good practice (Annex II A) to be implemented by the farmers on a voluntary basis. Nitrate vulnerable zones must be designated on the basis of monitoring results which indicate that the groundwater and surface waters in these zones are or could be affected by nitrate pollution from agriculture. The action program must contain mandatory measures relating to: (i) periods when application of animal manure and fertilizers is prohibited; (ii) capacity of and facilities for storage of animal manure; and (iii) limits to the amounts of animal manure and fertilizers applied to land.

This affected emissions in most countries, for example in Belgium, manure Action Plans (based on the Nitrate directive) in Flanders affected NH_3 volatilization from manure application. The first action plan in 1991 regulated the reduced in which manure can be spread and foresees low-emission techniques for the application of manure on land. The MAP2bis in 2000 focuses on the reduction of the manure surplus and manure processing in order to reduce the NH_3 emissions from manure application on land. Other MAP's followed.

In Denmark, the environmental policy has introduced a series of measures to prevent loss of nitrogen from agricultural soil to the aquatic environment. The measures include improvements to the utilisation of nitrogen in manure, a ban on manure application during autumn and winter, increasing area with winter-green fields to catch nitrogen, a maximum number of animals per hectare and maximum nitrogen application rates for agricultural crops. All farmers are obliged to do N-mineral acounting a a farm and field level with the N-excretaion data from FAS (Faculty of Agriucltural Sciences). The N figures also include the quantities of mineral fertilisers bought and sold. Suppliers of mineral fertilisers are required to report all N sales to commmercial farmers to the Plant Directorate. An active environmental policy has brought about a decrease in the N-excretion, a decrease of emission per produced animal, because of more efficient feeding. As a result of increasing requirements to reduce the nitrogen loss to the environment, the consumption of nitrogen in synthetic fertiliser has more than halved from 1990 to 2007.

In the Netherlands, manure and fertilizer policy influences livestock numbers. Especially young cattle, pigs and poultry numbers decreased by the introduction of measures like buying up part of the so-called pig and poultyr production rights (ceilings for total animal numbers) by the government and lowering the maximum nutrient application standards for manure and fertilizer.

However, greater compliance to standards and requirements for animal welfare and the housing of animals may contribute to increasing emissions (so-called pollution swapping).

Beside the environmentally-targeted directives, also the so-called first pillar of the CAP (dealing with market support in contrast to pillar two covering rural development measures) had a strong impact on the greenhouse gas emissions from agriculture in Europe, namely through the milk quota system, which lead to a strong reduction of animal numbers in the dairy sector to compensate for the increasing animal performance during the last decades.

Other important policies affecting greenhouse gas emissions from agriculture, particularly by addressing the abatement of air pollution through the control of NO_x and NH_3 emissions include, under others,

- the 1999 *Gothenburg Protocol* under the *Convention on Long Range Transboundary Air Pollution (CLRTAP)* to 'Abate Acidification, Eutrophication and Ground-level Ozone', which entered into force on 22 June 2006;
- the National Emission Ceilings Directive (NEC - Directive 2001/81/EC), which sets upper limits for each Member State for the total emissions in 2010 of the four pollutants responsible for acidification, eutrophication and ground-level ozone pollution;
- the *Integrated Pollution Prevention and Control* (IPPC) Directive, which was established in 1996 (http://ec.europa.eu/environment/ippc/index.htm), and aims at minimizing pollution from point sources, i. e., intensive animal production facilities (pig and poultry farms, with > 2000 fattening pigs; >750 sows; or > 40,000 head of poultry). These are required under the directive

to apply control techniques for preventing NH_3 emissions according to Best Available Technology (BAT).

Structural changes are caused also by the general development of countries. For example, in Finland, the membership in the EC resulted in changes in the economic structure followed by an increase in the average farm size and a decrease in the number of small farms (Pipatti 2001), causing also a decrease in the livestock numbers for most animal types. Swedish agriculture has undergone radical structural changes and rationalisations over the past 50 years. One fifth of the Swedish arable land cultivated in the 1950s is no longer farmed. Closures have mainly affected smallholdings and those remaining are growing larger. In 1999, some 31,000 agricultural holdings were livestock farms, 14,000 were purely crop husbandry farms, and only 5,000 were a combination of the two. Livestock farmers predominately engage in milk production and the main crops grown in Sweden are grain and fodder crops.101 The decrease of agricultural land area has continued since Sweden joined the European Union in 1995 and the acreages of land for hay and silage has increased. Organic farming has increased from 3 % of the arable land area in 1995 to 17 % in 2007.

6.1 Overview over the sector

CRF Sector 4 'Agriculture' contributes 9 % to total EU-15 GHG emissions, making it the second largest sector after 'Energy'. The most important GHGs from 'Agriculture' are N_2O and CH_4 accounting for 5 % and 4 % of the total GHG emissions respectively. The emissions from this sector decreased by 11 % from 419 Tg in 1990 to 371 Tg in 2007 (Figure 6.1). In 2007, the emissions decreased by 0.4 % compared to 2006. The key sources in this sector are:

4 A 1 Cattle:(CH_4)

4 A 3 Sheep:(CH_4)

4 B 1 Cattle:(CH_4)

4 B 13 Solid Storage and Dry Lot:(N_2O)

4 B 8 Swine:(CH_4)

4 D 1 Direct Soil Emissions:(N_2O)

4 D 2 Pasture, Range and Paddock Manure:(N_2O)

4 D 3 Indirect Emissions:(N_2O)

Figure 6.1 shows that the three largest key sources account for about 70% of agricultural GHG emissions of the EU-15.

Figure 6.1 EU-15 GHG emissions for 1990–2007 from CRF Sector 4: 'Agriculture' in CO_2 equivalents (Tg) and share of largest key source categories in 2007

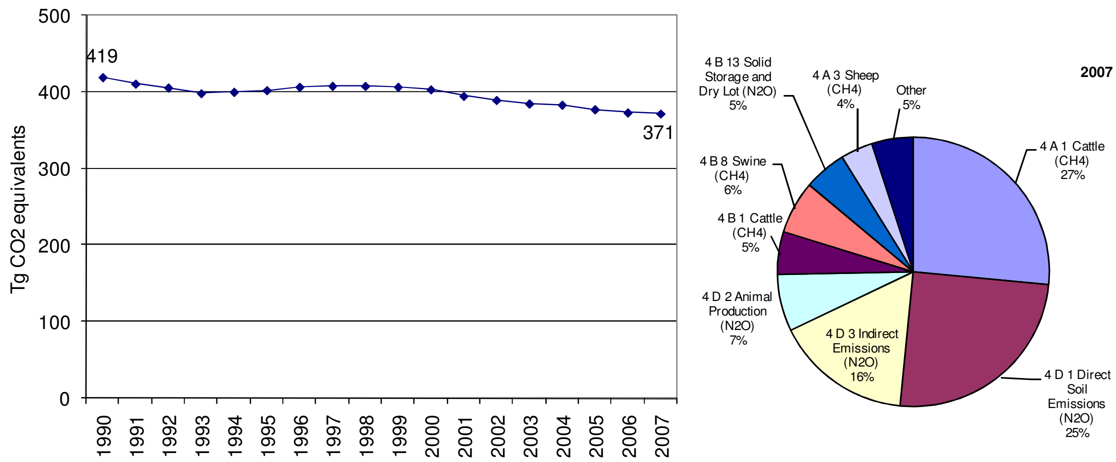
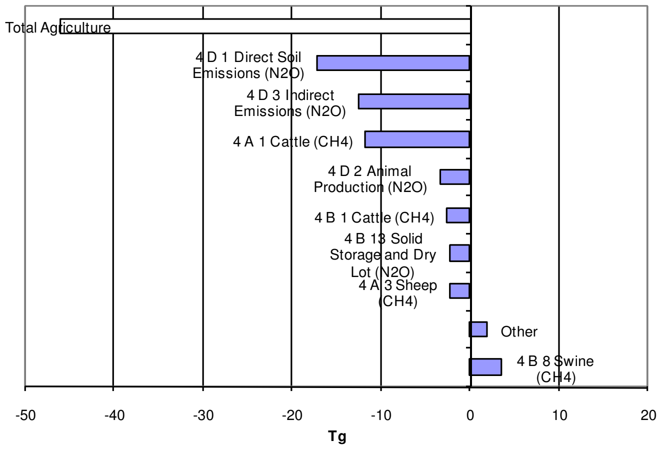


Figure 6.2 shows that large reductions occurred in the largest key sources CH_4 from 4.A.1: 'Cattle' and N_2O from 4.D.1: 'Direct soil emissions' and 4.D.3: 'Indirect emissions'. The main reasons for this are declining cattle numbers and decreasing use of fertiliser and manure in most Member States.

Figure 6.2 Absolute change of GHG emissions by large key source categories 1990–2007 in CO_2 equivalents (Tg) in CRF Sector 4: 'Agriculture'



6.2 Source Categories

6.2.1 Enteric fermentation (CRF Source Category 4A) (EU-15)

Table 6.1 shows total GHG and CH_4 emissions by Member State from 4A Enteric Fermentation. Between 1990 and 2007, CH_4 emission from 4A Enteric fermentation decreased by 10 %. The absolute decrease was largest in Germany, the absolute increase was largest in Spain.

Table 6.1: 4A Enteric Fermentation: Member States' contributions to total GHG and CH_4 emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2007 (Gg CO_2 equivalents)
Austria	3,764	3,215	3,764	3,215
Belgium	4,126	3,569	4,126	3,569
Denmark	3,259	2,787	3,259	2,787
Finland	1,929	1,560	1,929	1,560
France	30,960	28,342	30,960	28,342
Germany	21,803	16,995	21,803	16,995
Greece	2,877	2,930	2,877	2,930
Ireland	9,494	8,841	9,494	8,841
Italy	12,179	11,027	12,179	11,027
Luxembourg	271	247	271	247
Netherlands	7,540	6,318	7,540	6,318
Portugal	2,622	2,979	2,622	2,979
Spain	11,780	13,560	11,780	13,560
Sweden	3,058	2,736	3,058	2,736
United Kingdom	18,173	15,395	18,173	15,395
EU-15	**133,834**	**120,499**	**133,834**	**120,499**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from cattle is the largest single source of CH_4 emissions in the EU-15 accounting for 2.4 % of total GHG emissions in 2007. Between 1990 and 2007, CH_4 emissions from enteric fermentation from cattle declined by 11 % in the EU-15 (Table 6.2). In 2007, the emissions were 1 % higher compared to 2006. The main driving force of CH_4 emissions from enteric fermentation is the number of cattle, which was 16 % below 1990 levels in 2007. The Member States with most emissions from this source were France and Germany (42 %). All Member States except Spain, Portugal and Greece reduced CH_4 emissions from enteric fermentation of cattle between 1990 and 2007.

Table 6.2: 4A1 Cattle: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3.561	2.999	3.001	3,0%	1	0%	-560	-16%	T2	NS	CS
Belgium	3.874	3.318	3.330	3,4%	12	0%	-544	-14%	T2	NS	D/CS
Denmark	2.950	2.202	2.359	2,4%	157	7%	-591	-20%	T2	NS	CS
Finland	999	782	760	0,8%	-21	-3%	-239	-24%	T2	NS	CS
France	27.933	25.579	25.729	26,0%	150	1%	-2.204	-8%	C	NS	CS
Germany	20.359	15.472	15.581	15,8%	109	1%	-4.778	-23%	CS,D,T2	RS	CS,D
Greece	864	916	927	0,9%	11	1%	63	7%	T1	NS	D
Ireland	8.422	8.336	8.100	8,2%	-237	-3%	-323	-4%	T2	NS	CS
Italy	10.040	8.366	8.676	8,8%	311	4%	-1.364	-14%	T2	NS	CS
Luxembourg	267	232	241	0,2%	9	4%	-26	-10%	T2	NS	CS
Netherlands	6.783	5.577	5.636	5,7%	59	1%	-1.147	-17%	T2	NS	CS
Portugal	1.814	2.118	2.097	2,1%	-21	-1%	282	16%	T2	NS	CS
Spain	6.473	8.038	8.274	8,4%	235	3%	1.800	28%	T2, CS	NS	D, CS
Sweden	2.698	2.439	2.384	2,4%	-55	-2%	-314	-12%	CS	NS	CS
United Kingdom	13.484	11.891	11.730	11,9%	-161	-1%	-1.754	-13%	T2	NS	CS,D
EU-15	**110.522**	**98.264**	**98.824**	**100,0%**	**560**	**1%**	**-11.697**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Enteric fermentation from sheep is the sixth largest single source of CH_4 emissions in the EU-15 and accounts for 0.4 % of total GHG emissions in 2007. Between 1990 and 2007, CH_4 emissions from enteric fermentation of sheep declined by 13 % in the EU-15 (Table 6.3). In 2007, the emissions were 2 % lower compared to 2006. The main driving force of CH_4 emissions from enteric fermentation is the number of sheep, which was 16 % below 1990 levels in 2007. The Member States with most emissions from this source were Spain and the United Kingdom (52 %). Nine Member States reduced CH_4 emissions from enteric fermentation of sheep.

Table 6.3: 4A3 Sheep: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	52	52	59	0,4%	7	12%	7	13%	T1	NS	D
Belgium	32	26	25	0,2%	-1	-2%	-7	-22%	T1/T2	NS	D/CS
Denmark	33	37	31	0,2%	-5	-15%	-2	-5%	T2	NS	CS
Finland	15	21	21	0,1%	0	2%	6	43%	T2	NS	CS
France	2.296	1.830	1.813	12,7%	-16	-1%	-483	-21%	C	NS	D
Germany	556	430	426	3,0%	-4	-1%	-130	-23%	T1	RS	D
Greece	1.364	1.382	1.385	9,7%	3	0%	21	2%	T2	NS	CS
Ireland	1.032	756	691	4,9%	-65	-9%	-342	-33%	T1	NS	D
Italy	1.468	1.382	1.384	9,7%	2	0%	-84	-6%	T1	NS	D
Luxembourg	1	2	2	0,0%	0	-3%	0	28%	T1	NS	D
Netherlands	286	231	230	1,6%	-1	-1%	-56	-20%	T1	NS	D
Portugal	560	714	684	4,8%	-30	-4%	124	22%	T2	NS	CS
Spain	4.258	4.060	4.038	28,4%	-21	-1%	-219	-5%	T2, CS	NS	D, CS
Sweden	68	85	85	0,6%	0	1%	17	25%	T1	NS	D
United Kingdom	4.354	3.471	3.351	23,6%	-120	-3%	-1.002	-23%	T2	NS	CS,D
EU-15	**16.375**	**14.478**	**14.226**	**100,0%**	**-251**	**-2%**	**-2.149**	**-13%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.2.2 Manure management (CRF Source Category 4B) (EU-15)

Table 6.4 shows total GHG, CH_4 and N_2O emissions by Member State from 4B Manure Management. Between 1990 and 2007, CH_4 emission from 4B Manure Management increased by 3 %, whereas N_2O emission from 4B Manure Management decreased by 9 %.

Table 6.4: 4B Manure Management: Member States' contributions to total GHG emissions, CH_4 and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2007 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2007 (Gg CO2 equivalents)
Austria	2,065	1,763	1,060	886	1,005	878
Belgium	2,668	2,360	1,709	1,567	960	792
Denmark	1,436	1,634	751	1,048	685	586
Finland	895	781	230	284	665	497
France	20,617	19,934	13,779	13,919	6,838	6,015
Germany	9,099	7,879	6,228	5,477	2,870	2,402
Greece	798	781	497	487	301	294
Ireland	2,726	2,542	2,328	2,158	397	384
Italy	7,383	6,853	3,462	3,057	3,921	3,797
Luxembourg	126	124	86	98	41	26
Netherlands	3,810	3,506	2,996	2,634	814	872
Portugal	1,751	1,742	1,176	1,170	575	573
Spain	8,695	12,439	6,231	9,458	2,465	2,981
Sweden	1,077	951	349	472	728	478
United Kingdom	5,718	4,541	3,567	2,857	2,151	1,684
EU-15	**68,863**	**67,830**	**44,447**	**45,572**	**24,416**	**22,258**

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B1 Cattle account for 0.5 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, CH_4 emissions from this source decreased by 12 % (Table 6.5). Germany and France are responsible for 57 % of the total EU-15 emissions from this source. All Member States except Finland, Luxembourg, Portugal and Sweden had reductions between 1990 and 2007. In absolute terms, France and Germany had the most significant decreases from this source.

Table 6.5: 4B1 Cattle: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	587	454	452	2,4%	-2	0%	-135	-23%	T2	NS	CS
Belgium	337	285	287	1,5%	2	1%	-49	-15%	T2	NS/RS	CS
Denmark	282	251	252	1,3%	1	1%	-30	-11%	T2	NS	CS
Finland	66	90	91	0,5%	0	0%	25	38%	T2	NS	CS
France	8.817	8.105	8.181	42,8%	76	1%	-636	-7%	C/ T1	NS	D/ CS
Germany	3.373	2.688	2.704	14,2%	16	1%	-668	-20%	D,T2,T3	RS	CS,D
Greece	202	199	201	1,1%	1	1%	-1	-1%	T1	NS	D
Ireland	1.867	1.663	1.610	8,4%	-52	-3%	-257	-14%	T2	NS	CS
Italy	1.636	1.166	1.183	6,2%	17	1%	-454	-28%	T2	NS	CS
Luxembourg	53	69	63	0,3%	-6	-9%	9	17%	T2	NS	CS
Netherlands	1.571	1.453	1.471	7,7%	18	1%	-101	-6%	T2	NS	CS
Portugal	47	70	70	0,4%	0	0%	23	50%	T2	NS	CS
Spain	473	435	433	2,3%	-2	-1%	-40	-8%	T2, CS	NS	D, CS
Sweden	213	308	317	1,7%	9	3%	104	49%	T2	NS	CS
United Kingdom	2.114	1.829	1.780	9,3%	-49	-3%	-333	-16%	T2	NS	CS,D
EU-15	**21.638**	**19.065**	**19.095**	**100,0%**	**30**	**0%**	**-2.543**	**-12%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 emissions from 4B8 Swine account for 0.6 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, CH_4 emissions from this source increased by 18 % (Table 6.6). France and Spain are responsible for 57 % of the total EU-15 emissions from this source. In absolute terms, Spain had the most significant increases from this source.

Table 6.6: **4B8 Swine: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor**

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	448	395	407	1,7%	12	3%	-40	-9%	T2	NS	CS
Belgium	1.350	1.258	1.252	5,3%	-6	0%	-98	-7%	CS/M	NS/RS	CS
Denmark	448	747	749	3,2%	2	0%	301	67%	T2	NS	CS
Finland	81	108	110	0,5%	2	2%	29	37%	T2	NS	CS
France	4.206	5.044	5.044	21,4%	0	0%	838	20%	C/ T1	NS	D/ CS
Germany	2.727	2.525	2.593	11,0%	68	3%	-134	-5%	T1	M	D,CS
Greece	146	134	132	0,6%	-2	-2%	-14	-10%	T1	NS	D
Ireland	328	431	415	1,8%	-16	-4%	87	27%	T1	NS	D
Italy	1.432	1.423	1.395	5,9%	-28	-2%	-37	-3%	T2	NS	CS
Luxembourg	31	34	34	0,1%	0	-1%	3	10%	T1	NS	D
Netherlands	1.140	1.063	1.082	4,6%	19	2%	-58	-5%	T2	NS	CS
Portugal	1.087	1.045	1.047	4,4%	2	0%	-40	-4%	T2	NS	CS
Spain	5.329	8.478	8.521	36,1%	42	0%	3.192	60%	T2, CS	NS	D, CS
Sweden	99	126	114	0,5%	-12	-10%	15	15%	T2	NS	CS
United Kingdom	1.119	731	717	3,0%	-15	-2%	-402	-36%	T2	NS	CS,D
EU-15	**19.971**	**23.544**	**23.613**	**100,0%**	**69**	**0%**	**3.642**	**18%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B13 Solid Storage and Dry Lot account for 0.5 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, N_2O emissions from this source decreased by 11 % (Table 6.7). Italy, France and Spain are responsible for 63 % of the total EU-15 emissions from this source. In absolute terms, France had the most significant decrease from this source while Spain had the largest increases.

Table 6.7: **4B13 Solid Storage and Dry Lot: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor**

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	965	838	841	4,4%	3	0%	-124	-13%	T1	NS	CS
Belgium	892	769	735	3,9%	-34	-4%	-157	-18%	T1	NS/RS	D
Denmark	590	462	504	2,7%	41	9%	-86	-15%	CS	NS	D
Finland	652	492	476	2,5%	-16	-3%	-176	-27%	D	NS	D
France	6.604	5.770	5.780	30,5%	10	0%	-824	-12%	C/ T1	NS	D/ CS
Germany	1.476	993	1.003	5,3%	10	1%	-473	-32%	T1,CS	NS	D
Greece	282	272	274	1,4%	1	0%	-8	-3%	D	NS	D
Ireland	341	342	330	1,7%	-12	-4%	-12	-3%	T1	NS	D
Italy	3.728	3.168	3.345	17,6%	177	6%	-383	-10%	T2	NS	D, CS
Luxembourg	39	18	23	0,1%	5	27%	-16	-40%	T1	EJ	D
Netherlands	597	698	713	3,8%	16	2%	116	19%	T2	NS	D
Portugal	560	568	558	2,9%	-10	-2%	-2	0%	D	NS	D
Spain	2.387	2.828	2.866	15,1%	38	1%	479	20%	D, CS	NS	D
Sweden	649	354	344	1,8%	-11	-3%	-305	-47%	T2	NS	CS
United Kingdom	1.468	1.182	1.168	6,2%	-13	-1%	-300	-20%	T2	NS	CS,D
EU-15	**21.230**	**18.755**	**18.959**	**100,0%**	**205**	**1%**	**-2.271**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4B14 Other account for 0.02 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, N_2O emissions from this source increased by 23 % (Table 6.8). The UK and Italy are responsible for 80 % of the total EU-15 emissions from this source.

Table 6.8: 4B14 Other: Member States' contributions to N_2O emissions

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	17	16	16	1,7%	0	1%	-1	-3%
Belgium	57	55	48	5,0%	-7	-13%	-9	-16%
Denmark	NO	NO	NO	-	-	-	-	-
Finland	NE	NE	NE	-	-	-	-	-
France	NA	NA	NA	-	-	-	-	-
Germany	NO	NO	NO	-	-	-	-	-
Greece	13	14	14	1,5%	0	1%	2	12%
Ireland	NO	NO	NO	-	-	-	-	-
Italy	NO	295	293	30,7%	-3	-1%	293	-
Luxembourg	0,02	0,29	0,30	0,03%	0	3%	0	1172%
Netherlands	NO	NO	NO	-	-	-	-	-
Portugal	NO	NO	NO	-	-	-	-	-
Spain	NO	NO	NO	-	-	-	-	-
Sweden	64	111	112	11,7%	1	1%	48	74%
United Kingdom	626	494	471	49,3%	-23	-5%	-155	-25%
EU-15	**777**	**986**	**955**	**100,0%**	**-31**	**-3%**	**178**	**23%**

Abbreviations explained in the Chapter 'Units and abbreviations'.
Emissions of Finland were not estimated due to lack of data.

6.2.3 Agricultural soils (CRF Source Category 4D) (EU-15)

N_2O emissions from this source category account for 4 % of total GHG emissions. Table 6.9 shows total GHG and N_2O emissions by Member State for N_2O from 4D Agricultural Soils. N_2O emissions from this source decreased by 15 % between 1990 and 2007. All EU-15 Member States decreased emissions except Spain.

Table 6.9: 4D Agricultural Soils: Member States' contributions to total GHG and N_2O emissions

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO_2 equivalents)	N_2O emissions in 2007 (Gg CO_2 equivalents)
Austria	3,340	2,970	3,333	2,961
Belgium	4,546	3,693	4,546	3,693
Denmark	8,314	5,652	8,314	5,652
Finland	4,300	3,188	4,300	3,188
France	55,951	47,362	55,951	47,362
Germany	30,729	26,606	31,404	27,239
Greece	9,715	7,444	9,715	7,444
Ireland	7,009	6,365	7,009	6,365
Italy	19,435	17,791	19,435	17,791
Luxembourg	378	340	378	340
Netherlands	11,122	8,599	11,122	8,599
Portugal	3,437	2,489	3,437	2,489
Spain	19,090	19,735	19,090	19,735
Sweden	5,248	4,744	5,248	4,744
United Kingdom	30,415	23,280	30,415	23,280
EU-15	**213,029**	**180,257**	**213,697**	**180,882**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.10 provides information on emission trends and information on methods applied activity data and emissions factor of the key source from 4D1 Direct soil emissions by Member State. Direct N_2O emissions from agricultural soils is the largest source category of N_2O emissions and accounts for 2.3 % of total EU-15 GHG emissions in 2007. Direct N_2O emissions from agricultural soils occur from the application of mineral nitrogen fertilisers and organic nitrogen from animal manure. Between 1990 and 2007, emissions declined by 16 % in the EU-15. The Member States with most emissions from this source were France and Germany. All Member States except the Netherlands reduced N_2O emissions from agricultural soils.

The main driving force of direct N_2O emissions from agricultural soils is the use of nitrogen fertiliser and animal manure, which were 25 % and 6 % below 1990 levels in 2007, respectively. N_2O emissions from agricultural land can be decreased by overall efficiency improvements of nitrogen uptake by crops, which should lead to lower fertiliser consumption on agricultural land. The decrease of fertiliser use is partly due to the effects of the 1992 reform of the common agricultural policy and the resulting shift from production-based support mechanisms to direct area payments in arable production. This has tended to lead to an optimisation and overall reduction in fertiliser use. In addition, reduction in fertiliser use is also due to directives such as the nitrate directive and to the extensification measures included in the agro-environment programmes (EC, 2001).

Table 6.10: 4D1 Direct soil emissions: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1.805	1.610	1.633	1,7%	23	1%	-172	-10%	T1a,b	NS	D
Belgium	2.367	2.155	2.052	2,2%	-103	-5%	-315	-13%	T1	NS/RS	D
Denmark	4.231	2.889	2.956	3,2%	67	2%	-1.275	-30%	D/CS	NS	D/CS
Finland	3.378	2.460	2.443	2,6%	-17	-1%	-935	-28%	D	NS	CS, D
France	26.776	22.224	22.174	23,7%	-49	0%	-4.601	-17%	C/ T1	NS	D/ CS
Germany	22.757	20.705	19.950	21,4%	-755	-4%	-2.807	-12%	CR,D,T1,T2	S, RS,AS,M,Q	D
Greece	2.741	1.566	1.452	1,6%	-114	-7%	-1.289	-47%	T1a,T1b	NS	D
Ireland	2.862	2.590	2.453	2,6%	-138	-5%	-410	-14%	T1a, T1b	NS	D
Italy	9.581	8.836	8.694	9,3%	-142	-2%	-888	-9%	D	NS	D, CS
Luxembourg	178	162	166	0,2%	4	3%	-12	-7%	T1a T1b	EJ NS	D
Netherlands	4.674	4.850	4.868	5,2%	18	0%	194	4%	T1b,T2	NS	CS
Portugal	1.449	943	797	0,9%	-146	-15%	-652	-45%	T1a	NS	D
Spain	10.106	9.885	9.975	10,7%	89	1%	-131	-1%	T1a, T1b, CS	NS	D
Sweden	3.174	2.901	2.919	3,1%	18	1%	-255	-8%	CS, T1a, T1b	NS	CS, D
United Kingdom	14.469	11.371	10.855	11,6%	-516	-5%	-3.614	-25%	T1a, T1b	NS	D
EU-15	**110.547**	**95.148**	**93.386**	**100,0%**	**-1.762**	**-1,9%**	**-17.161**	**-16%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D2 Pasture, Range and Paddock Manure account for 0.6 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, N_2O emissions from this source decreased by 11 % (Table 6.11). France, the United Kingdom and Greece are responsible for 59 % of the total EU-15 emissions from this source. France had the greatest reduction in absolute terms while Spain had the largest increases.

Table 6.11: 4D2 Pasture, Range and Paddock Manure: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	218	217	223	0,9%	6	3%	4	2%	T1a,b	NS	D
Belgium	936	791	735	2,9%	-56	-7%	-201	-21%	T1	NS/RS	D
Denmark	312	201	206	0,8%	5	2%	-106	-34%	D/CS	NS	D
Finland	165	149	148	0,6%	-1	-1%	-16	-10%	D	NS	D
France	8.593	7.411	7.440	29,2%	29	0%	-1.153	-13%	C/ T1	NS	D/ CS
Germany	1.821	1.460	1.475	5,8%	16	1%	-346	-19%	C	M	C
Greece	3.383	3.382	3.379	13,3%	-3	0%	-4	0%	D	NS	D
Ireland	2.802	2.783	2.680	10,5%	-103	-4%	-122	-4%	T1a	NS	D
Italy	1.736	1.556	1.570	6,2%	14	1%	-166	-10%	D	NS	D, CS
Luxembourg	59	53	55	0,2%	2	4%	-3	-6%	T1	EJ	D
Netherlands	1.449	662	603	2,4%	-59	-9%	-847	-58%	T1b	NS	CS
Portugal	662	753	755	3,0%	1	0%	93	14%	T1a	NS	D
Spain	1.366	1.560	1.620	6,4%	60	4%	254	19%	T1a, T1b, CS	NS	D
Sweden	303	341	320	1,3%	-20	-6%	17	6%	T2	NS	CS
United Kingdom	4.980	4.366	4.270	16,8%	-97	-2%	-711	-14%	NO	NO	NO
EU-15	**28.787**	**25.684**	**25.478**	**100,0%**	**-206**	**-1%**	**-3.308**	**-11%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

N_2O emissions from 4D3 Indirect Emissions account for 1.5 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, N_2O emissions from this source decreased by 17 % (Table 6.12). France, the UK, Spain and Italy are responsible for 68 % of the total EU-15 emissions from this source.

Table 6.12: 4D3 Indirect Emissions: Member States' contributions to N_2O emissions and information on method applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	1.310	1.092	1.105	1,8%	13	1%	-205	-16%	T1a,b	NS	D
Belgium	1.242	927	906	1,5%	-21	-2%	-336	-27%	T2	NS/RS	D
Denmark	3.743	2.207	2.401	3,9%	194	9%	-1.341	-36%	D/CS	NS	D
Finland	758	598	597	1,0%	-1	0%	-161	-21%	D	NS	D
France	20.582	17.720	17.748	29,2%	27	0%	-2.834	-14%	C/T1	NS	D/ CS
Germany	6.693	5.820	5.676	9,3%	-144	-2%	-1.017	-15%	CR,D,T1	NS,RS,M	CR,D
Greece	3.591	2.697	2.613	4,3%	-84	-3%	-978	-27%	T1a	NS	D
Ireland	1.345	1.289	1.232	2,0%	-57	-4%	-113	-8%	T1b	NS	D
Italy	8.118	7.464	7.527	12,4%	63	1%	-591	-7%	D	NS	D, CS
Luxembourg	141	116	118	0,2%	2	2%	-23	-16%	T1a	EJ NS	D
Netherlands	4.975	3.187	3.124	5,1%	-63	-2%	-1.851	-37%	T1,T3	NS	D
Portugal	1.324	1.040	935	1,5%	-105	-10%	-389	-29%	T1a	NS	D
Spain	7.515	7.774	7.911	13,0%	137	2%	395	5%	T1a, T1b, CS	NS	D
Sweden	1.139	919	921	1,5%	2	0%	-218	-19%	CS, T1	NS	D
United Kingdom	10.797	8.211	7.982	13,1%	-229	-3%	-2.815	-26%	NO	NO	NO
EU-15	**73.275**	**61.064**	**60.797**	**100,0%**	**-267**	**0%**	**-12.478**	**-17%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

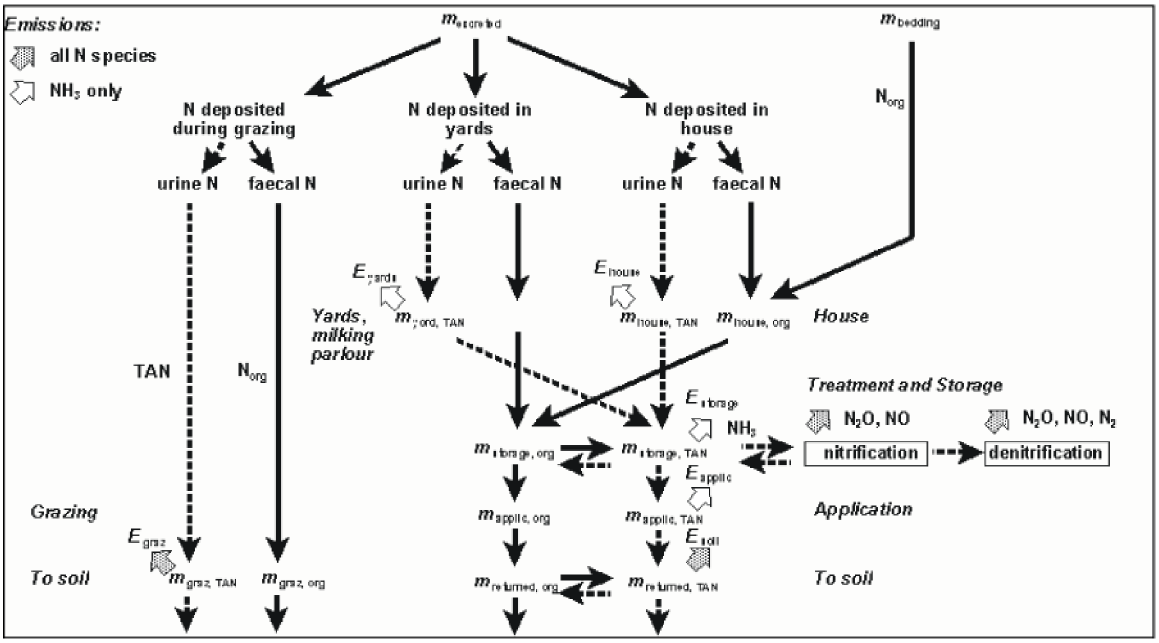
6.3 Methodological issues and uncertainty

All Member States consider their greenhouse gas inventories in the agricultural sector for complete for those categories that are reported to occur in the countries. For categories 4.A, 4.B (both methane and nitrous oxide) and 4.D (nitrous oxide) emissions in all relevant sub-categories are considered (CRF Tables 7s2). CH_4 emissions from rice fields are reported for France, Greece, Italy, Portugal and Spain.

Many countries recognise that in the agriculture sector the emissions from the different categories are inherently linked and are best estimated in a comprehensive model that covers not only greenhouse gases (CH_4 and N_2O) in a consistent manner, but also ammonia. Estimations of ammonia emissions are required for reporting under the Convention on Long-Range Transboundary Air Pollution and are needed to estimate indirect N_2O emissions. Hence, some countries have developed comprehensive models covering consistently different source categories and different gases.

- Germany: GAS-EM (GASeous Emissions) calculates consistently the emissions from the agriucltural sector (Dämmgen et al., 2002). Figure 6.3 shows the flow of nitrogen in manure management systems tracking all fluxes and N-transformation processes in a mass-conservative mode.
- Denmark: DIEMA (Danish Integrated Emission Model for Agriculture) covers emissions of greenhouse gases, ammonia and particulate matter (Mikkelsen et al., 2005). DIEMA operates with 30 different livestock categories (animal type, weight class, age), which are subdivided by stable and manure type to around 100 combinations. Information is obtained for each class and aggregated to the reported animal categories (Mikkelsen et al., 2005)
- Finland is developing the calculation method towards a mass-flow approach in order to avoid double-counting.

Figure 6.3 Flow of nitrogen in manure management systems (Dämmgen et al., 2007)



6.3.1 Enteric Fermentation (CRF source category 4.A)

6.3.1.1 Source category description

Methane is produced in herbivores as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. The amount of methane that is released depends on the type of digestive tract, age, and weight of the animal, and the quality and quantity of the feed consumed. Ruminant livestock (e.g., cattle, sheep) are major sources of methane with moderate amounts produced from non-ruminant livestock (e.g., pigs, horses). The ruminant gut structure fosters extensive enteric fermentation of their diet. Generally, the higher the feed intake, the higher the methane emission. Although, the extent of methane production may also be affected by the composition of the diet feed intake is positively related to animal size, growth rate, and production (e.g., milk production, wool growth, or pregnancy).

CH_4 emissions in the source category Enteric Fermentation stem for 9 Member States to over 85% from the sub-category “Cattle”. Substantial emissions from the sub-category “Sheep” (up to 47% of emissions in category 4.A., Greece) are reported by Greece, Italy, Portugal, Spain, and United Kingdom). Emissions accounting for more than 5% of the emissions in this category are further reported byfor the sub-category “Goats” (Greece, 19%) and for the sub-category “Swine” (Denmark, 11%).

An overview of the CH_4 emissions, animal population and the corresponding implied emission factors for CH_4 emissions from enteric fermentation for the most important categories cattle and sheep (key source at EC-level) and also goats and swine are given in Table 6.13. Data are given for 2007as the last inventory year and the base year 1990. The table shows that there is a general trend of decreasing animal numbers which are partly compensated by higher emissions per head due to intensification of livestock production in Europe.

Table 6.13: Total CH_4 emissions in category 4A and implied Emission Factor at EU-15 level for the years 1990 and 2007

1990 1)	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	2409	2854	780	75	151
Animal population [1000 heads]	26245	63952	114501	12682	115026
Implied EF (kg CH_4/head/yr)	92	45	6.8	5.9	1.3

2007	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH_4 emissions [Gg CH_4]	1976	2730	677	69	163
Animal population [1000 heads]	17952	58171	96308	11703	122253
Implied EF (kg CH_4/head/yr)	110	47	7.0	5.9	1.3

2007 value in percent of 1990	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
CH4 emissions [Gg CH4]	82%	96%	87%	92%	108%
Animal population [1000 heads]	68%	91%	84%	92%	106%
Implied EF (kg CH4/head/yr)	120%	105%	103%	100%	101%

Information source: CRF for 1990 and 2007, submitted in 2009

6.3.1.2 Methodological Issues

CH_4 emissions from enteric fermentation is a key source category for cattle and sheep. For cattle, this is also true for all member states. Accordingly, most Member States have used Tier 2 methodology for calculating enteric CH_4 emissions, as shown in Table 6.14. In addition to the methodology applied by the Member States for calculating CH_4 emissions, the table indicates also the total emissions in the category "enteric fermentation", the contribution of the animal types considered (dairy and non-dairy cattle and sheep) to the total emissions, and whether the emissions from the animal class are belonging to the key source categories in the different Member States.

The table indicates also the Tier level of the source category and of the emission estimates for the animal types considered. For this purpose we compare the implied emission factor for dairy cattle, non-dairy cattle and sheep with the IPCC default values for Western Europe of 100 kg CH_4 head^{-1} year^{-1}, 48 kg CH_4 head^{-1} year^{-1} and 8 kg CH_4 head^{-1} year^{-1}, respectively. Greece uses the default values of Eastern European countries of 56 kg CH_4 head^{-1} year^{-1} for non-dairy cattle (for a detailed description of the estimation of the Tier level see section 6.4.1). A value of 56 kg CH_4 head^{-1} year^{-1} was also used by Austria and Portugal for non-dairy cattle, however, according to the national inventory reports of these countries they were derived on the basis of a Tier 2 calculation. For cattle, virtually all emissions are calculated with the help of country-specific data (99%), while for sheep still 28% of the emissions are estimated with a Tier 1 approach. The Tier levels for goats, swine, and reindeer are included in Table 6.85.

Sheep is no key source category for most countries, even though several Member States did not report disaggregated key source categories for category 4A. However, considerable emissions from this category are reported by 3 countries only. Therefore, most countries are applying Tier 1 methodology. Those Member States where sheep emissions are belonging to the key source categories have indeed developed a Tier 2 approach. In the case of the United Kingdom, where the default value was used, but it is adjusted for lambs, considering also the lifetime of lambs. Thus we assigned a Tier level of 1.5.

On EU-15 level, 97% of the CH_4 emissions in category 4.A have been estimated with a Tier 2 approach. Overall, a Tier level between 1.4 and 2.0 can be derived for the source category 'enteric fermenation' with a Tier level of Tier 1.95 for EU-15. This estimate includes also the Tier level for goat (Tier 1.3), swine (Tier 1.4) and reindeer (estimated by Finland and Sweden with national emission factors). The thus aggregated Tier level accounts for 98% of the emissions in category 4A and has been complemented with 'other emissions' assuming that these are estimated with a Tier 1 approach giving Tier 1.93.

Table 6.14: Total emissions, contribution of the main sub-categories to CH_4 emissions in category 4A, methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and sheep.

Member State	Total		Dairy Cattle		Non-dairy cattle		Cattle	Sheep	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	3,215	Tier 1.9	39%	Tier 2.0	54%	Tier 2.0	y	2%	Tier 1.0
Belgium	3,569	Tier 1.9	36%	Tier 2.0	58%	Tier 2.0	y	1%	Tier 1.0
Denmark	2,787	Tier 2.0	54%	Tier 2.0	31%	Tier 2.0	y	1%	Tier 2.0
Finland	1,560	Tier 2.0	49%	Tier 2.0	40%	Tier 2.0	y	1%	Tier 1.0
France	28,342	Tier 1.9	34%	Tier 2.0	57%	Tier 2.0	y	6%	Tier 1.0
Germany	16,995	Tier 2.0	47%	Tier 2.0	45%	Tier 2.0	y	3%	Tier 1.0
Greece	2,930	Tier 1.5	15%	Tier 1.0	17%	Tier 1.0	y	47%	Tier 2.0
Ireland	8,841	Tier 2.0	28%	Tier 2.0	63%	Tier 2.0	y	8%	Tier 2.0
Italy	11,027	Tier 1.8	40%	Tier 2.0	39%	Tier 2.0	y	13%	Tier 1.0
Luxembourg	247	Tier 2.0	43%	Tier 2.0	54%	Tier 2.0	y	1%	Tier 1.0
Netherlands	6,318	Tier 1.9	61%	Tier 2.0	29%	Tier 2.0	y	4%	Tier 1.0
Portugal	2,979	Tier 2.0	26%	Tier 2.0	44%	Tier 2.0	y	23%	Tier 2.0
Spain	13,560	Tier 1.9	14%	Tier 2.0	47%	Tier 2.0	y	30%	Tier 2.0
Sweden	2,736	Tier 1.9	37%	Tier 2.0	50%	Tier 2.0	y	3%	Tier 1.0
United Kingdom	15,395	Tier 2.0	28%	Tier 2.0	48%	Tier 2.0	y	22%	Tier 2.0
EU-15	**120,499**	**Tier 1.92**	**34%**	**Tier 2.0**	**48%**	**Tier 2.0**	**y**	**12%**	**Tier 1.7**
EU-15: Tier 1	4%		1%		0%			28%	
EU-15: Tier 2	96%		99%		100%			72%	

a Contribution to CH_4 emissions from enteric fermentation
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n). nr: not reported. Assessment for total cattle.

Details on the applied methodologies for the estimation of CH_4 emissions from enteric fermentation are given in Table 6.15.

Table 6.15: Methodology used by Member States for calculating CH_4 emissions in category 4A

Member State	Methodology
Austria	IPCC Tier 1for Swine, Sheep, Goats, Horses and Other Animals (Deer). For Cattle Tier 2. For the calculation of emissions from category Poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was use.
Belgium	Tier 2 approach is in both regions (harmonized), Flanders and Wallonia for key-source animal types. CH_4 emissions from enteric fermentation from the other, non key source, animal categories (sheep, goats, swine, horses and mules and asses) are estimated using the Tier 1 methodology.
Denmark	The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture) (Mikkelsen, 2006; Mikkelsen and Gyldenkærne 2006). The implied emission factors for all animal categories are based on the Tier 2 approach. The category Non-Dairy Cattle includes Calves, Heifer, Bulls and Suckler Cows and the implied emission factor is a weighted average of these different subcategories. Data given for Non-Dairy Cattle covers data for heifer older than ½ year. The category Swine includes the subcategories Sows, Piglets and Slaughtering Pigs. The feed intake for sows and piglets has increased while the feed intake for slaughtering pigs has decreased as a result of improved fodder efficacy.
Finland	Tier 1 for Horses, Swine, Goats and Fur animal (Norway EFs). Tier 2 method for Cattle. CH_4 emissions from enteric fermentation of Reindeer have been calculated by estimating the GE on the basis of literature (McDonald, 1988) by using national data for estimating dry matter intake and its composition (hay and lichen) and calculating the respective emission factor. The same methodology has been used for estimating GE and EF for Sheep. Cattle's are not used for work in Finland.
France	Emissions from Dairy Cattle are calculated using an equation developed at INRA (Tier 2+). Tier 1 other animal types.
Germany	Dairy cattle are differentiated by productivity and feed composition at the "Kreise" level. Tier 2 for dairy and non-dairy cattle and swine.
Greece	Sheep: Tier 2 methodology. Livestock sub-categories are characterised based on the age of animals, their sex, weight, feeding situation and on the various management systems of animals. Other animal categories: Tier 1.
Ireland	Cattle: Tier 2. For Dairy cows and Suckler Cows, the country was divided into three regions: (1) south and east, (2) west and midlands, and (3) north west, coinciding with regions used for implementing the Nitrates Directive based on slurry storage requirements of local planning authorities. In the approach outlined by O'Mara (2006), the daily energy requirement of cows in each region is calculated by month or part thereof based on maintenance requirements, milk yield and composition, requirements for foetal growth and gain or loss of bodyweight (INRA, 1989). Given data for liveweight and liveweight gain, energy requirements of animals were estimated during the winter housing periods and grazing seasons of the animal's lifetime using the INRAtion computer programme, version 3.0. This programme is devised by the French research organisation INRA, and is based on the net energy system for Cattle. Other animals: Tier 1 Methodology, EFs IPCC default.
Italy	The Tier 2 IPCC GPG approach has been followed for Dairy, Non-Dairy and Buffalo. Country-specific emission factor suggested by the Research Centre on Animal Production for rabbits have been use. A Tier 1 approach, with IPCC default emission factors, has been used to estimate methane emissions from swine, sheep, goats, horses, mules and asses.
Luxembourg	The IPCC Tier 1 method has been applied to all farm animal categories with the exception of cattle for which a Tier 2 method has been used(option B).
Netherlands	Cattle: Tier 2, calculated annually for several subcategories of dairy, non-dairy and young cattle. The calculation of the methane production via enteric fermentation by dairy cows is performed using dynamic modelling (Tier 3; Smink, 2005), employing the model of Mills et al. (2001), including updates (Bannink et al., 2005a,b). This model is based on the rumen model of Dijkstra et al. (1992). It has been developed for dairy cows and is therefore not suitable for all cattle categories. The model calculates the gross energy intake and methane production per cow per year on the basis of data on the share of feed components (grass silage, maize silage, wet by-products and concentrates) and their chemical nutrient composition (sugars, NDF, etc).All relevant documents concerning methodology, emission factors and activity data are published on the website www.greenhousegases.nl.
Portugal	Tier 2 for all animal types, with an enhanced characterization of livestock, with subdivision per age, sex and management conditions for most animal types. Milk yield was estimated dividing the annual production of milk cow over the number of cows in production101, both of which are published by the National Statistical Institute (INE). Three different cattle types were considered: (1) Imported breeds; (2) Traditional breeds on pasture; (3) Traditional breeds on range. The methodology used by the French I.N.R.A. (INRA, 1984) was used to estimate feed intake for each swine sub-class.
Spain	Cattle and Sheep: Tier 2. Other animal categories: Tier 1. If Tier 1 was used, the default emission factor for developed countries was reduced by 20% for young animals. If Tier 2 was used, some of the activity data required are not available in Spain.
Sweden	Significant Cattle subgroups: national emission factor (Tier 1). Reindeer: according to Tier 2 methodology using a Finnish value of gross energy requirements. Other animal categories: Tier 1. The national methodology for Dairy Cows, Beef Cows and Other Cattle.

Activity Data

Animal population of dairy and non-dairy cattle, sheep, goat, swine, and poultry in 2007 are given in Table 6.16. The characterization of the livestock population across the background tables 4.A, 4.B(a), and 4.B(b) is done in a consistent way by all Member States and will therefore be discussed only here. Luxembourg and Netherlands have chosen to use the option B for the classification of cattle. In order to allow the calculation of an EC implied emission factor for the categories listed under option A, these numbers were "converted" using the following rule: Mature Dairy Cattle → Dairy Cattle; Mature Non-dairy Cattle + Young Cattle → Non-dairy cattle.

Other animal types with population data reported in Table4.A are deer (Austria and United Kingdom), reindeer (Finland and Sweden), fur farming (Denmark, Finland) and rabbits (Italy, Portugal), and other poultry (Spain).

Some information on the source of the animal numbers for the different Member States is given in Table 6.17.

Table 6.16: Animal population [1000 heads] in 2007

Member State 2007	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Poultry
Austria	525	1,476	351	60	3,286	13,027
Belgium	514	2,136	150	29	6,255	32,389
Denmark	545	1,021	87	28	13,723	16,741
Finland[1)]	296	631	119	6	1,448	9,791
France	3,851	15,869	8,924	1,304	11,506	249,433
Germany	4,071	8,616	2,538	180	27,125	126,864
Greece	216	419	8,823	5,384	898	32,207
Ireland	1,087	4,915	5,656	7	1,581	14,826
Italy	1,839	4,444	8,237	920	9,273	188,872
Luxembourg[2)]	80	304	9	3	83	82
Netherlands[2)]	2,826	4,699	1,369	324	11,663	95,984
Portugal	312	1,117	3,395	465	2,337	38,531
Spain	919	5,608	22,194	2,892	26,563	165,748
Sweden	370	1,190	509	6	1,676	18,080
United Kingdom	525	1,476	351	60	3,286	13,027
EU-15	19,405	60,672	96,308	11,703	122,253	1,166,448

Information source: CRF for 1990 and 2007, submitted in 2009

[1)] Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. [2)] For Luxembourg and the Netherlands the numbers for cattle have been calculated using the figure given under option B.

Table 6.17: Information on the source of animal population data

Member State	Activity Data
Austria	The Austrian official statistics (Statistic Austria, 2006) provides national data of annual livestock numbers on a very detailed level. In 1998-2002 swine numbers were fluctuating due to a high elasticity to market prices. The animal numbers of Young Swine were not taken into account because the emission factors for Breeding Sows already includes nursery and growing pigs (Schechtner 1991). Information about the extent of organic farming in Austria was provided in the Austrian INVEKOS database (Kirner and Schneeberger, 1999). From 2004 onwards INVEKOS data of organic cattle population as reported in the so called 'Green Reports' of the ministery of agriculture (BMLFUW 2007) was used.
Belgium	The National Institute of Statistics (NIS) publishes land-use and the livestock figures yearly (NIS, 2006 http://www.statbel.fgov.be/downloads/cah2006m_fr.xls). All agricultural businesses have to fill in a form each year about the situation at 1 may of that year and sent it to the NIS. Further details on the agricultural census methodology and QA/QC issues can be found on the NIS website (www.statbel.fgov.be). Mules and Asses are included in the category Horses. "Other" includes Horses, Mules and Asses, Goats and Rabbits.
Denmark	Livestock production is primarily based on the agricultural census from Statistics Denmark. The emission from slaughter pigs and poultry is based on slaughter data. Approximate numbers of horses, goats and sheep on small farms are added to the number in the Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares.
Finland	The number of cattle, sheep, swine, poultry and goats was received from the Matilda-database maintained by the Information Centre of the Ministry of Agriculture and Forestry (http://www.mmmtike.fi/en/) as well as from the Yearbook of Farm Statistics published annually by the Ministry of Agriculture and Forestry. The number of animals describes the number of animals in 1st of May (cattle, swine, poultry) and it has been reported consistently over the time series. Cattle category has been divided into the following sub-categories: Dairy cows, Suckler cows, Bulls, Heifers and Calves for which separate emission factors have been calculated.
France	Agricultural statistics are issued by the ministry of agriculture (SCEES/AGRESTE). Activity data is a one year average. Heifers are included in Other Cattle, but heifers more than 2 years old (40% of the total heifer livestock) are considered as Dairy cattle.
Germany	A complete animal census at the "Kreise" level is available for every second year in the official agricultural statistics. For the other years, animal numbers are available at the "Länder" level. The number of horses is taken from the official statistics, but are probably too low, they are partly corrected (Daemmgen, 2006). Numbers for sheep have to be corrected for some years. Calculation methods and elaboration of activity data are detailed in Daemmgen et al. (2007).
Greece	Data on animal population, agricultural production and cultivated areas used for the emissions calculation were provided by the NSSG. Data on animal population 2007 are provisional estimations. Animal population except Sheep, is a 3-year average. Because of the analytic methodology used for Sheep, data on disaggrated population are the actual reported in the Statistics for each year. Milk yield derives from data of the annual Agricultural Statistics.
Ireland	Because of the importance of agriculture in the country, Ireland has very extensive and up-to-date statistical data on all aspects of the sector, compiled and published by the Central Statistics Office. The Irish cattle herd is now characterised by 11 principal animal categories for which annual census data are published by CSO. The number of Cows in each category given by CSO statistics was allocated to the regions using CMMS reports published by the Department of Agriculture and Food (DAF, 2007). The most important parameter is liveweight gain as it directly affects the energy requirement and thus feed intake. There is little statistical information on the liveweight gain of the different types of Cattle in the Irish Cattle herd, but the weight of carcasses of all slaughtered cattle is recorded by the Department of Agriculture and Food.
Italy	Livestock data are collected from the National Institute of Statistics (ISTAT) and are based on specific national surveys, such as the 'milk production' and the 'farm structure and production' surveys, and from a general agricultural census carried out every 10 years. The last Farm was carried out at the end of 2005, surveying about 1.38 million agricultural holdings of an economic size of at least 1 European Size Unit. Since 2006 submission, results from the MeditAIRaneo project have been included in the preparation of the emission inventory.
Luxembourg	The activity data are the livestock data reported in the national statistics.
Netherlands	Activity data for the animal population are based on the annual agricultural survey performed by Statistics Netherlands (CBS). Data can be found on the website www.cbs.nl and in background documents (Van der Hoek and Van Schijndel, 2006; Van Schijndel and Van der Sluis, 2008). For cattle three categories are distinguished: Dairy cattle: adult female cows (for milk production); Non-dairy cattle: adult cows (for meat production); Young cattle showing a mix of different age categories (for breeding and meat production).
Portugal	Activity data are 3-years average except for last year. Annual livestock numbers were available from the statistical databases of the National Statistics Institute (INE) for Cattle, Swine, Sheep, Goats, Horses, Mules and Donkeys, dissagregated per region, age and sex. The number of Rabbits, Hens, Broilers, Turkeys, Ducks, Geese and Guinea-fowl, is only available for 1999 – from the national agriculture census that is done every ten years.
Sweden	The Farm Register provides the main basis for agricultural statistics in Sweden. The Register is administered by the Swedish Board of Agriculture and Statistics Sweden and provides annual information on the total number of animals of different categories on Swedish farms. The information on livestock refers to the situation prevailing in mid-June of that year and thus is considered to be equivalent to a one-year average. Mink and foxes are minor contributors to greenhouse gas emissions and are not included in the inventory due to a lack of well-founded emission factors. The number of slaughter chickens (mean number of chickens kept during the year) is provided by the Swedish Poultry Meat Association.

Member State	Activity Data
United Kingdom	The animal population data are collected in an annual census (Defra). Dairy Cattle - changed animal weights with data from Steve Walton, Defra stats.Pre-1995 is corrected home killed slaughter weights (UKlivestock Slaughter Statistics, Defra, SERAD, WAG and DARDNI and their predecessors, 1995 and onwards are weights from the over 30 months scheme (courtesy of Rural Payments Agency). In using the animal population data, it is assumed that the reported numbers of animals are alive for that whole year.The exception is the treatment of sheep where it is normal practice to slaughter lambs and other non-breeding sheep after 6 to 9 months. Hence it is assumed that breeding sheep are alive the whole year but that lambs and other non-breeding sheep are only alive 6 months of a given year (based on Smith and Frost, 2000).

Emission Factors and other parameters

Considerable variation is found in the IEF for dairy and non-dairy cattle with values between 92 kg CH_4 head^{-1} yr^{-1} (Germany) and 132 kg CH_4 head^{-1} yr^{-1} (Sweden) for dairy cattle, and 37 kg CH_4 head^{-1} yr^{-1} (Netherlands) and 56 CH_4 head^{-1} yr^{-1} (Portugal) for non-dairy cattle. The difference can mainly be explained by the different levels of intensity for dairy production and will be discussed below. The IEF for the EU-15 Member States and the CH_4 conversion factors used are given in Table 6.18. For EU-15, the implied emission factor in 2006 was 110 kg CH_4 head^{-1} yr^{-1}.

More detailed information on the development of the emission factors for category 4A is given in Table 6.19.

The following outliers can be identified:

- *Implied Emission Factor for Dairy cattle, Netherlands*

  The slightly lower Dutch IEF compared to the default IPCC IEF for adult dairy cattle at a comparable milk production rate (at a milk production rate of 6700 kg per cow per year) can be explained by the higher feed digestibility in the Netherlands.

- *Implied Emission Factor for Non-dairy cattle, Denmark.*

  Non-Dairy Cattle” includes calves, heifers, bulls and suckler cows and the implied emission factor is a weighted average of these different subcategories. The Danish IEF for non-dairy cattle is lower compared with the default value, this is due to lower weight and lower feed intake and a higher digestibility of feed.

- *Implied Emission Factor for Non-dairy cattle, Germany*

  The low IEF is due to large share of cattle with low EF. The level of IEF seems to be comparable to that given by a number of other countries (comparison based on 2007 submissions, including Option B). Further, the low IEF is consistent with a low animal weight for non-dairy cattle in Germany.

- *Implied Emission Factor for Sheep and goat, Denmark*

  The emissions from sheep include lamb and thus explaine the high IEF value. The same situation exists for goats, which include kids. This is due to the availability of data. The Danish normative data from the Faculty of Agricultural Sciences operate with sheep including lamb as a standard and do not distinguish between sheep and lamb.

- *Implied Emission Factor for Non-dairy cattle, Portugal*

  In Portugal non dairy cattle are usually kept in range (mother cows) or in solid storage systems (steers and feedlots). According to agriculture experts the use of liquid systems has no expression.

- *Implied Emission Factor for Sheep, Romania*

  A IPCC default value of 5 kg CH_4/head/year has been used for the estimation of Enteric Fermentation CH_4 emissions from sheep, considering (i) temperate climate zone, (ii) value for Eastern Europe, (iii) conditions as in developing countries. The specified value has been used consistently along the time series.

Table 6.18: Implied Emission factors for CH_4 emissions from enteric fermentation and CH_4 conversion factors used in Member State's inventory

Member State	Implied EF (kg CH_4/head/yr) 1)						CH_4 conversion (%) 1)				
2007	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine		Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine
Austria	115	56	8.0	5.0	1.5		6.0	6.0	6.0	5.0	0.6
Belgium	118	46	8.0	5.0	1.5						
Denmark	131	40	17.2	12.7	1.1		5.9	5.9	6.0	5.0	0.6
Finland[1)]	122	47	8.4	5.0	1.5		6.0	6.0	NA	NA	NA
France	118	49	9.7	11.8	1.1		NA	NA	NA	NA	NA
Germany	92	42	8.0	5.0	1.2		5.3	6.0	6.0	5.0	0.6
Greece	96	56	7.5	5.0	1.5		NE	NE	4.8	NE	NE
Ireland	110	54	5.8	5.0	0.4		6.0	6.0	7.0	NE	NE
Italy	113	46	8.0	5.0	1.5		6.0	4.4	NA	NA	NA
Luxembourg[2)]	127	42	8.0	5.0	1.5		6.0	6.0	6.0	5.0	0.6
Netherlands[2)]	129	37	8.0	5.0	1.5		NE	NE	NE	NE	NE
Portugal	119	56	9.6	8.1	1.4		6.0	5.9	6.0	5.0	0.6
Spain[3)]	98	54	8.7	5.0	1.5		5.5	5.3	6.6	NA	NA
Sweden	132	54	8.0	5.0	1.5		6.7	7.0	6.0	5.0	0.6
United Kingdom	105	43	4.7	5.0	1.5		6.0	6.0	NE	NE	NE
EU-15	110	47.4	7.0	5.9	1.3		5.8	5.7	6.2	5.0	0.6

Information source: CRF for 1990 and 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.

[1)] Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. The IEF has been calculated as a weighted average. [2)] The IEF for Luxembourg and the Netherlands has been calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle). [3)] The values for the CH4 conversion were given as a fraction for Spain and have been multiplied by 100.

Table 6.19: Member State's background information for CH_4 emissions in category 4.A. Emission Factor and other parameters

Member State	Emission Factor and other parameters
Austria	Country specific emission factors for cattle calculated from the specific gross energy intake and the methane conversion rate (IPCC for "all other cattle" because there are few if any feedlot cattle with a high-energy diet). Austrian energy intake data were recalculated by from the Agricultural Research and Education Centre (AREC) Raumberg-Gumpenstein (Poetsch et al. 2005, Gruber and Poetsch, 2006). The time series of average milk yields per dairy cow was taken from national statistics. For the period from 1990 to 2007 a constant average milk yield of 3 000 kg kg was applied, resulting in a Gross Energy Intake of 235.3 MJ per suckling cow and day. For the calculation of emissions from poultry the IPCC Tier 2 method with Swiss emission factors (Gross Energy Intake, Methane Conversion Rate) was used. The animal category Other livestock corresponds to deer with default EF used for sheep.
Belgium	The average animal weight and weight gain originate in Flanders from the Department Agriculture and Fishery and in Wallonia from average weights published by the federal finance department. In Flanders, data for feed digestibility (DE%) originate from a report [http://www.rivm.nl/bibliotheek/rapporten/680125001.html] from the Netherlands, a neighbouring country with comparable feeding situations. In both regions a methane conversion rate (Ym) of 6% is used to calculate the emission factor for each cattle type. The emission factors for all categories with exception for dairy cows stay constant over the entire time series. For dairy cows the emission factor increases with increasing milk production.
Denmark	Feed consumption for all animal categories is based on the Danish normative figures. The estimation of the national values of Ym is based on model "Karoline" developed by FAS based on average feeding plan for 20% of all dairy cows in Denmark obtained from the Danish Agricultural Advisory Centre DAAC (Danfær, A.2005). New investigations from FAS have shown a change in fodder practice from use of sugar beets to use of maize. Research showed that sugar beets as feeding stuff is resulting in a higher methane conversion rate than the default values. Enteric CH_4 emissions are, in general, lower than the IPCC default values due to the professional way farms are managed in Denmark. For goats and horses new subcategories are introduced in 2007 and therefore the IEF differs from the other years. For sheep the IEF is constant.
Finland	IPCC gives no default emission factor for reindeer, thus it has been calculated by using national methodology for estimating gross energy intake of reindeer from the basis of their forage. The same equation has been used for sheep also. Emission factors for cattle are updated annually. EF´s for other animal groups will be updated if more national data will become available. Average daily weight gain for cattle was estimated to remain constant.

Member State	Emission Factor and other parameters
France	The EF for Dairy Cattle, is depending to the milk production. Emissions factors are used for enteric fermentation from a study published in 2008 by the French National Institute of Agronomy. These emission factors are based on parameters equivalent to Ym and GE, but these parameters are not directly available in the study.
Germany	The calculation of the EF for Dairy Cattle is based on milk production, animal weight (derived from nation data on milk production and milk quality), and animal feed. The latter (grass/grass silage or maize/maize silage) is derived from the regional approach. Feed digestibility is estimated as function of feed composition and productivity. For milk-feed calves it has been considered that they do not belong to the ruminant animals.
Greece	The average milk production for domestic and in flock and for nomadic sheep is 0.48 kg/day and 0.43 kg/day respectively. For dairy cattle, the emission factor used was an interpolation between Eastern Europe and West Europe respective factors, based on average annual milk production. This procedure was performed for the first time in the current submission, due to the availability of confirmed data from NSSG concerning daily cattle milk production,
Ireland	The Tier 2 emission factors for the 11 animal categories was initially carried out for the 2006 herd and then repeated for 1990 and 2005. The study and analysis underlying the new emission factors is available (O'Mara, 2006). Emission factors for the Beef cattle categories were determined by calculating lifetime emissions for the animal and by partitioning between the first, second and third years of the animal's life.
Italy	Data to calculate the emission factor from dairy and non-dairy cattle are national (ISTAT, Centro Ricerche Produzioni Animali, Reggio Emilia - CRPA). This information has been discussed in a specific working group in the framework of the MidetAIRaneo project (CRPA, 2006; CRPA, 2005). The emission factor for buffalo has been calculated by Condor et al. (2006). The emission factor for rabbits is national.
Luxembourg	For the Tier 1 method, default GE are usually provided in the IPCC Guidelines. For the Tier 2 method, GE is the combination of various feed intake – or net energy – estimates relating to maintenance, activity, growth, etc. of the animals.
Netherlands	The emission factors for three cattle types are calculated annually (e.g. adult dairy, adult non-dairy and young cattle, respectively). Swine, sheep, goat and horses: default.
Portugal	For the emission factor for Rabbit, the default EF for Horse has been downscaled to the average weight of a rabbit according to the scaling equation in IPCC GPG. Default EF for Horses, Mules and Asses, due to the unavailability of a more detailed livestock characterization and specific characterization of national populations. In accordance with the unavailability of emissions factors in IPCC96 for broilers, laying hens, turkeys, ducks, geese, guinea fowl and other poultry, emissions from these classes were not estimated and were assumed as negligible.
Sweden	A national methodology based on feed energy requirements expressed as metabolisable energy is used in the Swedish inventory to estimate emission factors for dairy cows, beef cows and other cattle. The calculations for dairy cows were revised some years ago. The emission factors for other cattle groups were also reevaluated, using the same methodology. The initial step in estimating emission factors for cattle according to the Swedish method is enhanced characterisation of feed intake estimates (Tier 2 methodology). The energy requirements for maintenance, growth, lactation and pregnancy are estimated, but expressed as metabolisable energy (MJ/day) instead of as net energy. The metabolisable energy requirement is then recalculated to digestible energy. A lactation period of 305 days and a non-lactating period of 60 days was used (Bertilsson, 2002; Nieminen, 1998). The default values in the IPCC Guidelines are used for the less significant animal groups. Reindeer: according to IPCC GPG (Tier 2) using a Finnish value of gross energy requirements.
United Kingdom	Apart from cattle, lambs and deer, the methane emission factors are IPCC Tier 1 defaults. The dairy cattle emission factors are estimated following the IPCC Tier 2 procedure and vary from year to year.For dairy cattle, the calculations are based on the population of the 'dairy breeding herd' rather than 'dairy cattle in milk'. The emission factors for beef and other cattle were also calculated using the IPCC Tier 2 procedure, but do not vary from year to year. The enteric emission factors for Beef cattle were almost identical to the IPCC Tier 1 default so the default was used in the estimates. The emission factor for Lambs is assumed to be 40% of that for adult Sheep (Sneath, 1997). The exception is the treatment of sheep where it is normal practice to slaughter lambs and other non-breeding sheep after 6 to 9 months.

Milk productivity is one of the most important factors determining the level of CH_4 emissions from dairy cattle. Several countries have reported milk productivity, which are reproduced in Table 6.20 and Table 6.21 beside information on feed intake, animal weight, and feed digestibility. The data show clearly that a strong intensification of cattle husbandry occurred, with increases in the milk yield ranging from 22% (Ireland) to 91% (Spain). This is thus more than the increase in the CH_4 emission factor. The increased production was only partly achieved by increased energy intake (up to a maximum of 35%, but some countries report also a stable feed intake), and partly by an improved feed efficiency. This is expressed in the feed digestibility, which for some countries increased by up to 6%, however it must be kept in mind that most countries do not estimate a time-varying feed digestibility (only 3 do, compared to 13 countries which report a time-dependent milk productivity). Higher feed digestibility reduces the portion of carbon intake that is transformed to methane in ruminants. As the feed intake increase is smaller than the increase in milk productivity (for EU15 the numbers are 21% and 42%, respectively), the feed quality and consequently also the feed digestibility increase most probably in more countries. This suggests that these countries tend to overestimate the increase in methane emissions from enteric fermentation of dairy cattle. Calculating the average for those countries which have reported data, the milk yield was higher by 11% than the default value for Western Europe (11.5 kg/day) in 1990, and increased to a level which was 57% above IPCC default in 200. Even though feed digestibility for dairy cattle was not separately estimated for each year by all countries, the level is 18% to 19% above IPCC default (60%) digestibility.

Table 6.20: Additional background information for calculating CH_4 emissions from enteric fermentation from dairy cattle

Member State	Dairy Cattle			
2007	Feed Intake 1)	Animal Weight (kg)	Milk prod. 1)	Feed Digest. (%)
Austria	292	700	16	70
Belgium	297	1200	17	75
Denmark	335	575	24	71
Finland	311	582	22	70
France	NA	NA	17	NA
Germany	264	594	19	74
Greece	NE	NE	10	
Ireland	240	535	14	NE
Italy	288	603	17	65
Luxembourg	322	650	19	66
Netherlands	NE	NE	NE	NE
Portugal	303	NE	17	60
Spain	271	648	19	71
Sweden	339	NE	NE	NE
United Kingdom	267	577	19	74
EU-15	276	621	18	71

Member State	Dairy Cattle			
1990	Feed Intake 1)	Animal Weight (kg)	Milk prod. 1)	Feed Digest. (%)
Austria	248	700	10	66
Belgium	251	1200	11	75
Denmark	278	575	17	71
Finland	247	503	16	70
France	NA	NA	14	NA
Germany	212	539	13	72
Greece	NE	NE	7	
Ireland	222	535	11	NE
Italy	236	603	12	65
Luxembourg	268	650	13	66
Netherlands	NE	NE	NE	NE
Portugal	241	NE	12	60
Spain	200	642	10	71
Sweden	339	NE	NE	NE
United Kingdom	224	550	14	74
EU-15	229	599	13	71

Information source: CRF for 1990 and 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.
1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Table 6.21: Additional background information for calculating CH_4 emissions from enteric fermentation from non-dairy cattle

Member State	Non-dairy Cattle			
2007	Feed Intake 1)	Animal Weight (kg)	Milk prod. 1)	Feed Digest. (%)
Austria	142	426	NO	72
Belgium	113	814	NA	75
Denmark	130	325	NO	71
Finland	119	NA	NA	70
France	NA	NA	NA	NA
Germany	101	279	NE	72
Greece	NE	NE	NE	NE
Ireland	141	304	8	NE
Italy	140	383	NA	NA
Luxembourg	107	350	NA	64
Netherlands	NE	NE	NE	NE
Portugal	145	423	3	62
Spain	154	465	1	70
Sweden	181	NE	NE	NE
United Kingdom	189	NE	NE	
EU-15	145	388	4	71

Member State	Non-dairy Cattle			
1990	Feed Intake 1)	Animal Weight (kg)	Milk prod. 1)	Feed Digest. (%)
Austria	123	364	NO	74
Belgium	104	762	NA	75
Denmark	107	325	NO	71
Finland	103	NA	NA	70
France	NA	NA	NA	NA
Germany	93	249	NE	73
Greece	NE	NE	NE	NE
Ireland	132	279	8	NE
Italy	141	376	NA	NA
Luxembourg	104	322	NA	64
Netherlands	NE	NE	NE	NE
Portugal	130	355	2	62
Spain	155	460	1	69
Sweden	181	NE	NE	NE
United Kingdom	189	NE	NE	
EU-15	133	345	5	72

Information source: CRF for 1990 and 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.
1) Unit for feed intake: MJ/head/yr; unit for Milk productivity: kg/day/head.

Trends

Animal population. Regarding animal numbers, some major changes occurred since 1990. In all countries, the numbers of cattle and sheep are considerably reduced, on the average by 31% for dairy cattle and 10% for non-dairy cattle, and by 16% for sheep. An increase in the number of cattle has only been observed in the category of non-dairy cattle in Greece (10%), Sweden (4%), Ireland (6%), Portugal (14%) and Spain (62%). Largest decrease of the number of dairy cattle occurred in Spain (2007 at 57% of the 1990 level). For non-dairy cattle, largest decrease occurred in Germany (2007 at 66%).

The picture is a little bit different for the categories Goats and Swine, as some countries have encountered a significant increase of the populations, for example the goat population in Belgium in 2007 has increased by 232% respective to the population in 1990; in the Netherlands this figure amounts to 433%. However, due to a decrease of the goat number in other countries with a high population (mainly Spain with 2,892,000 heads in 200), the goat population at EU15 level was rather stable (2007 at 92% of 1990-level).

The swine population was increasing especially in Denmark (44%), Spain (62%), and Ireland (30%), but this was balanced from reductions in other countries. Poultry numbers saw a slight increase of 9% in EU15; only Austria reported CH_4 emissions from enteric fermentation of poultry.

The trend in animal numbers is to a large extend influenced by EC policy such as suckler cow premia, milk quota, but also environmental legislation linked to agricultural policy through cross-compliance and the rural development. Animal development is also determined by epidemies such as the avian flu (reducing e. g. the number of poultry in the Netherlands in 2003), the BSE crisis between 2001 and 2003, to name just the most important. Further examples for driving forces of the observed trends are given in Table 6.22 below.

Implied emission factor. At the aggregated level for EU-15, the implied emission factor for dairy cattle increase from 91.8 kg CH_4 head^{-1} yr^{-1} to 110 kg CH_4 head^{-1} yr^{-1} while at the same time the animal number of dairy cattle decreased by 31%, resulting in a decrease of European CH_4 emissions from enteric fermentation in the category of dairy cattle by Dairy Cattle.

The increase of the implied emission factor of 19% for dairy cattle is due to changes reported all countries, while for non-dairy cattle, 14 countries have used a time-varying implied emission factor. Changing IEFs, however, are not necessarily due to a changing (assumed) productivity of non-dairy cattle sub-categories, but can rather be the consequence of a different composition of non-dairy cattle (e. g. ratio of heifers to young cattle) with different implied emission factor. Nevertheless, the IEF for non-dairy cattle was more stable that that for dairy cattle and changed only by 5% between 1990 and 200 from 45.2 kg CH_4 head^{-1} yr^{-1} to 47.4 kg CH_4 head^{-1} yr^{-1}. It decreased in 3 countries (Ireland, Netherlands, Spain). The maximum decrease was observed in Ireland by 5%.

For sheep, the implied emission factors changed since 1990 in 7 countries, but stayed close to the 1990-value for EU15. Only Finland and Portugal saw a substantial increase of the IEF for sheep by 21% and 16%, respectively. Note that the IEF for sheep and goats used in Denmark (Tier 2 methodology) is with 17.2 kg CH_4 head^{-1} yr^{-1} and 12.7 kg CH_4 head^{-1} yr^{-1} considerably higher than the IPCC default values and the numbers used in other Member States. This is explaind by the Danish normative data, which operate with sheep including lamb and goats including kids. The emissions of lamb and kids are therefore included in the numbers for sheep and goats, respectively. On the other hand, the IEF for sheep for UK is with 4.7 kg CH_4 head^{-1} yr^{-1} the lowest from EU and correspond to the IEF for developing countries according to the IPCC 2006 GL. The emission factor was fixed by Tier 1 with the assumption that IEF for lambs is 40% of that for adult sheep (breeding sheep are alive the whole year but that lambs and other non-breeding sheep are only alive 6 months of a given year). The CH_4 conversion factor is IPCC default for most Member States.

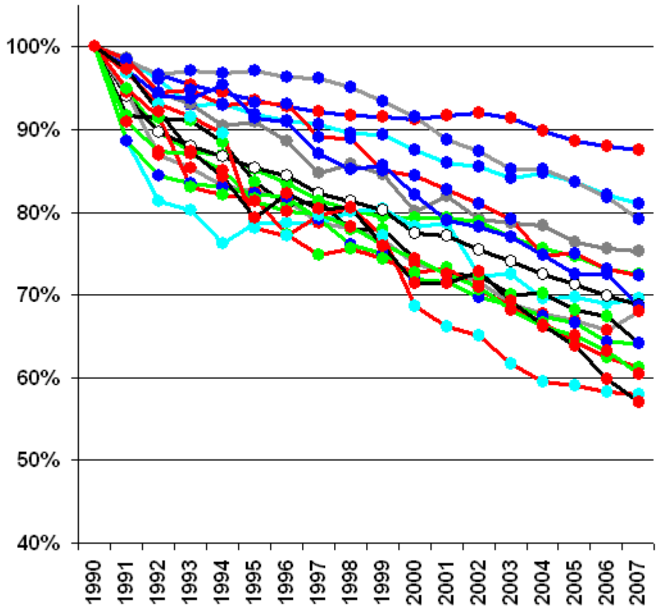
Figure 6.3 through Figure 6.11 show the trend in the activity data for the key source in the category of enteric fermentation as well as the trend of one important indicator for animal productivity, the average daily gross energy intake for dairy and non-dairy cattle and sheep. The trend of the populations of swine, goat, and poultry are included as well. Table 6.22 gives additional information on the trend in category 4A as reported in the national inventory reports.

Table 6.22: Member State's background information on the trend for CH_4 emissions in category 4.A.

Member State	Trend in category 4A
Austria	Up to the early 1990ies Austrian dairy husbandry was determined by traditional Austrian green feeding and traditional Austrian races. From the mid 1990ies onwards milk production has been intensified: diets with higher energy concentration were fed and the share of high yield breeds (e.g. Holstein Friesian) in dairy farming was increased.
Belgium	In Belgium, there is the trend of disappearance of small businesses, also reinforced by the BSE crises. Additionally in Flanders, this partly can be explained due to the subsidized cut down of the number of Cattle. This affected only swine in 2001 and 2002, but in 2003 also bovine animals and poultry. Nevertheless the land area used for agricultural purposes remained identical during this period. In 2005 Wallonia has 55% of the land used for agriculture, but 67% of agricultural businesses are situated in Flanders. The land area used for farming is on average 19 ha per farm in the Flemish region and 47 ha per farm in the Walloon region.
Denmark	The increase in the IEF for dairy cattle from 1990-2007 is the result of increasing feed consumption due to rising milk yields. On average, the milk yield has increased from 6200 litre per cow per year in 1990 to approximately 8600 litre per cow per year in 2007 (Statistics Denmark).
Finland	The IEF for sheep is calculated annually on the basis of forage consumption and the number of animals (lambs and ewes separately). Thus, next to the relative numbers of lambs and ewes, changes in the diet are reflected in the IEF, which lead to an inter-annual fluctuation of the emissions.
Ireland	Increased beef population is explained by the earlier finishing time for male beef cattle since the BSE crisis that affected agriculture during the 1990s.
Netherlands	Decreases in emissions from cattle the decrease in numbers is mainly explained by an increase in milk production per dairy cow combined with an unchanged total milk production. Milk production per cow increased significantly since 1990, a development which has resulted from both genetic changes in cattle (due to breeding programmes) and the change in amount and composition of feed intake. Total milk production in the Netherlands is determined mainly by EU policy on milk quota. Milk quota remained unchanged in the same period. In order to comply with the unchanged milk quota, animal numbers of (dairy) cattle had to decrease to counteract the effect of increased milk production per cow. The numbers of young (dairy) cattle follow the same trends as those of adult female cattle – namely, a decrease. (Van Schijndel and Van der Sluis, 2008). Goat numbers increased by a factor 5 and horse numbers nearly doubled in this period. The increase in the number of goats might be explained as an effect of the milk quota for cattle. The increased number of swine in 1997 was a direct result of the outbreak of classical swine fever in that year. In areas where this disease was present, the transportation of pigs, sows and piglets to the slaughterhouse was not allowed, so the animals had to remain on the pig farms for a relatively long period (accumulation of pigs).
Portugal	Portugal's IEF for sheep has been calculated with a Tier 2 method. The database available contains includes for the twelve native Portuguese breeds of sheeps information such as the number of registered animals, the number of producers, products (milk, meat or wool), dominant reproductive period, weaning age, age at slaughtering, weight (birth, 90 days and adult weight, distinguishing males from females), milk production, wool production (for sheep, males and females) and territorial distribution. Estimates were done individually for each race and distinctly for ewes, does, lambs (for slaughtering), kids (slaughtering) and males (rams, bucks and young males). Thus, the trend in the IEF does not solely depend on the number of adult sheep relative to lambs.

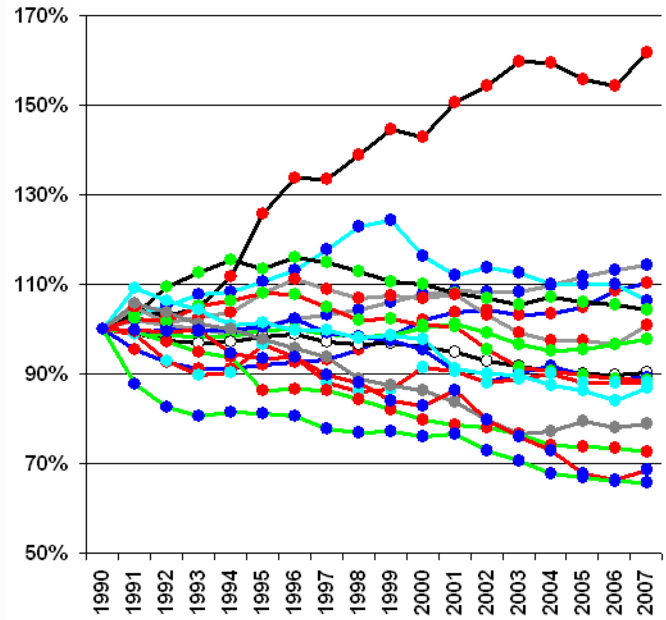
Figure 6.3: Trend of activity data (population) for dairy cattle.

Dairy cattle: Population (1000 head)



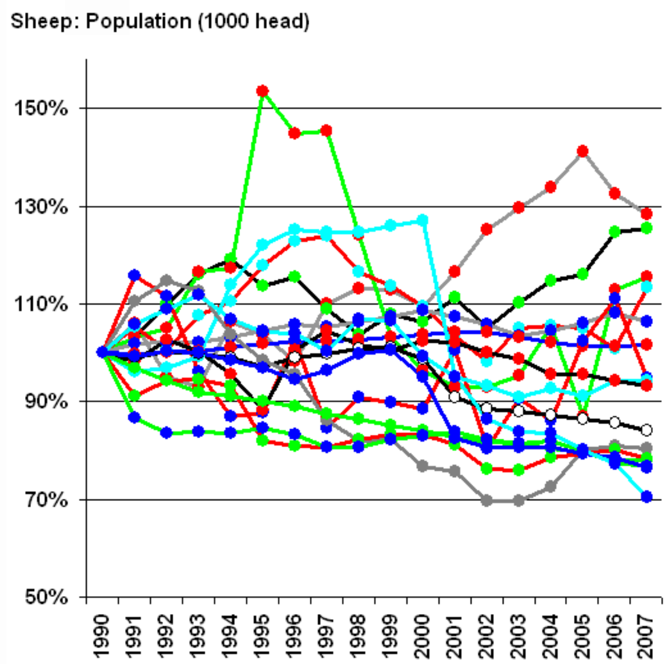
	1990	Trend (%) 1990-2007	2007
Greece	246	88%	216
Ireland	1,342	81%	1,087
Portugal	394	79%	312
Netherlands	3,755	75%	2,826
France	5,310	73%	3,851
Denmark	753	72%	545
Italy	2,642	70%	1,839
EU-15	28,182	69%	19,405
United Kingdom	2,847	69%	1,954
Luxembourg	118	68%	80
Sweden	576	64%	370
Germany	6,355	64%	4,071
Belgium	839	61%	514
Finland	490	60%	296
Austria	905	58%	525
Spain	1,611	57%	919

Figure 6.4: **Trend of activity data (population) for non-dairy cattle.**



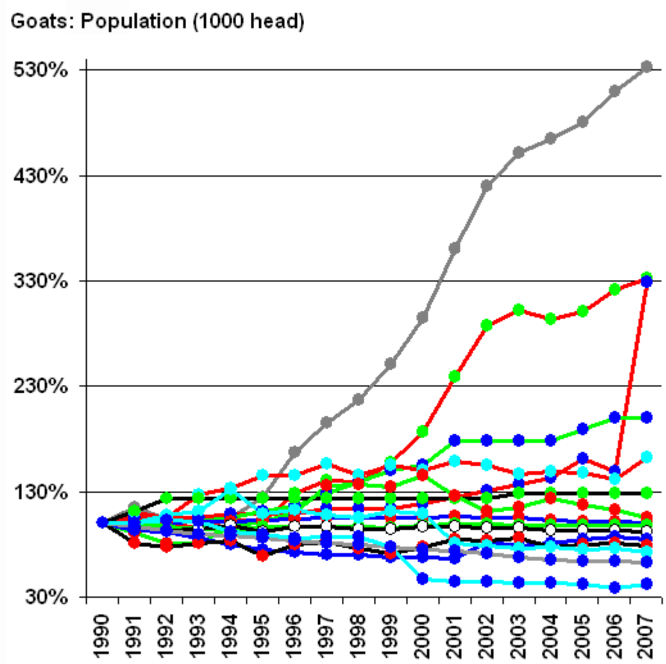
	1990	Trend (%) 1990-2007	2007
Spain	3,469	162%	5,608
Portugal	978	114%	1,117
Greece	380	110%	419
Ireland	4,628	106%	4,915
Sweden	1,142	104%	1,190
Luxembourg	186	101%	188
France	16,227	98%	15,869
EU-15	67,159	90%	60,672
United Kingdom	9,232	89%	8,229
Belgium	2,410	89%	2,136
Austria	1,679	88%	1,476
Italy	5,110	87%	4,444
Netherlands	3,168	79%	2,494
Finland	870	73%	631
Denmark	1,486	69%	1,021
Germany	13,133	66%	8,616

Figure 6.5: **Trend of activity data (population) for sheep**



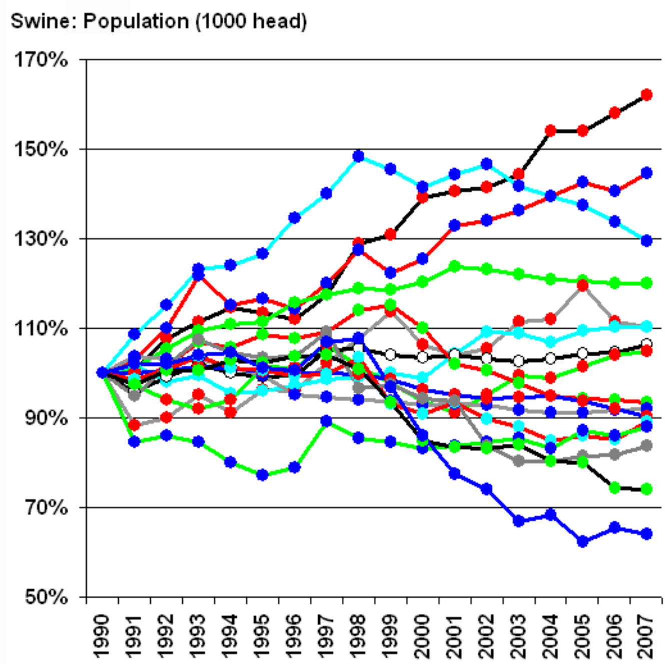
	1990	Trend (%) 1990-2007	2007
Luxembourg	7	128%	9
Sweden	406	125%	509
Finland	103	115%	119
Austria	310	113%	351
Portugal	3,197	106%	3,395
Greece	8,692	102%	8,823
Denmark	92	95%	87
Italy	8,739	94%	8,237
Spain	23,822	93%	22,194
EU-15	114,501	84%	96,308
Netherlands	1,702	80%	1,369
Belgium	192	78%	150
France	11,439	78%	8,924
Germany	3,310	77%	2,538
United Kingdom	44,469	76%	33,946
Ireland	8,021	71%	5,656

Figure 6.6: Trend of activity data (population) for goats



	1990	Trend (%) 1990-2007	2007
Netherlands	61	533%	324
Belgium	9	332%	29
Denmark	8	328%	28
Germany	90	200%	180
Austria	37	162%	60
Sweden	4	128%	6
Finland	6	105%	6
Greece	5,339	101%	5,384
France	1,329	98%	1,304
EU-15	12,682	92%	11,703
United Kingdom	113	84%	95
Spain	3,663	79%	2,892
Italy	1,259	73%	920
Portugal	745	62%	465
Ireland	17	42%	7
Luxembourg			

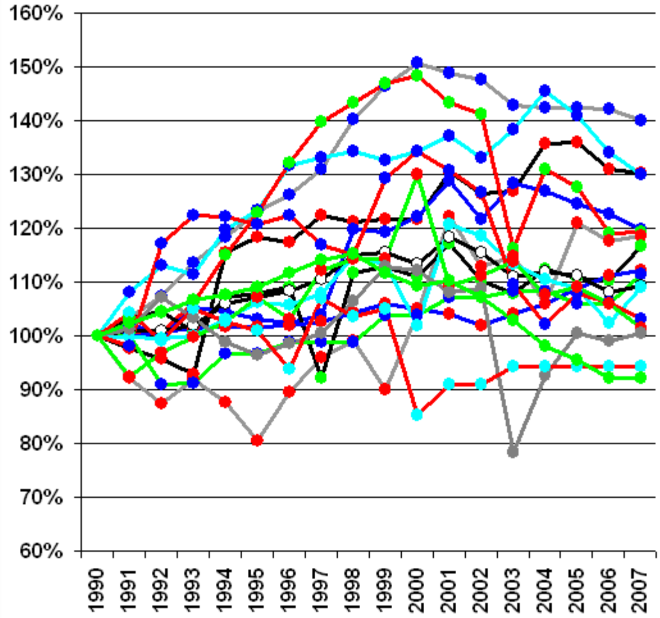
Figure 6.7: Trend of activity data (population) for swine



	1990	Trend (%) 1990-2007	2007
Spain	16,393	162%	26,563
Denmark	9,497	144%	13,723
Ireland	1,221	130%	1,581
France	9,587	120%	11,506
Luxembourg	75	110%	83
Italy	8,407	110%	9,273
EU-15	115,026	106%	122,253
Finland	1,381	105%	1,448
Belgium	6,700	93%	6,255
Portugal	2,536	92%	2,337
Greece	994	90%	898
Austria	3,688	89%	3,286
Germany	30,819	88%	27,125
Netherlands	13,915	84%	11,663
Sweden	2,264	74%	1,676
United Kingdom	7,548	64%	4,834

Figure 6.8: Trend of activity data (population) for poultry

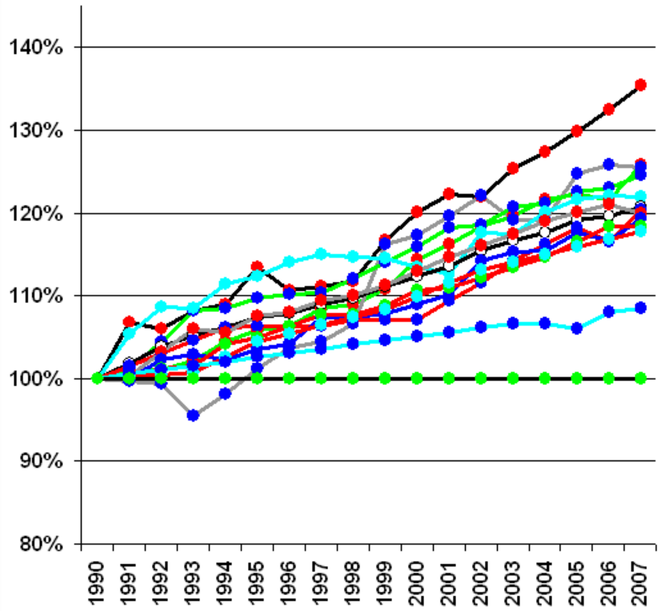
Poultry: Population (1000 head)



	1990	Trend (%) 1990-2007	2007
Portugal	27,511	140%	38,531
Spain	127,224	130%	165,748
Ireland	11,413	130%	14,826
United Kingdom	136,805	120%	163,871
Belgium	27,166	119%	32,389
Luxembourg	69	119%	82
Sweden	15,490	117%	18,080
Greece	28,747	112%	32,207
Germany	113,879	111%	126,864
EU-15	1,067,596	109%	1,166,448
Italy	173,342	109%	188,872
Denmark	16,249	103%	16,741
Finland	9,662	101%	9,791
Netherlands	95,561	100%	95,984
Austria	13,821	94%	13,027
France	270,658	92%	249,433

Figure 6.9:. **Trend of activity data (gross energy intake) for dairy cattle.**

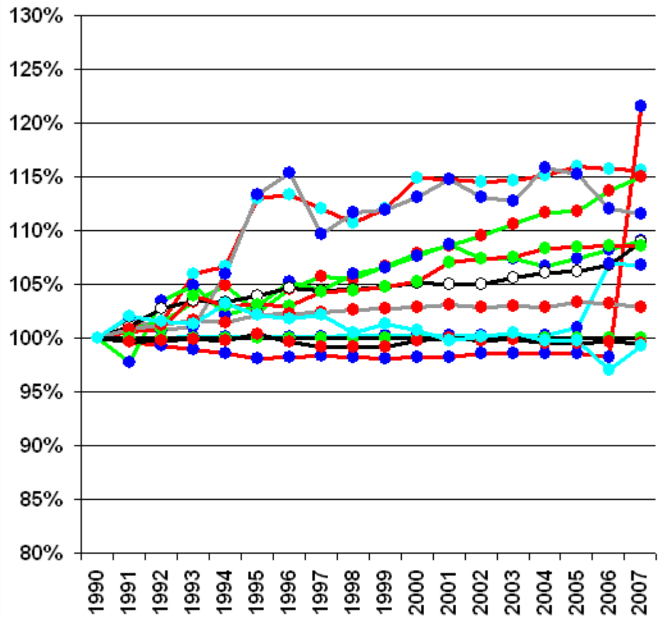
Dairy cattle: Average gross energy intake (GE) (MJ/head/day)



	1990	Trend (%) 1990-2007	2007
Spain	200	135%	271
Finland	247	126%	311
Portugal	241	125%	303
Germany	212	125%	264
Italy	236	122%	288
EU-15	229	121%	276
Denmark	278	120%	335
Luxembourg	268	120%	322
United Kingdom	224	119%	267
Belgium	251	118%	297
Austria	248	118%	292
Ireland	222	108%	240
Sweden	339	100%	339
France			
Greece			
Netherlands			

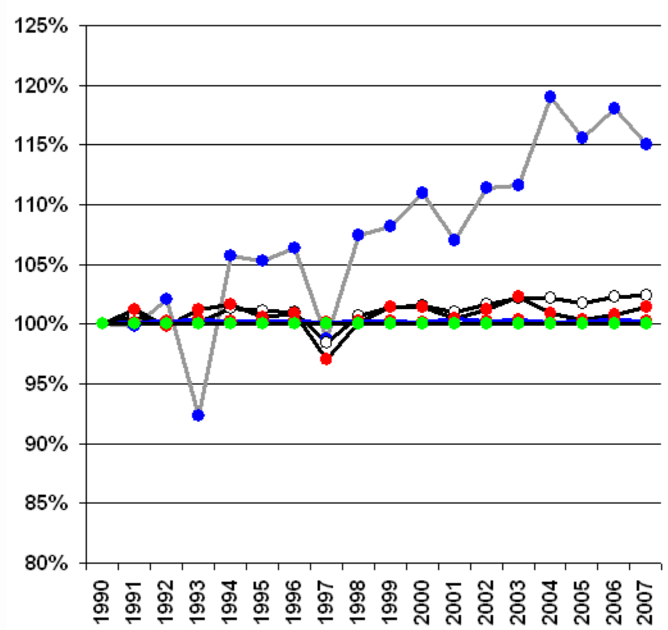
Figure 6.10: **Trend of activity data (gross energy intake) for non-dairy cattle.**

Non-dairy cattle: Average gross energy intake (GE) (MJ/head/day)



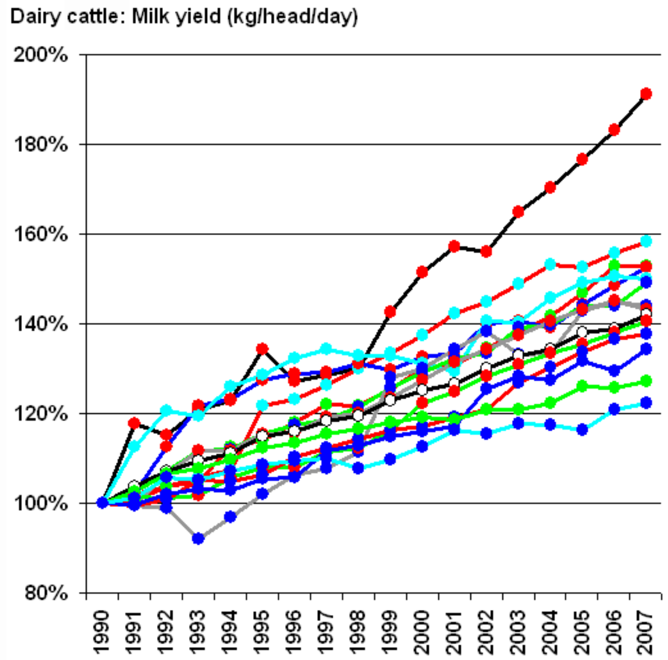
	1990	Trend (%) 1990-2007	2007
Denmark	107	122%	130
Austria	123	116%	142
Finland	103	115%	119
Portugal	130	112%	145
Germany	93	109%	101
EU-15	133	109%	145
Belgium	104	109%	113
Ireland	132	107%	141
Luxembourg	104	103%	107
United Kingdom	189	100%	189
Sweden	181	100%	181
Spain	155	100%	154
Italy	141	99%	140
France			
Greece			
Netherlands			

Figure 6.11: Trend of activity data (gross energy intake) for sheep



	1990	Trend (%) 1990-2007	2007
Portugal	21	115%	24
EU-15	20	102%	21
Spain	19	101%	19
Greece	23	100%	24
Denmark	44	100%	44
Austria	20	100%	20
Germany	20	100%	20
Ireland	20	100%	20
Luxembourg	20	100%	20
Sweden	20	100%	20
Finland			
Belgium			
United Kingdom			
Italy			
France			
Netherlands			

Figure 6.12: Trend of activity data (milk productivity) for dairy cattle



	1990	Trend (%) 1990-2007	2007
Spain	9.9	191%	18.9
Austria	10.4	158%	16.4
Belgium	11.0	153%	16.8
Greece	6.9	152%	10.5
Italy	11.5	150%	17.3
Germany	12.9	149%	19.2
Portugal	11.9	144%	17.1
Luxembourg	13.1	143%	18.8
EU-15	12.7	142%	18.1
Finland	15.7	141%	22.0
Denmark	17.1	138%	23.5
United Kingdom	14.3	134%	19.1
France	13.7	127%	17.4
Ireland	11.5	122%	14.0
Sweden			
Netherlands			

6.3.1.3 Uncertainty and time series consistency

CH_4 emissions from enteric fermentation belong to the source categories in agriculture, which are less uncertain. Animal numbers are assumed to be correct with a maximum uncertainty of 10% (with the exception of Portugal), and also the emission factor, which is calculated to a large extent with the Tier

2 methodology, is estimated to be known with a precision better than 20% for most countries, with 40% being the highest uncertainty estimate (Belgium and France) for cattle and 50% (Portugal) for other animal types. One exception is the high uncertainty assigned to some animal types (mules and asses, poultry and rabbit) in Portugal. The absence of statistic numbers for poultry, the need to estimate a time-series based on surrogate drivers, and the prevalence of dispersed animals in small farms, naturally causes higher uncertainty values for these animals. Finally, animals that are usually not considered as meat, such as equines, are less controlled and numbers tend to be known with less rigour.

The contribution of enteric fermentation to the overall inventory uncertainty is generally 1% or less, only France, Sweden and Ireland report a contribution of 4.1%, 2.6%, and 1.5% to the total inventory uncertainty, respectively.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.39 and Table 6.40. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4. Note that some countries (Finland, Germany) are using Tier 2 methodology for combining uncertainty estimates in agriculture at a much finer level of disaggregation and thus do not report AD and EF uncertainty estimates separately. Instead, due the combined uncertainty estimate is reported also in the cells for the EF uncertainty and the AD uncertainty is set to zero.

Table 6.25 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from enteric fermentation.

Table 6.23: Relative uncertainty estimates for activity data in category 4A (data from 2007 submission)

Member State 2006	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		10.0											
Belgium	5.0												
Denmark	10.0												
Finland	0.0												
France	5.1												
Germany			0.0	0.0	0.0								
Greece	5.0												
Ireland			1.0	1.0									1.0
Italy	20.0												
Luxembourg	10.0												
Netherlands		5.0									5.0		5.0
Portugal			6.1	6.5		19.1	19.1		71.2	271.8	11.0		770.6
Spain	3.1												
Sweden	5.0												
United Kingdom	10.0												

Table 6.24: Relative uncertainty estimates for implied emission factors in category 4A (data from 2007 submission)

Member State 2006	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		20.0											
Belgium	40.0												
Denmark	8.0												
Finland	32.1												
France	68.8												
Germany			10.0	6.2	5.4								
Greece	30.0												
Ireland			15.0	15.0									30.0
Italy	20.0												
Luxembourg	36.1												
Netherlands		15.0									50.0		30.0
Portugal			20.0	20.0		20.0	20.0		50.0	50.0	20.0		20.0
Spain	11.0												
Sweden	25.0												
United Kingdom	20.0												

Table 6.25: Member State's background information for the uncertainty estimates in category 4.A

Member State	Background information to uncertainy estimates
Austria	Activity Data: Animal numbers, in accordance to WINIWARTER & ORTHOFER (2000) were estimated at 10% uncertainty and considered statistically independent. Emission Factor: Uncertainties of emission factors for CH_4 emissions of enteric fermentation, according to AMON et al. (2002) were considered 20% for cattle and sheep (representing ruminants) and 30% for all other animals. EFs are correlated. Uncertainties of CH_4 emissions from Enteric Fermentation were estimated with a “Monte Carlo” simulation. Assuming a normal probability distribution, the calculated standard deviation is 4%. This indicates there is a 95% probability that CH_4 emissions are between +/- 2 standard deviations. Uncertainties considered are Gross Energy Intake, Methane Conversion Factor, Livestock, Share of oragnic farming, emission factor. The emission factors for the Tier 2 method are determined by the uncertainty of the gross energy intake and the CH_4 conversion rate.
Belgium	Activity Data: The only activity data here is the national livestock census. The uncertainty is judged small taken into account the features of the monitoring (census twice a year, individual earmarks and registration for all bovines, …),. Emission Factor: The emission factors are mainly the IPCC default values, using Tier 1 methodology. Consequently, the IPCC uncertainty estimate of 40% is used for the emission factor.
Denmark	Activity Data: Due to the large number of farms included in the norm figures, the arithmetic mean can be assumed as a very good estimate,with a low uncertainty. All cattle have theyr own ID-number (ear tags) and, thencd, the uncertainty in this number is almost non-existent. The Danish Plant Directorate, as the controlling authority, performs analysis of feed sold to farmers. Onaverage, 1600 to 2000 samples are analysed everly ear. Uncertainty in the data is seen as negligible. The combined effect of low uncertainty in actual animal numbers, feed ocnsumption and excretion rates gives a very low uncertainty in the activity data. The major uncertainty, therefore, relates to the emission factors.
Finland	Activity Data: Uncertainty estimates of animal numbers were based on knowledge on the reliability and coverage of data collection. Cattle has individual earmarks that enable very accurate assessment of animal numbers (uncertainty of ±3%), but uncertainty in animal numbers for other species in farms is higher (±5%). The uncertainty in animal numbers is estimated to be the highest for reindeer (±10%). Emission Factor: IPCC default uncertainties for emission factors were used excluding reindeer, for which the national emission factor has been used. The uncertainty in the Tier 2 method for evaluating emissions from enteric fermentation of cattle was assessed by estimating uncertainty in each calculation parameter (except coefficients, whose importance was expected to be minor) and combining uncertainties using Monte Carlo simulation. Uncertainty in CH_4 emissions from enteric fermentation of domestic livestock were estimated at -20% to +30% in 2007.
Germany	Activity Data: The uncertainties in the animal head counts in each class (with the exception of horses) are on the order of less than 6 % (DÄMMGEN, 2005). For the new Länder, herd sizes and their regional distribution for the years 1990 and 1991 were calculated using the RAUMIS model (HENRICHSMEYER et al., 1996), which provides regional data for agricultural production and products. As the data sources do not vary with the years, the time series is considered to be basically consistent. Derivation of the corrections is described in DÄMMGEN (2005). Emission Factor: The uncertainties in the methane emission factors are on the order of 30 % (EMEP, 2000: Chapter B1040-6). The primary sources of inaccuracy in these figures include the methane conversion factor (for

	cattle, 0.06 ± 0.005, i.e. 10 %, cf. IPCC, 2006) and the actual federation composition, especially that for cattle.
Luxembourg	Activity Data: "Animal numbers' uncertainty is estimated between 2% (for cattle, which are extremely well covered due to their inclusion in a register) and 10% for animals distributed over many small farms (sheep, horses, chicken)." Emission Factor: The uncertainty in CH_4 emission factors for livestock categories (sheep, goats, horses) is reported to be ±20%.
Netherlands	Activity Data: For cattle, uncertainty in animal numbers 5% (Olivier et al.,2009), Emission Factor: For cattle, uncertainty in emission factor 15% (Bannink, 2009).The uncertainty in the emission factor for swine and other animals is estimated to be 50% and 30%, respectively (Olivier et al.,2009)

The following issues related to time-series consistency are identified:

- *Sweden, AD general*

  The time series in the agricultural sector in Sweden are calculated consistently but the data needed are not always available for every year covered by the inventory. In cases where statistics are not produced annually, interpolation and extrapolation are necessary tools for the imputation of estimates. Methane from enteric fermentation may be a bit more certain with an error of about 30 %.

- *United Kingdom, AD general*

  In the United Kingdom, the time-series consistency of these activity data is very good due to the continuity in data provided.

- *Austria, agricultural data base*

  The FAO agricultural data base provides worldwide harmonized data (FAO AGR. STATISTICAL SYSTEM 2001). In the case of Austria, these data come from the national statistical system (Statistik Austria). However, there are inconsistencies between these two data sets. Analysis shows that there is often a time gap of one year between the two data sets.

- *Denmark, animal population of sheep, goats and horse*

  Agricultural Statistics, in agreement with the Danish Agricultural Advisory Centre (DAAC), as Statistics Denmark does not include farms less than 5 hectares. Statistics Denmark is the source for the database kept by FAO (Food and Agriculture Organization of the United Nations). This explains why the number of sheep, goats and horses in FAO and the Danish emission inventory disagree. The largest difference is found for horses. Improvements to the documentation of number of horses, sheep and goats on small farms, in cooperation with DAAC, is planned for the 2010 reporting. Since the year 2007, a decision was taken to improving methodology in estimation of animal number to add number of sheep, goats and horses on small farms less than 5 ha, and this led to the high interannual increase in the reported goat population by 200% between 2006 and 2007.

- *Denmark, IEF for dairy and non-dairy cattle*

  The adjustment of the feed intake led to a maximum increase of IEF for dairy and non-dairy cattle in 2007 compared to the inventory year 2006 in Denmark. The recalculation to the previous years will be provided in the next submission.

- *Germany, buffalo population*

  Buffalo have been kept in Germany since 1996. In 1990, their population was zero. They are therefore not reported for the whole time series

- *Luxembourg, goat population*

  For those animal categories for which no accurate data are available in official statistics for the years prior to 1997 (i.e. 4A4 and 4A10), it has not been attempted to "backcast" the methane emissions back to the base year, because: not estimated emissions under- but not overestimate the base year GHG emissions; it would not make much sense to devote efforts for estimating the missing years since CH_4 emissions for the concerned animal categories are particularly low and almost negligible.

Goat numbers in Luxembourg are not reported for the whole time series. The exact number of Luxembourg's goats was not recorded with precision before the year 2000. Numbers of goats are only available regularly, and with enough confidence, since 2000 onwards. In 1997, the first year goat population was reported, the goat population of Luxembourg corresponded to 0.003% of the goat population in EU-15. In 1990, the goat population of Luxembourg is assumed to be negligible.

- *Germany, animal population*

  There is some inconsistency in the time series of animal numbers in Germany due to the modification of the "Agrarstatistikgesetzes" with a rupture between 1998 and 1999. This applies particularly to sheep and horses, for both animal categories an approach for correction has been developed and applied (Daemmgen, 2006).

- *Estonia, animal population*

  The activity data on swine population in 1990–1998 were updated. The number of swine population for 1990–1998 was break downed/reported for three sub-categories of swine (breeding sows, fattening pigs and young swine) and for 1999–2007 for six sub-categories of swine (piglets, with live weight less than 20 kg; young pigs, with live weight 20–<50kg; pigs, with live weight 50–<80kg, 80–<110kg and 110 kg and more; and breeding sows). Based on assumptions, the activity data on swine population in 1990–1998 were recalculated for six sub-categories instead of three reported.

- *Romania, animal population*

  Considering the lack of FAO data for 2007, by expert judgment we considered that the number of mules and asses in 2007 equals the number in 2006.

6.3.2 Manure Management CH_4 (CRF source category 4.B(a))

6.3.2.1 Source category description

During storage and management of manure, CH_4 can be produced and emitted to the atmosphere. In accordance with the IPCC guidelines, the term 'manure' is used collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. Source category 4.B(a) excludes emissions that originate from burning of manure. The decomposition of manure generates CH_4 under anaerobic conditions (i.e., in the absence of oxygen). These conditions occur most readily when large numbers of animals are managed in a confined area (e.g., dairy farms, beef feedlots, and swine and poultry farms), and where manure is disposed of in liquid-based systems. If manure is managed or treated in liquid systems, it decomposes anaerobically and can produce a significant quantity of CH_4. The temperature and the retention time of the storage unit greatly affect the amount of methane produced.

Table 6.26 shows that at the European level, swine and cattle contribute more or less equally to CH_4 emissions from manure management (42% and 52% of total emissions in category 4B(a), respectively). For cattle, the contributions of non-dairy cattle are prevailing with percentages of total emissions in this category amounting to 25% and 17%, respectively. The highest contribution of cattle to CH_4 emissions from manure management are observed in Ireland (75%) and the United Kingdom (62%); the lowest in Portugal and Spain, where cattle contribute with only 5%. This is compensated with the emissions from swine manure with 90% of the total CH_4 from manure management. As also for enteric fermentation, significant emissions from sheep and goat occur in Greece with 11% and 4.2% of total CH_4 from manure management, respectively. Greece has also the highest contribution of poultry to CH_4 emissions from manure management with 16%.

At the EU-15 level, CH_4 emissions from manure management have decreased for cattle and sheep, but have increased for swine, which is mainly due to an intensification of swine production resulting in a higher IEF. Emissions from goats and poultry remained more or less stable.

Table 6.26: Total CH_4 emissions in category 4B(a) and implied Emission Factor at EU-15 level for the years 1990 and 200

	Dairy Cattle	Non-dairy cattle	Sw ine
	1990		
Total Emissions of CH_4 [Gg CH_4]	440	591	951
Total Population [1000 heads]	26245	63952	115026
Implied Emission Factor [kg CH_4 / head / year]	16.8	9.4	8.3

	Dairy Cattle	Non-dairy cattle	Sw ine
	2007		
Total Emissions of CH_4 [Gg CH_4]	366	544	1124
Total Population [1000 heads]	17952	58171	122253
Implied Emission Factor [kg CH_4 / head / year]	20.4	9.5	9.2

	Dairy Cattle	Non-dairy cattle	Sw ine
	2007 value in percent of 1990		
Total Emissions of CH_4 [Gg CH_4]	83%	92%	118%
Total Population [1000 heads]	68%	91%	106%
Implied Emission Factor [kg CH_4 / head / year]	122%	101%	111%

Source of information: CRF Table4s1 and 4.B(a) for 1990 and 2007, submitted in 2009
Dairy cattle includes Mature Dairy cattle, Non-dairy cattle includes Mature Non-Dairy Cattle and Young Cattle

6.3.2.2 Methodological Issues

Methods

CH_4 emissions from manure management are a key source category for cattle and swine at EU-15 level. This is true also for many Member States. Table 6.27 shows the total emissions in category 4.B(a), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. Also, it is reports whether the source category is a key source category for the Member States.

The method for calculation of CH_4 emissions from manure management implies the need to estimate for each animal category the excretion of volatile organic solids (VS) and a maximum methane producing capacity (B_0); furthermore, for each animal category and manure management system, a methane conversion factor must be determined, which is dependent on the climate region. Each country must determine the fractions of the manure managed in AWMS-climate region combination. A weighted average of the methane conversion factor over all occurring climate regions must then be calculated for each animal waste management system. The IPCC *Guidelines* list default values for all these parameters. In Table 6.27, we report also the Tier that has been used by the Member States to estimate CH_4 emissions from manure management according to the approach described in section 6.4.1 (see Table 6.86 through Table 6.89).In the case of CH_4 emissions from manure management, a Tier 2 approach was assigned according to the "median-rule" with the weighting factors 0.75, 0.13, and 0.13 for VS, B_0, or MCF, respectively. For the methane conversion factor, we calculated the default value by using the allocation to the different climate regions reported by the countries and multiplying with the respective IPCC value. For the Netherlands, no background data are given, so the level of the method could not be calculated. However, according to the NIR of the Netherlands, a country-specific Tier 2 method has been applied.

Overall, the quality of the emission estimates in category 4B(a) range between Tier 1.1 and Tier 2.0 with a Tier level for EU-15 of Tier 1.6 (corresponding to 64% of the emissions being calculated with country-specific data). This relatively low quality for this source category is due to the fact that countries with a high number of animals have intermediate quality (Tier 1.5, e.g. because no country-specific estimation of VS has been done).

Some additional information on the methodological approaches for some Member States is given in

Table 6.28.

Table 6.27: Total emissions and contribution of the main sub-categories to CH_4 emissions in category 4B(a), methodology applied and key source assessment by Member States for the sub-categories dairy cattle, non-dairy cattle and swine.

	Total		Dairy Cattle		Non-dairy cattle		Cattle	Swine	
	Gg CO_2-eq	b	a	b	a	b	c	a	b
Austria	886	Tier 1.8	25%	Tier 1.8	26%	Tier 1.8	y	46%	Tier 1.8
Belgium	1,567	Tier 1.7	11%	Tier 1.3	8%	Tier 1.3	y	80%	Tier 1.9
Denmark	1,048	Tier 1.9	21%	Tier 1.9	4%	Tier 1.9	y	71%	Tier 1.9
Finland	284	Tier 1.6	32%	Tier 1.9	12%	Tier 1.9	y	39%	Tier 1.2
France	13,919	Tier 1.2	11%	Tier 1.2	48%	Tier 1.2	y	36%	Tier 1.2
Germany	5,477	Tier 2.0	31%	Tier 2.0	19%	Tier 2.0	y	47%	Tier 2.0
Greece	487	Tier 1.1	18%	Tier 1.2	24%	Tier 1.2	y	27%	Tier 1.2
Ireland	2,158	Tier 1.6	22%	Tier 1.8	53%	Tier 1.8	y	19%	Tier 1.2
Italy	3,057	Tier 1.9	17%	Tier 2.0	21%	Tier 2.0	y	46%	Tier 2.0
Luxembourg	98	Tier 1.8	37%	Tier 1.8	27%	Tier 1.8	y	35%	Tier 1.8
Netherlands	2,634	Tier 2.0	44%	Tier 2.0	12%	Tier 2.0	y	41%	Tier 2.0
Portugal	1,170	Tier 1.9	3%	Tier 1.9	3%	Tier 1.8	y	90%	Tier 1.9
Spain	9,458	Tier 1.8	3%	Tier 1.8	1%	Tier 1.8	y	90%	Tier 1.8
Sweden	472	Tier 1.9	32%	Tier 1.9	35%	Tier 1.9	y	24%	Tier 1.9
United Kingdom	2,857	Tier 1.7	37%	Tier 1.8	25%	Tier 2.0	y	25%	Tier 1.2
EU-15	**45,572**	**Tier 1.6**	**17%**	**Tier 1.8**	**25%**	**Tier 1.5**	**y**	**52%**	**Tier 1.7**
EU-15: Tier 1	36%		24%		53%			31%	
EU-15: Tier 2	64%		76%		47%			69%	

a Contribution to CH_4 emissions from manure management

b Tier 1: default methodology; Tier 2: country-specific methodology

c Source category is key in the Member State's inventory (y/n)

Table 6.28: Member State's background information for the calculation of CH_4 emissions in category 4.B(a)

Member State	Methods
Austria	Cattle and swine: Tier 2 (key sources); Sheep, Goats, Horses and Other Soliped, Chicken, Other Poultry and Other animals: Tier 1.
Belgium	Tier 2 methodology is used for both cattle and swine in Flanders and for cattle alone in Wallonia since the 2009 submission. Wallonia may use this Tier 2 as well, but swine is not a key source in Wallonia and only grows 5 % of the total Belgian swine. EF used in de current methodology are close to the IPCC value. Because of the availability of detailed statistics on livestock composition in Flanders, including data on e.g. slaughter weights, a more extended variant of the IPCC methodology has been applied. Accounting for the fact that the weight of the cattle over the whole lifetime is not the same as the slaughter weight, the weight is integrated from birth to slaughtering. A study performed by the Flemish Institute for Technological Research (Vito), indicates that CH_4 emissions during manure processing are negligible.
Denmark	The emissions from the agricultural sector are calculated in a comprehensive agricultural model complex called DIEMA (Danish Integrated Emission Model for Agriculture, Mikkelsen, 2006). The IPCC Tier 2 approaches are used for the estimation of the CH_4 emission from manure management. The amount of manure is calculated for each combination of livestock subcategory and stable type. The estimation is based on national data for feed consumption (Poulsen et al. 2001) and standards for ash content and digestibility.In 2007, approximately 8% (0.97 Mt of cattle slurry and 1.18 Mt of pig slurry) were treated in biogas plants (DEA 2008). The reduction in the CH_4 emission is based on model calculations for an average size biogas plant with a capacity of 550 m3 per day. For methane, a reduction of 30% for cattle slurry and 50% for pig slurry is obtained (Nielsen et al. 2002, Sommer et al. 2001).
Finland	Methane emissions from manure management are calculated in the same generic way as emissions from enteric fermentation, i.e. by multiplying the number of the animals in each category with the emission factor for each category. In Finland the Tier 2 method is used for all animal categories. The national emission factor for each cattle subcategory has been calculated by using the IPCC Tier 2 methodology.
France	Tier 1+.
Germany	The IPCC 2006 Guidelines were applied and Tier 1b (advance) methodology was used for key source categories. The values for VS and MCF are updated (Daemmgen et al., 2008). The emission factors represent the general situation in Germany. Calculations are done at the district level.
Greece	CH_4 emissions from manure management were estimated according to the IPCC Tier 1 methodology, which is similar to the one used for the enteric fermentation.

Member State	Methods
Ireland	The analysis of the feeding regime for cattle (O' Mara, 2006) included a full evaluation of the organic matter content of the feeds applicable to the 11 categories that characterise the national herd, which facilitates the estimation of their respective levels of organic matter excretion.
Italy	IPCC Tier 2 approach has been used for estimating CH_4 EFs for manure management from cattle, buffalo and swine. For estimating slurry and solid manure EFs and the specific conversion factor, a detailed methodology (Method 1) has been applied at a regional basis (cattle and buffalo categories). Then, a simplified methodology, for estimating EFs time series, has been followed (Method 2). Since the 2006 submission, a reduction of CH_4 emissions because of biogas production has been considered.
Luxembourg	Tier 1 method has been applied to estimate methane emissions from manure management – i.e. for all animal categories except cattle. Population and methane emission growths are exactly the same as in enteric fermentation. What distinguishes one tier from the other is the fact that, for cattle, the average gross energy intake – as a component of the volatile solid daily excretion – is not a default value but, rather, the value obtained when estimating enteric fermentation methane related emissions with a Tier 2 method.
Netherlands	Tier 2 approach is used based on country specific data on animal manure production per animal, on manure characteristics (like organic matter (OM) content) and (liquid) manure storage conditions.
Portugal	All animal types: Tier 2. Emission factors by animal type and climatic conditions.Emissions factors for each animal type were established according to the tier 2 methodology, which considers the use of country specific information concerning the quantity of manure produce per animal and the share of each Manure Management System that is used for each animal type.
Spain	Tier 2 for beef and pork herds, Tier 1 for other animal categories using smooth temperature functions for the MCF and EF (modification accepted by IPCC). Management systems: own expert calculation.
Sweden	Tier 2 for Cattle and Swine, Tier 1 methodology is used for other animal groups.
United Kingdom	Cattle, Lambs and Deer: Tier 2; other: Tier 1. For Dairy cattle, the calculations are based on the population of the 'dairy breeding herd' rather than 'Dairy cattle in milk' used in earlier inventories.The former definition includes 'cows in calf but not in milk'. The waste factors used for beef and other cattle are now calculated from the IPCC Tier 2 procedure but do not vary from year to year.

Activity Data

Table 6.29 and Table 6.30 summarize the allocation of the produced manure over the animal wastes management systems 'liquid systems', 'solid storage and dry lot' and 'pasture, range and paddock' for the animal categories dairy and non-dairy cattle and swine in 200 and 1990, respectively. The table shows, that in all countries more manure is managed in liquid systems for swine than for cattle, whereby in Italy and Ireland 100% of the swine manure is managed in liquid systems. Only in the UK more manure is managed in solid than in liquid systems. In the category cattle, generally more manure is managed in liquid systems for dairy cattle than for non-dairy cattle, expressed in relative numbers, with the exception of Austria and France.

Substantial changes in the allocation of manure to manure management systems are reported for Sweden, Germany, Finland, and Denmark, however, with different signs of the direction of the changes. For example, liquid systems were more frequently used to manage manure from dairy cattle in Sweden (from 23% in 1990 to 55% in 200). The trend for non-dairy cattle goes into the other direction in Sweden with a decreasing portion of manure managed in liquid systems (in 1990 andin 200) and increasing use of solid storage systems.

Table 6.29: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 200

Member State	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
2007	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Austria	19%	NO	70%	11%	24%	NO	67%	10%	72%	NO	28%	NO
Belgium	33%	NO	24%	43%	15%	NO	39%	45%	100%			
Denmark	86%	NO	9%	5%	31%	NO	40%	30%	91%	NO	8%	1%
Finland	48%	NO	24%	28%	NO	NO	NO	NO	62%	NO	38%	NO
France	11%	NO	42%	47%	37%	NO	23%	40%	83%	NO	17%	0%
Germany	70%	NO	15%	15%	54%	NO	32%	14%	86%	NO	14%	
Greece		2%	90%	8%		3%	62%	33%	90%		10%	
Ireland	41%	NO	3%	57%	23%	NO	11%	65%	100%	NO	NO	NO
Italy	38%	NO	57%	5%	56%	NO	42%	3%	100%	NO	NA	NA
Luxembourg	33%	NO	17%	45%	25%	NO	20%	50%	90%	NO	5%	NO
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	48%	NO	22%	30%	NO	NO	20%	80%	93%	NO	2%	5%
Spain	15%	25%	60%	NO	NO	NO	37%	63%	91%	NO	NO	9%
Sweden	55%	NO	20%	25%	14%	NO	22%	43%	81%	NO	16%	NO
United Kingdom	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
EU15	40%	2%	33%	26%	33%	0%	30%	37%	89%		8%	3%

Source of information: CRF 4.B(a) for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Anaerobic lagoon + Liquid system. Missing fraction belong to the category 'Other'

Table 6.30: Member State's Allocation of Animal Waste Management Systems over liquid systems, solid storage and dry lot, and pasture range and paddock in 1990

Member State	Dairy Cattle - Allocation of AWMS (%)				Non-Dairy Cattle - Allocation of AWMS (%)				Swine - Allocation of AWMS (%)			
1990	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock
Austria	19%	NO	70%	11%	25%	NO	66%	9%	71%	NO	29%	NO
Belgium	31%	NO	27%	43%	16%	NO	39%	45%	100%			
Denmark	70%	NO	15%	15%	37%	NO	36%	28%	89%	NO	11%	NO
Finland	22%	NO	50%	28%	NO	NO	NO	NO	45%	NO	55%	NO
France	11%	NO	42%	47%	37%	NO	23%	40%	83%	NO	17%	0%
Germany	51%	NO	29%	20%	57%	NO	32%	10%	84%	NO	16%	
Greece		2%	90%	8%		3%	62%	33%	90%		10%	
Ireland	41%	NO	3%	57%	23%	NO	11%	65%	100%	NO	NO	NO
Italy	38%	NO	57%	5%	58%	NO	40%	2%	100%	NO	NA	NA
Luxembourg	23%	NO	32%	45%	19%	NO	31%	50%	90%	NO	5%	NO
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	35%	NO	35%	30%	NO	NO	28%	72%	95%	NO	3%	2%
Spain	15%	25%	60%	NO	NO	NO	31%	69%	95%	NO	NO	5%
Sweden	23%	NO	52%	25%	17%	NO	32%	40%	44%	NO	52%	NO
United Kingdom	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
EU15	32%	2%	40%	26%	38%	0%	30%	32%	88%		11%	1%

Source of information: CRF 4.B(a) for 1990, submitted in 2009
Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Anaerobic lagoon + Liquid system. Anaerobic lagoon contributes significantly only in Spain with 25% and in Ireland with 2% of the manure managed.

For some countries, background information on in addition to what is reported in Table 6.17 on the activity data used for the estimation of CH_4 emissions from manure management is given in the respective National Inventory Reports and is listed in Table 6.31.

Table 6.31: Member State's background information on the allocation to animal waste management systems used for the calculation of CH_4 and N_2O emissions in category 4.B(a)

Member State	Activity data
Austria	In Austria national statistics on manure management systems are not available. Up to now, only one comprehensive survey has been carried out. This manure management system distribution was used for the whole period from 1990-2005.Manure management systems are distinguished for Dairy Cattle, Suckling Cows and Cattle 1–2 years in "summer situation" and "winter situation".
Belgium	In Wallonia, the allocation of animals to AWMS comes from the NIS agricultural census of 1992 and 1996, where those data were published by animal type. Those data are not collected yearly by the NIS given their slow pace of change; an update would be desirable.

Member State	Activity data
Denmark	From 2006, all farmers have to report which stable type they are using to the Danish Plant Directorate. These information are now included in the inventory and are in overall consonant with the expert judgement from DAAC. At present, there exist no official statistics concerning the distribution of animals according to stable type. The distribution is, therefore, based on an expert judgement from the Danish Agricultural Advisory Centre (DAAC). Approximately 90-95% of Danish farmers are members of DAAC and DAAC regularly collects statistical data from the farmers on different issues, as well as making recommendations with regard to farm buildings.
Finland	Distribution over animal systems (slurry, solid storate, pasture) is country-specific from literature (MKL, 1993; Seppänen and Matinlassi, 1998) and expert judgement. Anaerobic lagoons and daily spread not used in Finland.
France	AWMS distribution national on the basis of a survey carried out in 1994.
Ireland	The allocation to animal waste management system is based on the farm facilities survey. The same values are used for all years. The bulk of animal wastes in housing are managed in liquid storage systems. New information obtained from a national farm facilities survey (Hyde et al., 2008).
Luxembourg	
Netherlands	Specified data on manure management are based on statistical information on management systems; these data are documented in Van Schijndel and Van der Sluis, 2008.
Portugal	Livestock numbers per animal type were available at Concelho level from two detailed agriculture surveys: RGA89 and RGA99. Livestock numbers in each Concelho area were allocated to each climate region, for year 1999, according to the land are percentage, and always assuming an homogeneous distribution of animals in the Concelho territorial area. Number of animals were summed at each Administrative Region (Região). Livestock population in each climate region and by Região was estimated annually from total livestock population in Região and considering the constant share and, finally, the total national livestock population for each region was calculated.
Sweden	Information on waste management systems is collected from the survveys publishes in the biannual statistical report on the use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). Three manure management systems are considered apart form grazing animals: liquid systems (including semi-liquid manure), solid storage and deep litter (sometimes categorised as "other" in the national inventory). National estimates of stable periods are collected from the statistical report on use of fertilisers and animal manure in agriculture (Statistics Sweden, MI 30-series). This information has been available biannually since 1997. Before 1997, the data are extrapolated to 1990. Since dairy cows are often stabled at night, the data on stable periods for this animal category is combined with an assumption that 45% of its manure was produced in the stable during the grazing period (caclulated according to the STANK model, Swedish Board of Agriculture, 2005)
United Kingdom	The distribution to AWMS was revised in 2000 for cattle and poultry. Data on 'no significant storage capacity' of farmyard manure were allocated. This could have a large effect on emissions because it amounted to around 50% of manure and the ‘Daily spread (DS)’ category has an emission factor of zero, compared to 0.02 for the ‘Solid storage and dry lot (SSD)’ category. There was a revision (in 2002) of the allocation of manure to the different management systems based on new data.

Emission Factors and other parameters

The implied emission factors for CH_4 emissions from manure management vary substantially among the Member States, as shown in Table 6.32. The range of the implied emission factors for dairy cattle, non-dairy cattle and swine covers about one order of magnitude, which is more than the range proposed in the IPCC *Guidelines* for different climate regions (for dairy cattle in Western Europe, for example, an emission factor of 14 kg CH_4 head^{-1} y^{-1} is proposed for cool climate regions and a factor of 81kg CH_4 head^{-1} y^{-1} of warm climate regions), but less than the ratio of the methane conversion factors of liquid (39% - 72%) and solid (1% – 2%) manure. The ratio of the highest and the smallest IEF used by the Member States is 8 for dairy cattle, and 17 for non-dairy cattle and 6, 6, and 8 for sheep, goats and swine, respectively. The highest IEF for dairy cattle is used by Netherlands with 39.2 kg CH_4/head/year and the smallest by Portugal with 4.9 kg CH_4/head/year.

As mentioned above, the two most important factors influencing the amount of CH_4 emitted from manure management systems are the climate region and if solid or liquid systems are dominating. We have already discussed the large range of systems used in the EU-15 Member States. The other two factors, the excretion rate of volatile solids and the methane producing potential, are not significantly influencing the order of magnitude.

The following outliers can be identified:

- *Implied Emission Factor for Dairy cattle, Portugal*

  Part of dairy cattle is managed in "Fossas" (Pits)", which corresponds best to the IPCC class "Pit storage below animal confinments". The storage time is very short, less than one month. Therefore, Portugal set the MCF to zero. In 2006 guidelines the MCF is revised to 3 per cent, but no clear distinction is made between pits and liquid/slurry system. A more detailed assessment would require a country-specific study.

- *Implied Emission Factor for Non-dairy cattle, Denmark.*

  Non-Dairy Cattle" includes calves, heifers, bulls and suckler cows and the implied emission factor is a weighted average of these different subcategories. The Danish IEF for non-dairy cattle is lower compared with the default value, this is due to lower weight and lower feed intake and a higher digestibility of feed.

- *Implied Emission Factor for Non-dairy cattle, France*

  The IEF is calculated with the default values of the IPCC. First, for the MCF indicator, the climate region is "temperate" in the metropolitan territory and "warm" in DOM and COM, high values of "MCF" are used for France. Then the part of non dairy cattle relating to liquid management must be higher than in other countries because this AWMS has a bigger impact.

- *Implied Emission Factor for Non-dairy cattle, Spain*

  Spain uses a Tier 2 approach. Gross energy is calculted using tier 2 methodology of enteric fermentation whilst percentages of manure management systems are taken from national references. The dominant systems for non-dairy cattle are solid storage and pasture, both of which have very a low MCF at 10ºC.

Table 6.32: Implied Emission factors for CH_4 emissions from manure management used in Member State's inventory

Member State	Implied EF (kg CH_4/head/yr)				
2007	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
Austria	20.4	7.4	0.19	0.12	5.9
Belgium	15.7	2.6	0.68	0.70	9.5
Denmark	18.8	1.7	0.32	0.26	2.6
Finland[1)]	14.6	2.6	0.19	0.12	3.6
France	18.3	20.1	0.28	0.18	20.9
Germany	19.6	5.7	0.30	0.30	4.6
Greece	19.0	13.0	0.28	0.18	7.0
Ireland	20.6	11.0	0.15	0.12	12.5
Italy	13.6	7.0	0.22	0.15	7.2
Luxembourg	42.8	8.3	0.19	0.12	19.5
Netherlands	39.2	6.2	0.18	0.34	4.4
Portugal	4.9	1.6	0.30	0.25	21.3
Spain	15.3	1.2	0.23	0.16	15.3
Sw eden	19.5	6.6	0.19	0.12	3.2
United Kingdom	25.8	4.2	0.11	0.12	7.1
EU-15	20.4	9.5	0.19	0.18	9.2

Source of information: CRF 4.B(a) for 2007, submitted in 2009 Abbreviations explained in the Chapter 'Units and abbreviation.

1) Finland reports non-dairy cattle under "other" in the following categories: bulls, cows, heifers, and calves. The IEF has been calculated as a weighted average. The IEF for the Netherlands and Luxembourg has been calculated as a weighted average has been calculated using the values given under option B (mature non-dairy and young cattle).

The parameter of interest are the allocation of manure to climate regions (Table 6.33) and methane conversion factor used (Table 6.34). Most of Europe falls into the cool climate region with average annual temperatures below 15°C. Accordingly, most countries are allocating 100% of the animal population to the cool climate region, with Italy and Portugal allocating a part of the population into the temperate region (for dairy cattle for example 8% and 58%, respectively) and only Greece allocating 100% of the animals to the temperate climate region. France assumes 0.1% of the dairy cattle and 0.9% of the non-dairy cattle in the warm climate region, which is due to the extra-territorial regions; the remaining manure is allocated to the temperate climate region. The distribution of the animals over the climate regions is somewhat different for different animal types; in Portugal, for example, the portion of animals living in the temperate region increases from dairy cattle over non-dairy cattle to swine.

For the categories dairy cattle, non-dairy cattle and swine, only in few cases is the allocation of animal population to climate regions reported to be dynamic. However, in Portugal, for example, a general shift of livestock production to warmer climate regions has been observed increasing the percentage of manure managed in the temperate region by 5%, 18%, and 2% for dairy cattle, non-dairy cattle, and swine, respectively.

The potential methane producing factor is IPCC default or close to IPCC default for most countries (Table 6.35); the amount of volatile organic solid excreted per animal (Table 6.36) and year varies across the countries on the basis of the animal characterization with a ratio of highest to lowest average VS excretion rate between 2.2 (dairy cattle) and 2 (swine).

Table 6.33: Member State's allocation of dairy cattle, non-dairy cattle and swine to the climate regions "cool", "temperate" and "warm"

Member State 2007	Dairy Cattle - Allocation by climate region[1)]			Non-Dairy Cattle - Allocation by climate region[1)]			Swine - Allocation by climate region[1)]		
	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)	Cool (%)	Temperate (%)	Warm (%)
Austria	100%	NO	NO	100%	NO	NO	100%	NO	NO
Belgium	100%	NO	NO	100%	NO	NO	100%		
Denmark	100%	NO	NO	100%	NO	NO	100%	NO	NO
Finland	100%	NA	NA	NO	NO	NO	100%	NA	NA
France	NO	100%	0.1%	NO	99%	0.9%	NO	99%	1.0%
Germany	100%	NO	NO	100%	NO	NO	100%	NO	NO
Greece		100%			100%			100%	
Ireland	100%	NO	NO	100%	NO	NO	100%	NO	NO
Italy	92%	8%	NO	87%	13%	NO	97%	3%	NO
Luxembourg	100%	NA	NA	100%	NA	NA	100%	NA	NA
Netherlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
Portugal	42%	58%	NO	24%	76%	NO	20%	80%	NO
Spain	87%	13%	NO	67%	33%	NO	63%	37%	NO
Sweden	100%	NO	NO	100%	NO	NO	100%	NO	NO
United Kingdom[1)]	NO	NO	NO	NO	NO	NO	NO	NO	NO
EU-15	69%	31%	0%	58%	41%	0%	77%	23%	0%

Source of information: CRF 4.B(a) for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] The portion lacking for 100% are reported as daily spread (only UK) and 'other'.

Table 6.34: Member State's Methane Conversion Factor used for dairy cattle, non-dairy cattle and swine for the different animal waste management systems

Member State 2007	Dairy Cattle - Methane Conversion Factor (%) [1)]				Non-dairy Cattle - Methane Conversion Factor (%) [1)]				Swine - Methane Conversion Factor (%) [1)]			
	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Pasture range paddock
Austria	90%	39%	1.00%	1.00%	90%	39%	1.00%	1.00%	90%	39%	1.00%	1.00%
Belgium	NO	19%	2.00%	1.00%	NO	19%	2.00%	1.00%		20%		
Denmark	NO	10%	1.00%	1.00%	NO	10%	1.00%	1.00%	NO	10%	1.00%	1.00%
Finland	NA	10%	1.00%	1.00%	NO	10%	1.00%	1.00%	NO	10%	1.00%	1.00%
France	NO	59%	1.75%	1.75%	NO	59%	1.75%	1.75%	NO	59%	1.75%	1.75%
Germany	NO	10%	2.00%	1.00%	NO	10%	2.00%	1.00%	NO	10%	2.00%	1.00%
Greece												
Ireland	NA	39%	1.00%	1.00%	NA	39%	1.00%	1.00%	NA	39%	NA	NA
Italy	NO	16%	3.00%	1.25%	NO	16%	3.00%	1.25%	NO	26%	NA	NA
Luxembourg	NA	39%	1.00%	1.00%	NA	39%	1.00%	1.00%	NA	39%	1.00%	NA
Netherlands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Portugal	42%	NA	1.25%	1.25%	NA	NA	1.25%	1.25%	42%	NA	1.25%	1.25%
Spain	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sweden[2)]	NO	1000%	100.00%	100.00%	NO	1000%	100.00%	100.00%	NO	1000%	100.00%	NO
United Kingdom												
EU15	58%	42%	1.98%	1.50%	90%	43%	1.87%	1.50%	57%	42%	1.68%	1.50%

Source of information: CRF 4.B(a) for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] Anaerobic lagoon + Liquid system. Anaerobic lagoon contributes only in Ireland with 2% of the manure managed. [2)] Values reported by Sweden have been multiplied with a factor of 100.

Table 6.35: Member State's methane producing potential for emissions from manure management for the main animal types

Member State 2007	CH4 producing potential (Bo) (CH4 m3/kg VS)				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
Austria	0.24	0.17	0.19	0.17	0.45
Belgium					
Denmark	0.24	0.17	0.19	0.17	0.45
Finland	0.24	0.17	0.19	0.17	0.45
France	0.24	0.17	0.19	0.17	0.45
Germany	0.24	0.18	0.19	0.18	0.45
Greece	NE	NE	NE	NE	NE
Ireland	0.24	0.24	0.19	0.17	0.45
Italy	0.14	0.13	0.19	0.17	0.46
Luxembourg	0.24	0.17	0.19	0.17	0.45
Netherlands	NE	NE	NE	NE	NE
Portugal	0.24	0.17	0.19	0.17	0.45
Spain	0.24	0.17	NA	NA	0.45
Sw eden	0.24	0.17	0.20	0.20	0.45
United Kingdom	0.24	0.24	NE	NE	NE
EU-15	0.23	0.19	0.19	0.17	0.45

Source of information: CRF 4.B(a) for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.36: Member State's volatile solid excretion from managed manure for the main animal types in 2007

Member State 2007	VS excretion (kg dm/head/day)				
	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine
Austria	4.2	1.9	0.4	0.3	0.4
Belgium	NE	NE			
Denmark	4.9	1.6	0.7	0.7	0.4
Finland	4.6	1.8	0.4	0.3	0.5
France	5.1	2.7	0.4	0.3	0.5
Germany*	3.1	1.4	0.4	0.3	0.3
Greece	NE	NE	NE	NE	NE
Ireland	2.9	1.3	0.4	0.3	0.5
Italy	6.4	2.8	0.4	0.3	0.3
Luxembourg	5.5	1.9	0.4	0.3	0.5
Netherlands	NE	NE	NE	NE	NE
Portugal	6.0	2.8	0.5	0.5	0.5
Spain	3.4	2.4	NA	NA	0.4
Sw eden	5.3	1.4	0.4	0.3	0.3
United Kingdom	3.5	2.7	NE	NE	NE
EU-15*	4.3	2.2	0.4	0.3	0.4

Source of information: CRF 4.B(a) for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'. * Values have been divided by 365 to convert from year to day. $ Values have been multiplied by 365 (non-dairy cattle)

Some additional background information on the factors and parameters used by the Member States is given in Table 6.37.

Table 6.37: Member State's background information on the emission factors and other parameters used for the calculation of CH_4 emissions in category 4.B(a)

Member State	Emission Factors and other parameters
Austria	The default MCF values for 'cool climate regions' were used. For liquid systems the revised GPG default value of 39% was applied. Austrian specific values for dairy cows were calculated in dependency of annual milk yields and corresponding feed intake data (gross energy intake, feed digestibility, ash content). For the calculation of VS excretion of suckling cows an average milk yield of 3 000 kg was applied. Austrian specific values on VS excretion for all other cattle categories were calculated from typical Austrian diets under organic and conventional management. As no major changes in diets of Non-Dairy Cattle occurred, methane emissions from manure management of Non-Dairy Cattle are calculated with a constant gross energy intake and thus constant VS excretion rate for the whole time series for swine. From Manure Management for Sheep, Goats, Horses, Poultry and Other Livestock / Deer are estimated with Tier 1 approach.
Belgium	Emission factors for each animal category have been developed by Siterem 2001. Those factors take into account the type and volume of manure produced during the time spent in stables, its density and carbon content, and its carbon volatilisation ratio. The resulting EF are comparable to the default IPCC for cool climate.
Denmark	The IEF for sheep, goats and horses is unaltered because of very few changes in feed intake and grassing days. A more detailed division in subcategories for goats and horses will be implemented for manure management in the 2010 submission. The IEF for sheep and goats includes lambs and kids, which corresponds the Danish normative data. This explains why the Danish IEF is nearly twice as high as the IPCC default value. Swine: typical animal mass is based on slaughter pigs. Old-style tethering systems with solid manure have been replaced by loose housing with slurry-based systems. The MCF for liquid manure is ten times higher than that for solid manure. For non-dairy cattle, the opposite development has taken place. An increasing proportion of bull-calves are raised in stables with deep litter, where the MCF is lower than for liquid manure.
Finland	Cattle: National values for digestible energy (DE %), fraction of animal´s manure managed annually in each manure management system (MS), average milk production and animal weight. For Reindeer it is assumed that all manure is deposited on pastures and for fur animals it is assumed that all manure is managed as solid. For fur animals, VSi value is based on expert judgement being 0.17 kg/head/day.
France	IPCC EFs, only some specific national conditions were considered.
Germany	According to the calculation at district level, IEF are varying with time and space due to differences in AWMS distribution and climate.
Greece	The choice of emission factors follows the same criteria as for the case of enteric fermentation.
Ireland	New information obtained from a national farm facilities survey (Hyde et al., 2008) and the work on emission factors for enteric fermentation in cattle is the basis of the CH_4 emission factors for manure management. The emission factors for manure management are derived using the quantified organic matter excretion as volatile solids (VS), a BO (the methane production potential of animal waste), the allocation to animal waste management system based on the farm facilities survey and the corresponding values of MCF (methane conversion factor) given for the cool climate zone.
Italy	The detailed calculation includes a monthly regional emission factor as an exponential function from the monthly average regional temperature for slurry and the average regional monthly storage temperature for solid manure (Husted, 1993; Husted, 1994). The storage temperature is by itself an exponential function of the regional temperature. A specific conversion factor has then been estimated to correlate methane emissions and volatile solid production (15.32 g CH_4 kg-1 VS for slurry and 4.80 g CH_4 kg-1 VS for solid manure). These factors have then been used to calculate the aggregated methane emissions. The methane producing potential B_0 has been calculated for reporting purposes only. Swine. National emission data from experimental research at the Research Centre on Animal Production (CRPA, 1996).
Netherlands	The Netherlands uses a country-specific emission factor for a specific animal category, which is expressed as amount of methane emitted per kg animal manure per year for all three manure management systems for every animal category on a Tier 2 level. These calculations are based on country-specific data on manure characteristics: organic matter (OM) and maximum methane-producing potential (B_0), manure management system conditions (storage temperature and period) for liquid manure systems, which determine the methane conversion factor (MCF). Country-specific data on manure characteristics (volatile solids and maximum methane producing potential). Country-specific data on manure management system conditions (storage temperature and period) are also taken into account for liquid manure systems. For the other manure systems (solid manure and manure produced in the meadow), IPCC default values for the methane conversion factor are used. The Netherlands uses a MCF of 1.5% for all animal categories; for manure production in the meadow, it uses the IPCC default MCF value.
Sweden	The B_0i and MCF factors used are the default values in the Good Practice Guidance, except for the revised MCF for liquid manure, where the value of 10 % given by IPCC Guidelines, is adopted as a national value. This value is considered to be a more appropriate for Swedish conditions, firstly because of Sweden's cold climate, and secondly because of the fact that the slurry containers usually have a surface cover.

Member State	Emission Factors and other parameters
United Kingdom	Apart from cattle, lambs and deer, IPCC Tier 1 defaults (IPCC, 1997) are used and do not change from year to year.The emission factors for lambs are assumed to be 40% of that for adult sheep.Emission factors for dairy cattle were calculated from the IPCC Tier 2 procedure. The waste factors used for beef and other cattle are now calculated from the IPCC Tier 2 procedure but do not vary from year to year.

Trends

Shifts in emission factors are partly explained by the increasing milk for dairy cows and by changes in the use of manure management systems. For example, in Denmark, an increasing IEF for dairy cattle results from an increasing milk yield and a shift to liquid manure systems. For pigs, there has been a similar development with a move from solid manure to slurry-based systems. For non-dairy cattle, the opposite development has taken place; an increasing proportion of bull-calves is raised in stables with deep litter, where the MCF is lower than for liquid manure. A similar effect is seen for Finland. The fluctuations underlying the general increase in emissions from 1990-2005 in Finland are related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture. In the Netherlands, liquid manure systems were replaced for poultry by solid manure systems which explain the decreasing emissions for poultry.

Figure 6.13 through Figure 6.23 show the trend of the development of animal productivity in terms of volatile solid excretion for dairy and non-dairy cattle and swine, and the IEF for CH_4 emissions from manure management. These figures show how the different development of the animal sectors in the various countries affects the average characteristics at EC level. Spain is the country with the largest increase in the Swine population and also the country which estimates the highest estimated volatile solid excretion rate. Thus the trend observed at EU-15 level (steepest increase in volatile solid excretion) can entirely be explained by a shift of the weight towards Spanish conditions.

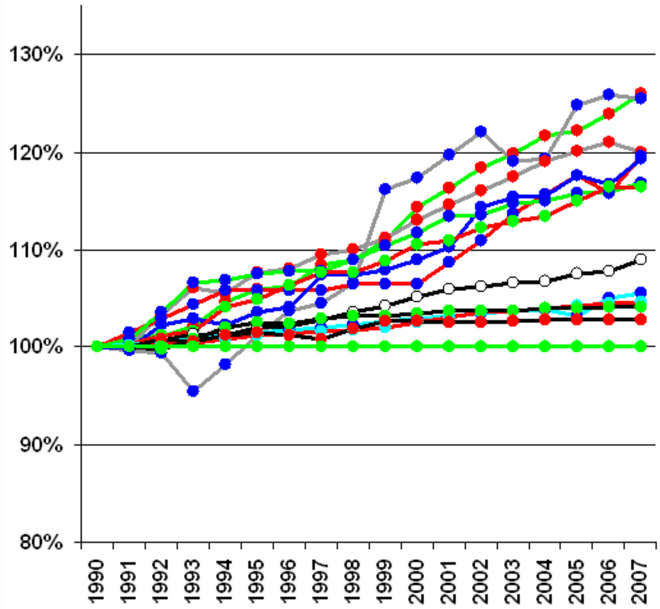
Table 6.22 gives additional information on the trend in category 4B(a) as reported in the national inventory reports.

Table 6.38: Member State's background information on the trend for CH_4 emissions in category 4.A.

Member State	Trend in category 4B(a)
Denmark	The emission from manure management has increased due to a change towards greater use of slurry-based stable systems, which have a higher emission factor than systems with solid manure. By coincidence, the decrease and the increase almost balance each other out and the total CH_4 emission from 1990 to 2007 has decreased by 5%. For pigs, there has been a similar development as for dairy cattle with a move from solid manure to slurry-based systems. Updated stable type data for 2007 shows fewer animals on slurry systems than previous estimated by the expert judgement from the Danish Agricultural Advisory Centre.
Finland	Methane emissions from manure management have been fluctuating during 1990-2007 but overall there is an increase of 23% in the emissions since 1990. This is due to an increase in the number of animals kept in a slurry-based system. This is due to an increase in the number of animals kept in a slurry-based system. The fluctuation in the emissions is related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of the manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared with solid storage or pasture.
Germany	A reduction of the CH_4 emissions during the time period observed in Germany can be explained by the reduction of animal numbers after the German reunification. There is some inconsistency in the time series of animal numbers due to the modification of the "Agrarstatistikgesetzes" with a rupture between 1998 and 1999. This applies particularly to sheep and horses, for both animal categories an approach for correction has been developed and applied.
Ireland	A decrease of the IEF for non-dairy catte between 2005 and 2006 (by 5%) is explained by the strong increase of recovery of biogas from the animal waste storage for energy purposes in 2006.
Spain	The interannual increase of CH_4 emissions for Swine 2005/2006 by 11% is due to several factors: a) an increse of 5% in the numbers of animals that superimposes to an increase in the per animal weight, and b) to an increase of the annual average temperatures (based on annual meteorological - not climatic - data for temperature).

Figure 6.13: Trend of volatile solid excretion for dairy cattle

Dairy cattle: Volatide solid excretion (kg dm/head/year)



	1990	Trend (%) 1990-2007	2007
Finland	3.7	126%	4.6
Portugal	4.8	125%	6.0
Luxembourg	4.5	120%	5.5
Denmark	4.1	119%	4.9
United Kingdom	3.0	119%	3.5
Germany	2.7	117%	3.1
Belgium	3.1	116%	3.6
EU-15	3.9	109%	4.3
Ireland	2.8	106%	2.9
Austria	4.0	105%	4.2
Sweden	5.1	104%	5.3
Spain	3.3	103%	3.4
Italy	6.4	100%	6.4
France	5.1	100%	5.1
Greece			
Netherlands			

Figure 6.14: Trend of volatile solid excretion for non-dairy cattle

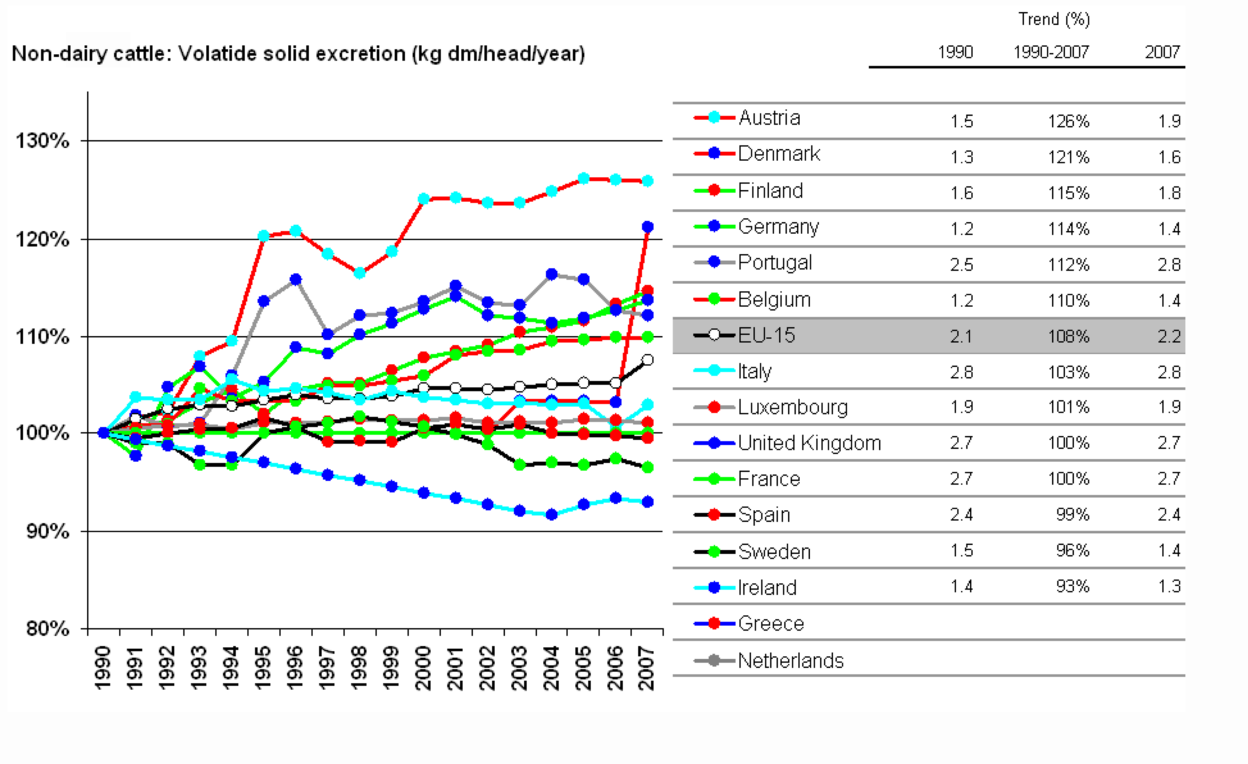


Figure 6.15: Trend of volatile solid excretion for swine

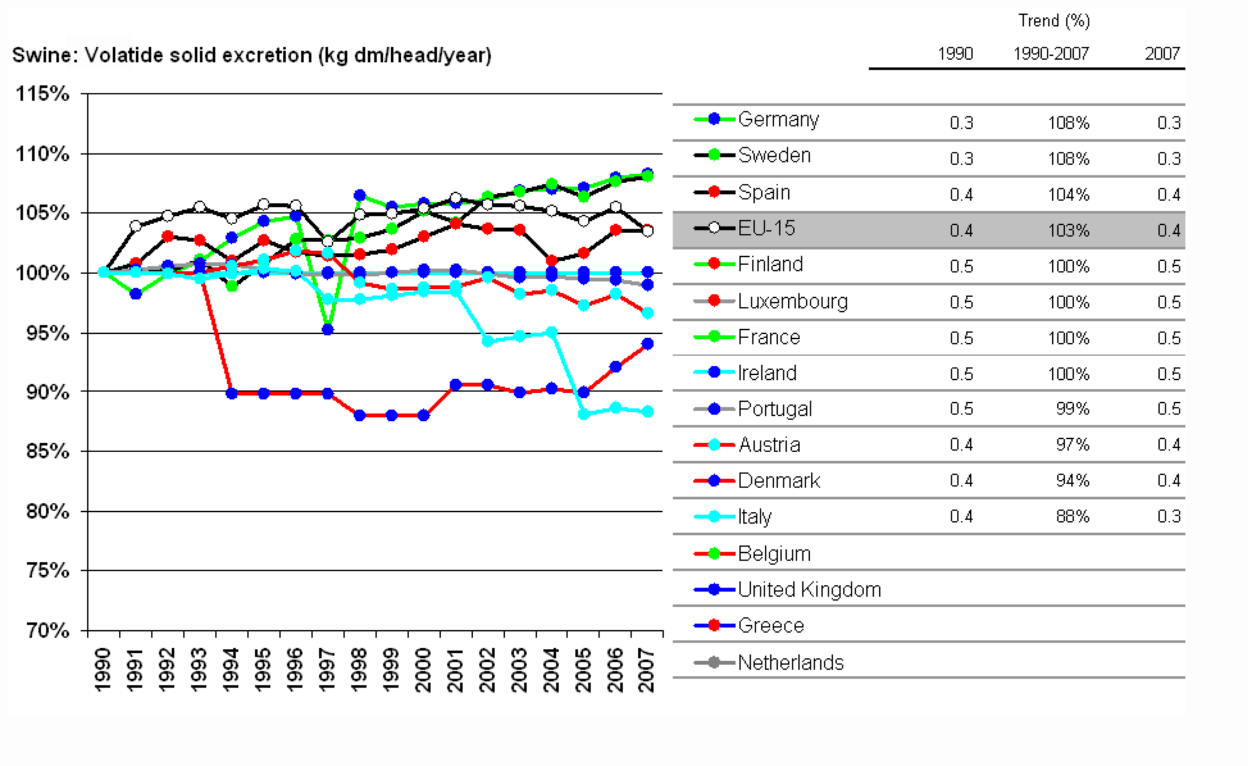
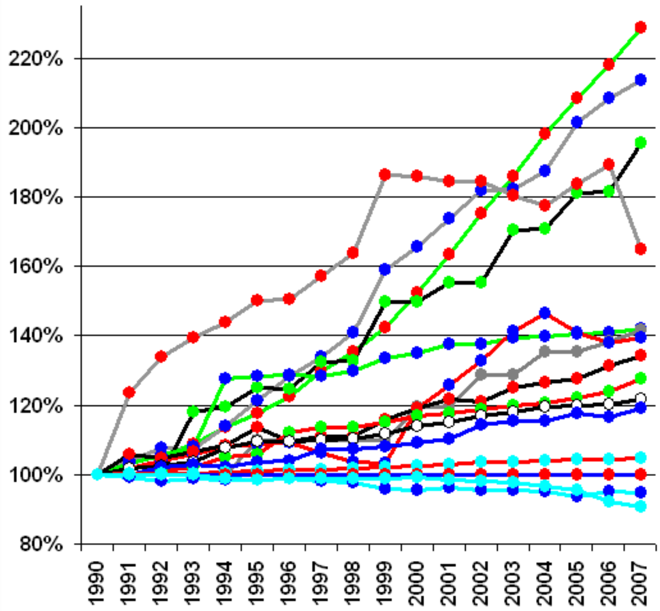


Figure 6.16: Trend of IEF for CH_4 emissions from category 4B(a) for dairy cattle

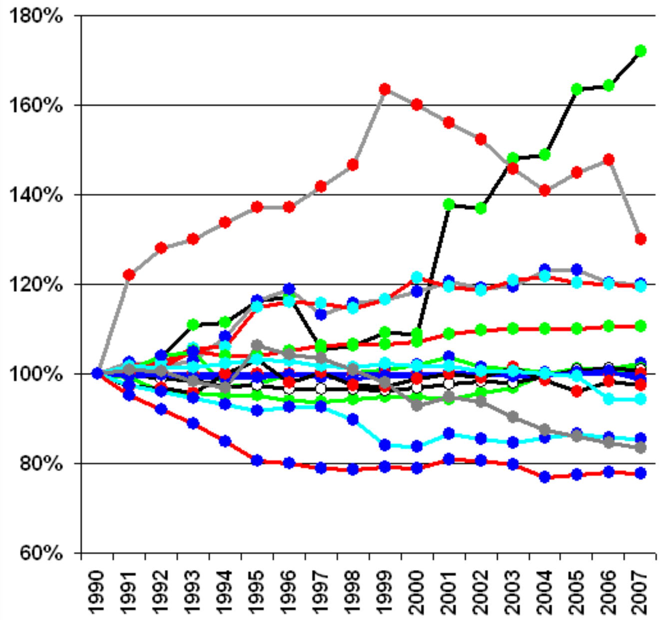
Dairy cattle: CH4 from manure management (kg dm/head/day)



	1990	Trend (%) 1990-2007	2007
Finland	6.4	229%	14.6
Portugal	2.3	213%	4.9
Sweden	10.0	195%	19.5
Luxembourg	26.0	165%	42.8
Germany	13.8	142%	19.6
Netherlands	27.7	141%	39.2
Denmark	13.5	139%	18.8
Spain	11.4	134%	15.3
Belgium	12.3	128%	15.7
EU-15	16.8	122%	20.4
United Kingdom	21.6	119%	25.8
Austria	19.5	105%	20.4
France	18.3	100%	18.3
Greece	19.0	100%	19.0
Ireland	21.7	95%	20.6
Italy	15.0	91%	13.6

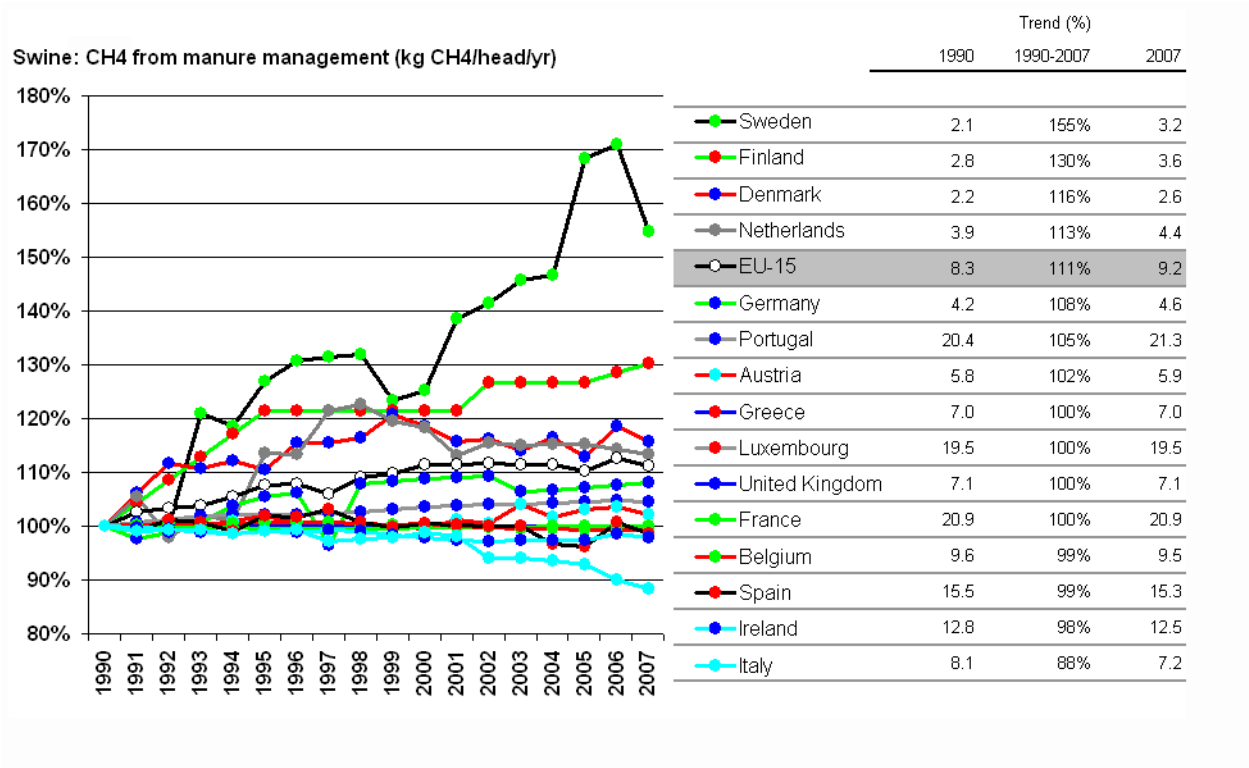
Figure 6.17: Trend of IEF for CH_4 emissions from category 4B(a) for non-dairy cattle

Non-dairy cattle: CH4 from manure management (kg dm/head/day)



	1990	Trend (%) 1990-2007	2007
Sweden	3.9	172%	6.6
Luxembourg	6.4	130%	8.3
Portugal	1.3	120%	1.6
Austria	6.2	119%	7.4
Belgium	2.4	111%	2.6
Germany	5.6	102%	5.7
France	19.9	101%	20.1
EU-15	9.4	101%	9.5
Greece	13.0	100%	13.0
United Kingdom	4.2	99%	4.2
Spain	1.2	97%	1.2
Italy	7.5	94%	7.0
Ireland	12.9	85%	11.0
Netherlands	7.5	83%	6.2
Denmark	2.2	78%	1.7
Finland			

Figure 6.18: Trend of IEF for CH_4 emissions from category 4B(a) for swine



6.3.2.3 Uncertainty and time series consistency

As for enteric fermentation, the activity data in the category 4B(a) are considered to be relatively certain with uncertainty estimates around 10% for most countries. Highest uncertainty for the activity data are estimated by Italy and Sweden (20%). Portugal assigns a high uncertainty to the population data of several animal types.

The uncertainty estimate for the emission factors is higher and ranges between 11% (Spain) and 100%.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.39 and Table 6.40. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in 6.4. Table 6.41 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from manure management. The table lists only information on activity-data uncertainty that is not covered in category 4A.

Table 6.39: Relative uncertainty estimates for activity data in category 4B(a)

Member State 2006	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		10.0									10.0		
Belgium	10.0												
Denmark	10.0												
Finland	0.0												
France	2.5												
Germany			0.0	0.0	0.0						0.0		
Greece	5.0												
Ireland			1.0	1.0									1.0
Italy	20.0												
Luxembourg													
Netherlands		10.0							10.0		10.0	10.0	
Portugal			6.1	6.5		19.1	19.1		71.2	271.8	11.0	41.1	770.6
Spain	2.0												
Sweden	20.0												
United Kingdom	10.0												

Table 6.40: Relative uncertainty estimates for implied emission factors in category 4B(a)

Member State 2006	Total	Cattle	Dairy Cattle	Non-Dairy Cattle	Buffalo	Sheep	Goats	Camels and Llamas	Horses	Mules and Asses	Swine	Poultry	Other
Austria		70.0									70.0		
Belgium	40.0												
Denmark	100.0												
Finland	15.9												
France	83.4												
Germany			20.0	15.0	14.8						16.5		
Greece	50.0												
Ireland			15.0	15.0									30.0
Italy	100.0												
Luxembourg													
Netherlands		100.0							100.0		100.0	100.0	
Portugal			60.6	46.8		59.3	58.4		61.0	61.0	91.0	66.0	66.0
Spain	11.0												
Sweden	50.0												
United Kingdom	30.0												

Table 6.41: Member State's background information for uncertainty estimates in category 4.B(a)

Member State	Background information to uncertainy estimates
Austria	Emission Factor: Based on the identical animal numbers, uncertainties of emission factors for CH_4 from manure were assessed at 70% (AMON et al. 2002), and for N_2O emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000.
Belgium	Activity Data: The activity data are the livestock census, but also the type of animal housing. The type of housing is more difficult to assess than the number of animals. Consequently the uncertainty on the activity data is estimated at 10 %. Emission Factor: The CH_4 emission factors are based on a regional-specific study. However, given that many assumptions were necessary to calculate these emission factors, the uncertainty on these emission factors is estimated to be similar to the uncertainty on enteric fermentation emission factor.
Denmark	Emission Factor: The emission factor for CH_4 from manure management is 10%. This figure may be underestimated and the uncertainty is, therefore, increased to 100 % until further investigations reveal new data.
Finland	Emission Factor: The uncertainty estimate of the CH_4 emission factor for manure management for all species (±30%) was based on uncertainty estimates of other countries, i.e. Norway, the Netherlands, the USA (Rypdal & Winiwarter 2001) and the UK (Charles et al. 1998), complemented with expert judgement.
Germany	Emission Factor: 30 % for emission factors for CH_4 and NH_3. The errors for the other emission factors are not known. Figures for N_2O, NO and N2 are taken from IPCC (2006).
Netherlands	Activity Data: The uncertainty in the annual CH_4 and N_2O emissions from manure management from cattle and swine is estimated to be approximately 100%. The uncertainty in the amount of animal manure (10%) is based on a 5% uncertainty in animal numbers and a 5–10% uncertainty in excretion per animal. The resulting uncertainty of 7–11% was rounded off to 10%. Emission Factor: The uncertainty in the CH_4 emission factors for Manure management, based on the judgments of experts, is estimated to be 100% (Olivier et al.,2009). Of the three factors that together make up the emission factor (emission per amount of manure), MCF (Methane Conversion Factor) is the most uncertain. The factor captures for instance assumptions on temperature (temperature is important to the rate of methane production) on technology of manure systems (e.g., sometimes methane (biogas) is col-lected and used) and on the actual management (e.g. whether a tank is directly cleaned after its use). The microbiology of methane formation itself is relatively well known. Most of the uncertainty is created by the assumptions about 'average' manure manage-ment (Olsthoorn and Pielaat, 2003)
Portugal	Activity Data: Territorial units under each climate class could easily change as much as 30% in either direction, value that was assumed as representative of uncertainty for this factor. Emission Factor: Uncertainty for the quantity excreted, VS parameter, was set at 20%, considering the use of an enhanced livestock characterization. Uncertainty values vary from 10% for horses up to 22% for dairy cows. The uncertainty of the biogas density was assumed not to be determinant of the overall uncertainty value.

6.3.3 Manure Management N_2O (CRF source category 4.B(b))

6.3.3.1 Source category description

During storage and management of manure, N_2O can be produced and emitted to the atmosphere. In accordance with the IPCC guidelines, the term 'manure' is used collectively to include both dung and urine (i.e., the solids and the liquids) produced by livestock. As for methane emissions, source category 4.B(b) excludes emissions that originate from burning of manure. Also excluded are emissions from manure deposited on pastures by grazing animals, which are reported under category 4.D2.

Direct N_2O emissions occur via combined nitrification and denitrification of nitrogen contained in the manure and depends on the availability of nitrogen and carbon. As nitrification requires the presence of oxygen, N_2O emissions are favored by aerobic conditions, which are favored in solid manure storage and treatment systems. Denitrification is an anaerobic process and yields molecular nitrogen next to N_2O. Under conditions of reduced moisture, high nitrate concentrations and acid medium, the emissions of N_2O relative to N_2 increase. Losses of other forms of nitrogen (NH_3, NO_x) are possible and will potentially lead to N_2O emissions once they re-deposit on the surface. These 'indirect' N_2O emissions are reported in source category 4.D3.

Generally, GHG emissions (in CO_2-equivalents) from manure management are predominantly as CH_4 rather than as N_2O. At the EU-15 level, this ratio is at about a factor of 3.1, ranging from 0.9 (Finland) to 8.4 (Ireland). Values close or smaller to unity are found for example for Italy (1.2).

The differences of the ratio across the countries can partly be explained by the implied emission factor used for CH_4 emissions in the manure management category (see discussion above), and partly by the nitrogen excretion factors. Total nitrogen excretion by Member State and manure management system are given in Table 6.42.

Table 6.42 shows that the implied emission factors used for N_2O emission from manure management are IPCC default for all countries are close to the default value and that only small changes in the IEF occurred in the time between 1990 and 200 with an -2% increase of the IEF for solid systems and of 3% for liquid systems.

Table 6.42: Total N_2O emissions in category 4B(b) and implied Emission Factor at EU-15 level for the years 1990 and 200

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	1990		
Total Emissions of N_2O [Gg N_2O-N]	0	8	68
Total Nitrogen excreted [Gg N]	16	3024	2534
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.16%	1.72%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2007		
Total Emissions of N_2O [Gg N_2O-N]	0	8	61
Total Nitrogen excreted [Gg N]	16	2844	2224
Implied Emission Factor [kg N_2O-N / kg N]	0.10%	0.17%	1.75%

	Anaerobic lagoon	Liquid systems	Solid storage and dry lots
	2007 value in percent of 1990		
Total Emissions of N2O [Gg N2O-N]	99%	97%	89%
Total Nitrogen excreted [Gg N]	99%	94%	88%
Implied Emission Factor [kg N2O-N / kg N]	100%	103%	102%

6.3.3.2 Methodological Issues

Methods

Emissions of nitrous oxide are much higher from solid storage systems than from liquid systems; the percentage of emissions from solid storage systems thus varies between 72% in Sweden and 97% in Portugal.

Table 6.43 shows the total emissions in category 4B(b), how this is composed and the methodology used for calculating the emissions for cattle and swine by Member States. The table shows also that ‘solid storage’ is a key category for all Member States. Activity Data are the excretion of nitrogen per animal and the distribution over the manure management systems. This is done by most Member States at a higher disaggregation level than categories that are reported in the CRF. The emission factor of N_2O per nitrogen managed in a certain manure management system is usually IPCC default.

The quality of the emission estimates are calculated from the Nex factor for the each manure management system (assigning Tier 1 or Tier 2 when comparing to IPCC default), combined with the MEAN-rule (see section 6.4.1.5, Table 6.90 through Table 6.93) and then further combined with the Tier level of the emission factor for the manure storage system by using the MEDIAN rule with weighting factors for Nex and the IEF being 2/3 and 1/3.

As most countries use country-specific nitrogen excretion rates for most animals but use default emission factors, the Tier level of Tier 1.7 is assigned. The combined uncertainty of both solid, liquid, and other systems (4% of total emissions, for which a Tier 1 was assumed) range between Tier 1.4 and

Tier 2.0. Nitrogen excretion is reported by animal type and not by manure management system in the CRF tables. To assign nevertheless a Tier level for the nitrogen excretion by manure management system, the allocation of animal waste to manure management systems from the calculation of CH_4 emissions from manure management is used.Netherland does not report nitrogen excretion rates and no allocation of animal waste to manure management systems could be done. However, according to the national inventory report, a Tier 2 approach can be assumed for the Nex values.

For EU-15, the overall Tier level is Tier 1.7 (62% of emissions estimated using country-specific information). This value is somewhat lower for solid systems (Tier 1.6) than for liquid systems (Tier 1.7). A compilation of national methodologies for the estimation of nitrogen excretion can be found in Table 6.49; most data are based on country-specific information. This is important if we assess the uncertainty of the EU15 emission estimate: given that nitrogen excretion is largely controlling N_2O emissions from manure management, the error of the estimates of the different countries can be assumed to be largely independent one from another. Only two countries are relying on IPCC default values, i.e. Greece using values reported for the Mediterranean region and France (for dairy cattle) using the value for Western Europe.

Additional background information on the methodology, if available, is summarised in Table 6.44.

Table 6.43: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4B(b), methodology applied (EF) and key source assessment by Member States for the sub-categories solid storage and liquid systems

	Total		Solid Storage			Liquid Systems	
	Gg CO_2-eq	b	a	b	c	a	b
Austria	878	Tier 1.7	96%	Tier 1.7	y	2%	Tier 1.7
Belgium	792	Tier 1.8	93%	Tier 2.0	y	1%	Tier 1.7
Denmark	586	Tier 1.9	86%	Tier 1.7	y	14%	Tier 1.9
Finland	497	Tier 1.4	96%	Tier 1.1	y	4%	Tier 1.4
France	6,015	Tier 1.5	96%	Tier 1.4	y	4%	Tier 1.5
Germany	2,402	Tier 1.8	42%	Tier 2.0	y	58%	Tier 1.7
Greece	294	Tier 1.7	93%	Tier 1.0	y	2%	Tier 1.7
Ireland	384	Tier 1.7	86%	Tier 1.7	y	14%	Tier 1.7
Italy	3,797	Tier 1.7	88%	Tier 1.6	y	4%	Tier 1.7
Luxembourg	26	Tier 2.0	91%	Tier 2.0	y	8%	Tier 2.0
Netherlands	872	Tier 1.7	82%	Tier 1.7	y	18%	Tier 1.7
Portugal	573	Tier 1.7	97%	Tier 1.7	y	1%	Tier 1.7
Spain	2,981	Tier 1.7	96%	Tier 1.7	y	4%	Tier 1.7
Sweden	478	Tier 1.8	72%	Tier 2.0	y	5%	Tier 1.7
United Kingdom	1,684	Tier 1.7	69%	Tier 1.7	y	3%	Tier 1.7
EU-15	**22,258**	**Tier 1.7**	**85%**	**Tier 1.6**	**y**	**10%**	**Tier 1.7**
EU-15: Tier 1	38%		39%			28%	
EU-15: Tier 2	62%		61%			72%	

a Contribution to N_2O emissions from manure management; b Quality level (between Tier 1 and Tier 2); c Source category is key in the Member State's inventory (y/n); nr: not reported

Table 6.44: Member State's background information on the methodology for estimating N_2O emissions in category 4.B(b)

Member State and reference	Methods
Austria	For the estimation of N_2O emissions from manure management systems only a Tier 1 approach is available. Manure management from Solid storage and dry lot is the key source.
Denmark	Emissions from manure management are calculated in with the model DIEMA (Danish Integrated Emission Model for Agriculture, Mikkelsen et al., 2006).
Germany	Emissions of nitrogen compounds from manure management are calculated with the mass-flow approach (EMEP, 2003; Daemmgen et al., 2007). In a first step, both the excretion of total nitrogen and of total ammoniacal nitrogen (TAN) is estimated. Simultaneous NO, N2 and N_2O emissions are calculated on the basis of total nitrogen, but are subtracted from the TAN pool only. The distribution over manure management systems (solid storage and liquid systems) is from (Luettich et al., 2007). Main drivers of the emissions are manure storage system and temperature. Emissions of nitrogen compounds from grazed areas are occurring simultaneously, using IPCC methodologies (Tier 1) for N_2O and NO emission estimates.All calculations are done on the district level using the agricultural model RAUMIS.
Italy	Tier 1 methodology and IPCC default emission factors were used for the management systems. For sheep and goat, a detailed analysis has been carried out with information from ASSONAPA, the National Association for Sheep Farming. For slurry and solid manure production parameters, specifically for the cattle and buffalo category, updated data have been incorporated, according to new country specific data available.
Netherlands	Activity data are collected in compliance with a Tier 2 method. The method used is fully in compliance with the IPCC Good Practice Guidance (IPCC, 2001).
Sweden	The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.
United Kingdom	It is assumed that 20% of the total N emitted by livestock volatilises as NOx and $NH_3$and does not contribute to N_2O emissions. This is because in the absence of a more detailed split of NH_3 losses at the different stages of the manure handling process it has been assumed that NH_3 loss occurs prior to major N_2O losses. Emission estimates are made with 20% smaller Nex factors than those reported in the CRF. The methodology for estimating N_2O from manure management is in accordance with the IPCC Guidelines Tier 2 methodology; it is based on emission factors from the IPCC Guidelines in combination with national activity data.

Activity Data

In EU-15, a total of 8,278 Gg N was managed in manure management systems or excreted on pasture range and paddock in 200. The largest share of this manure-nitrogen was excreted by grazing animals, followed by manure managed in liquid and solid storage systems. Compared with 1990, this was a decrease of manure-nitrogen by 9%. The largest decrease of nitrogen managed occurred for the solid storage and dry lot systems, which in 200 wasless than in 1990. The decrease of nitrogen was particularly pronounced in the Netherlands, where total nitrogen decreased by 31%. At the same time, the manure managed on solid storage systems increased by 19% indicating a strong shift from pasture to solid systems in the Netherlands. This is a consequence of the increase of the time period dairy cattle are kept indoors. Firstly this is done to increase cost-effectiveness of milk production and secondly to increase the efficiency of manure application as an effect of Dutch manure-policy.

The nitrogen managed in the various manure management systems in 200 is given in Table 6.45. Background information on the allocation to manure management systems is given in Table 6.31. Nitrogen excretion data per head will be discussed below.

Table 6.45: Member State's nitrogen managed in the manure managed systems anaerobic lagoon, liquid systems, daily spread, and other systems, manure excreted on pasture range and paddock, and total nitrogen excreted in 2007

Member State 2007	Anaerobic lagoon	Liquid systems	Daily Spread	Solid storage and dry lot	Other	Pasture range paddock	Total
Austria		42		86	7	23	158
Belgium		16	2	78	85	80	261
Denmark		202		52		23	277
Finland		43		48		23	114
France		483		593		764	1,840
Germany		889		378		182	1,449
Greece		13	1	28	6	347	395
Ireland		111		34		275	419
Italy		326		343	30	161	860
Luxembourg		4		2	1	6	13
Netherlands		325		73		81	480
Portugal	16	14		57		77	165
Spain		237	17	294		341	889
Sw eden		47		35	11	42	136
United Kingdor		92	112	120	60	438	822
EU-15	16	2,844	132	2,224	199	2,862	8,278

Information source: CRF Table 4.B(b) for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

As all countries are using IPCC default values for the IEF or values that are close to it (with the exception of the IEFs for solid storage used by Germany and f6r liquid systems by Denmark and Germany), these numbers apply also for the EC N_2O inventory for manure management. An overview of the implied emission factors is given in Table 6.46.

Table 6.46: Implied Emission factors for N_2O emissions from manure management used in Member State's inventory in 2007

Member State	Implied EF (kg N_2O-N / kg N)			
2007	Anaerobic lagoon	Liquid system	Solid storage and dry lot	Other
Austria	NO	0.10%	2.0%	0.5%
Belgium	NO	0.12%	1.9%	0.1%
Denmark	NO	0.08%	2.0%	NO
Finland	NO	0.10%	2.0%	NE
France	NA	0.10%	2.0%	NA
Germany	NO	0.32%	0.5%	NO
Greece	NA	0.10%	2.0%	0.5%
Ireland	NO	0.10%	2.0%	NO
Italy	NO	0.10%	2.0%	2.0%
Luxembourg	NO	0.10%	2.0%	0.1%
Netherlands	NO	0.10%	2.0%	NO
Portugal	0.10%	0.10%	2.0%	NO
Spain	NO	0.10%	2.0%	NO
Sw eden		0.10%	2.0%	2.0%
United Kingdom	NO	0.10%	2.0%	1.6%
EU-15	0.10%	0.17%	1.7%	1.0%

Information source: CRF Table 4.B(b) for 2007, submitted in 2009
Abbreviations explained in the Chapter 'Units and abbreviations'.

An important parameter in the calculation of N_2O emissions from manure management is nitrogen excretion rate per head and year, which is given in Table 6.47 for EU15-countries and the main animal types. The table shows a range by a factor of up to 2 between the highest and the lowest value used is found. For example, for dairy cattle, we have a range from about 70 kg N head^{-1} y^{-1} from 67 for Spain and 138 kg N head^{-1} y^{-1} for Denmark. Vary large ranges are found for non-dairy cattle with values between 42 (Sweden) and 65 kg N head^{-1} y^{-1} (Ireland) and sheep with values between 5.1 kg N head^{-1} y^{-1} (Spain) and 18.3 kg N head^{-1} y^{-1} (France).

Additional information on the development of the emission factor is available for some Member States and is summarized in Table 6.48. Additional background information on the calculation of nitrogen excretion rates are summarised in Table 6.49.

Table 6.47: Total Nitrogen excretion by AWMS [Gg N] for dairy and non-dairy cattle, sheep, swine, and poultry in 200

Member State 2007	Dairy	Non-Dairy	Sheep	Swine	Poultry
Austria	96.5	45.9	13.1	14.1	0.5
Belgium	113.0	60.1	7.4	11.7	0.5
Denmark	137.6	44.9	16.9	9.0	0.6
Finland	121.9	47.8	9.0	18.7	0.6
France	100.0	57.3	18.3	16.4	0.6
Germany	123.7	50.3	7.4	13.2	0.7
Greece	70.0	50.0	12.0	16.0	0.6
Ireland	85.0	65.0	6.0	8.4	0.3
Italy	116.0	49.8	16.2	11.7	0.5
Luxembourg	102.0	46.8	17.0	11.6	0.6
Netherlands	NA	NA	NA	NA	NA
Portugal	87.6	48.1	8.0	7.9	0.8
Spain	67.5	52.5	5.1	9.4	0.7
Sweden	126.0	41.7	6.2	9.1	0.4
United Kingdom	111.8	48.9	5.3	11.2	0.5
EU-15	109.6	50.5	7.9	11.1	0.6

Information source: CRF Table 4.B(b) for 2007, submitted in 2009
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.48: Member State's background information on the emission factor for calculation of N_2O emissions in category 4.B(b)

Member State	Emission Factors
Denmark	IEF for "Solid Storage and dry lot" is a weighted value: 0.005 for poultry manure without bedding and 0.02. Other manure default. Effects from biogas-treated slurry are included in the N_2O emissions.
Italy	Liquid system, solid storage and other management systems (chicken-dung drying process system since 1995 when it became widespread in poultry breeding) have been considered according to their significance and major application in Italy.
Sweden	Default values from the IPCC Guidelines.IEFs may change over the years, depending on the relative size of the respective subgroups aggregated.
United Kingdom	The assigning of manure 'stored in house' manure to 'daily spread' is acceptable only if emissions from the housing phase are thought to be very small.For farmyard manure, storage capacity within the house or yard might comprise between 7 weeks - 12 months (poultry) or several months (cattle) (Smith, 2002, pers. comm.). Calculations were performed with the N_2O Inventory of Farmed Livestock to compare housing and storage phases (Sneath et al. 1997).For pigs and poultry, the emission factor for housing is the same as or greater than that of storage.It would therefore lead to significant underestimation to use the daily spread emission factor.The FYM in this case has therefore been re-allocated to SSD or 'other' as appropriate. For dairy and non-dairy cattle, the emission factor for the housing phase is around 10% of the storage phase, so the non-stored FYM has been split between SSD and DS to account for this.

Table 6.49: Member State's background information for the development of nitrogen excretion rates used in the calculation of N_2O emissions in category 4.B(b)

Member State	Nitrogen excretion rates
Austria	N-excretion data are calculated following the guidelines of the European Commissions according to the requirements of the European Nitrate Directive based on feed rations which are estimated on the basis of field studies on representative grassland and dairy farm areas for cattle and take into consideration the daily gain of weight, nitrogen and energy uptake, efficiency, etc. Similar level of detail for pigs. (Gruber & Poetsch, 2005; Poetsch et al., 2005; Steinwidder & Guggenberger, 2003). Piglets are not considered in N-excretion data separately (included in sows). However, there are included in the population data, which gives rise to an inconsistency in the CRF table.
Belgium	N_2O emissions from manure storage are based on N excretion data estimated through local production factors. In Wallonia, emissions are calculated using the model developed by (Siterem, 2001) also used for CH_4 and NH_3 emissions. It includes emissions from animal husbandry, excreta deposited in buildings and collected as liuid slurry or solid manure, and application of mineral fertilizer and manure nitrogen to land. Such factors were first determined for the implementation of the CE Nitrates Directive 91/676 on http://www.nitrawal.be/pdf/arretenitrates_mb2.pdf, but were representing the nitrogen after deduction of the atmospheric losses, so new factors were calculated on this basis for the purposes of estimating atmospheric emissions. For Flanders, nitrogen excretion factors are from the Manure Bank of the Flamish Land Agency (www.vlm.be) and are based on the regional situation. The nitrogen excretion factors for cattle, horses, sheep, goats and rabbits are used as described in the Manure Action Plans (MAP2bis
Denmark	N-excretion (kg N/head/yr) is weighted values from the following categorisation: Non-dairy cattle: Calves, Bulls, Heifers and Suckling Cattle, Sheeps, Goats, Swine: Piglets, Slaugthering pigs, Fur animals, Poultry: Broilers, Hens, Ducks, etc.The variations in N-excretion in the time-series reflect changes in feed intake, fodder efficiency and allocation of subcategories. The Danish N-excretion levels are generally lower than IPCC default values. This is due to the highly skilled, professional and trained farmers in Denmark, with access to a highly competent advisory system.
Finland	Annual N excretion per animal for cattle, sheep, swine, horses, poultry and fur animals has been calculated by animal nutrition experts of MTT Agrifood Research Finland (Nousiainen, J. pers.comm.). Values for annual N excretion (Nex) are based on calculations on N intake-N retention for typical animal species in typical forage system. Annual nitrogen excretion per animal and in the case when animals are kept less than one year in farms (swine, poultry), replacement of animals with new ones has been taken account in the calculations. For reindeer, values for goats have been used.N-excretion for Fur animals is average of two sub-categories: Minks and Fitches and Fox and Racoon.
Germany	Dairy cattle: N-excretion factors are calculated on the basis of milk productivity, protein content of teh milk, the weight, number of births and the composition of the rations. Swine and hens: N-excretion is calculated on the basis of productivity (number of births or weight gain), the weight and the feed composition. For Dairy cattle and national data for other animals. Country-specific data for other animal categories. Values for the content of total ammoniacal nitrogan (TAN) were estimated for Cattle, Swine, Sheep, Horses, and Poultry. Other parameter required for the estimation of N_2O emission (the effective surface area, the ventilation conditions and the temperature during storage) are not available.
Greece	IPCC default N excretion values referring to Mediterranean countries were chosen.
Ireland	For Cattle, the excretion rates are consistent with the nitrogen content of Cattle feeds and the quantities excreted by the animal, as analysed in conjunction with the determination of Tier 2 CH_4 emission factors for Cattle.The published nitrogen excretion rates are used along with the information on the allocation of animal manures to each applicable animal waste management system from the Farm Fatility Survey. The nitrogen excretion rates of 92.5 and 50 kg/N for Dairy Cattle and Other Cattle, respectively, taken from the REPS survey data are close to the upper end of the range reported for typical Irish farming systems (Mulligan, 2002; Hynds, 1994). These findings indicate that Dairy Cows producing 4,200, 5,600 and 7,000 kg of milk per year in Ireland excrete 82, 89 and 96 kg N, respectively while excretion rates for beef cattle are highly variable and range from 27 kg N to 69 kg N per year depending on performance level and age. The IPCC default nitrogen excretion rates of 8, 12 and 0.6 kg are used for S
Italy	Country-specific N-excretion data (Inter-regional nitrogen balance project results, CRPA, 2006; Xiccato et al., 2005). The nitrogen balance project involved Emilia Romagna, Lombardia, Piemonte and Veneto regions, where animal breeding is concentrated. The nitrogen balance methodology was followed, as suggested by IPCC. N-excretion rates are time-dependent for cattle, buffalo, and pigs.
Luxembourg	The nitrogen excretion per AWMS cannot be calculated since the nitrogen excretion per head of animal is not yet estimated for Luxembourg. The default factors suggested for Western Europe in the IPCC Guidelines have to be further investigated to decide whether or not they might be applied to Luxembourg's situation as regards manure management of animals.
Netherlands	Standard factors for manure production and manure N-excretion per animal per animal category and per manure management system are calculated by Netherlands Statistics and decided on by WUM (Working group for Uniform calculations on Manure- and minerals) annually, based on specific data such as milk yield. More specified data on manure management are based on statistical information on management systems and is documented (Van der Hoek, 2006). http://www.greenhousegases.nl/documents/4B_N2O_manure.pdf
Portugal	Country-specific nitrogen excretion factors (Ministry of Agriuclture). The nitrogen excretion rates reflect the analysis results obtained in the Laboratory Rebelo da Silva, complement with international sources

Member State	Nitrogen excretion rates
	such as (Ryser, 1994) and data submitted by other countries. These rates are considered more representative of the national conditions than those that were formely submitted and which was set from information received from the Agriculture Ministry (Seixas, 2000). The nitrogen rates are presented in next table together with the default nitrogen excretion rates from IPCC for Western Europe. There is an acceptable agreement between country-specific values and IPCC defaults for all species other than Sheep, Goats and Equines.
Spain	IPCC methodology using Nex fraction of the "Near East & Mediterranean" climate region and applying age-related correction factors.
Sweden	The Swedish Board of Agriculture publishes data on manure production from most of the aniumal subgroups included in the inventory. The given values are according to the STANK model, which is the official model for input/output accounting on farm level (Linder, 2001). They are a function e. g. of milk productivity for dairy cattle, age and number of production cycles for pigs etc.
United Kingdom	Nitrogen excretion factors for dairy cattle take into account the animal weight.

Trends

The decreases in N_2O emissions of 9% (total; 3% in liquid systems and 11% for solid systems) are mainly due to decreases in nitrogen excretion. For liquid systems, the implied emission factor increases (a decrease by 16% are estimated for Denmark and an increase for Germany by 8%); so that the decrease in N_2O emissions is buffered. For solid systems, a dynamic IEF has been reported for Denmark which report an increase of the IEF by 2%, and for Belgium (-2%), Denmark (+2%) and Germany (-10%). In all other countries, the IEF is not time-dependent.

Figure 6.19 through Figure 6.25 show the trend of the nitrogen excretion rate per head and the nitrogen managed in solid storage and dry lot systems. The trend in emissions is driven by animal numbers, animal performance (nitrogen excretion) and the distribution of manure over the manure management systems, which have discussed above. The effect of the AWMS is contrary to that observed for the methane emissions.

The category “other“ animal waste management systems for Italy is reported for the years 1995 onwards only in the Italian inventory. This nitrogen excretion refers to poultry manure that is undergoing a drying-process. This system has been widely used from 1995 (CRPA, 2000).

Nitrogen excretion for buffalo is reported for Germany (buffalo are occurring from 1996 onwards), Italy and Greece only. While Greece and Germany use a constant excretion factor of 50.0 and 82.0 kg N head^{-1} year^{-1}, respectively, the N excretion of buffalo varies significantly in Italy with values between 92 and 107 kg N head^{-1} year^{-1}. The N-excretion values result from the weighted average of cow buffalo and other buffaloes and the variability is due to the interannual variation of the proportion of the two livestock number as published by the National Institute of statistics. Cow buffaloes have a higher N excretion, comparable with dairy cows, because they are prevalently breeded for milk production (mozzarelle di bufala).

Table 6.50 gives additional information on the trend in category 4B(b) as reported in the national inventory reports.

Table 6.50: Member State's background information on the trend for N_2O emissions in category 4B(b).

Member State	Trend in category 4B(b)
Austria	Emissions of Cattle dominate the trend. From 1990 to 2007 the N_2O emissions from Manure Management decreased by 12.7% to 2.8 Gg.The reduction of diary cows is partly counterbalanced by an increase in emissions per animal (because of the increasing gross energy intake, milk production and N excretion of diary cattle since 1990).
Denmark	The total amount of nitrogen in manure has decreased by 9% from 1990 to 2007, despite the increasing production of pigs and poultry. This reduction is particularly due to an improvement in fodder efficiency, especially for slaughter pigs.
Finland	Nitrous oxide emissions from manure management have decreased by 25% over the time period 1990-2007. The fluctuation in the emissions is related to both changes in animal numbers, which is largely dependent on agricultural policy, as well as changes in the distribution of manure management systems used. Slurry-based systems increase methane emissions per animal tenfold compared to the solid storage or pasture.
Netherlands	The emissions of N_2O from Manure management increased 7% between 1990 and 2007, from 2.6 to 2.8 Gg N_2O in 2007 (Table 6.1). The relatively large decrease in N_2O emissions of solid manure in 2003 is a direct result of the decrease in poultry animal manure. This decrease was due to the reduction in the number of poultry animals that followed the avian flu epidemic. In 2004 and 2005, N_2O emissions increased once again following the recovery of poultry animal numbers, while in 2006 the emission decreased as a consequence of lower poultry numbers. In 2007 emissions increased as a result ofincreasing animal population and higher N excretion per animal.The slightly increased N_2O emissions from Manure management between 1990 and 2007 are explained by an increase in a higher IEF partly counteracted by a decrease in N excretion in the stable.
Sweden	The N_2O emissions have decreased since 1990, mainly because of a change from solid manure management to slurry management in dairy and pork production. Due to more intense Swine production, the values for Sows and Pigs for meat production were updated in 2001.

Figure 6.19: Trend of nitrogen excretion rates for dairy cattle

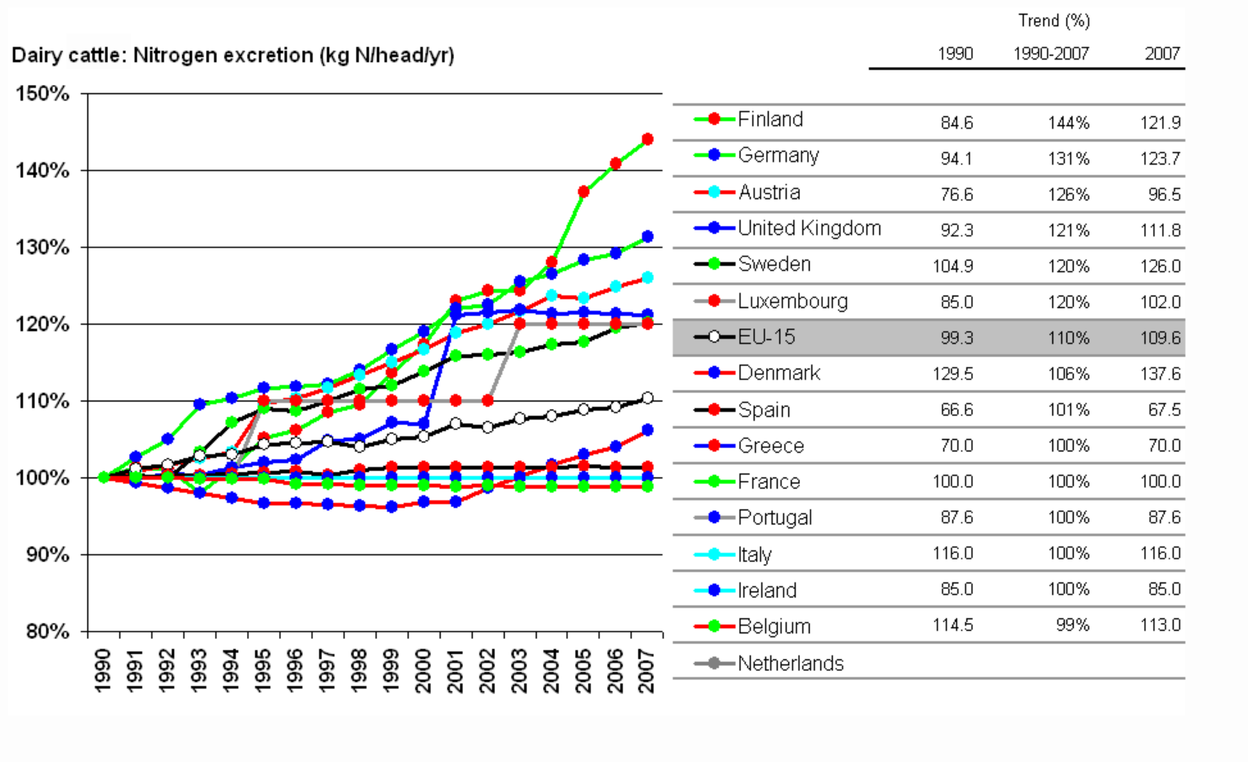
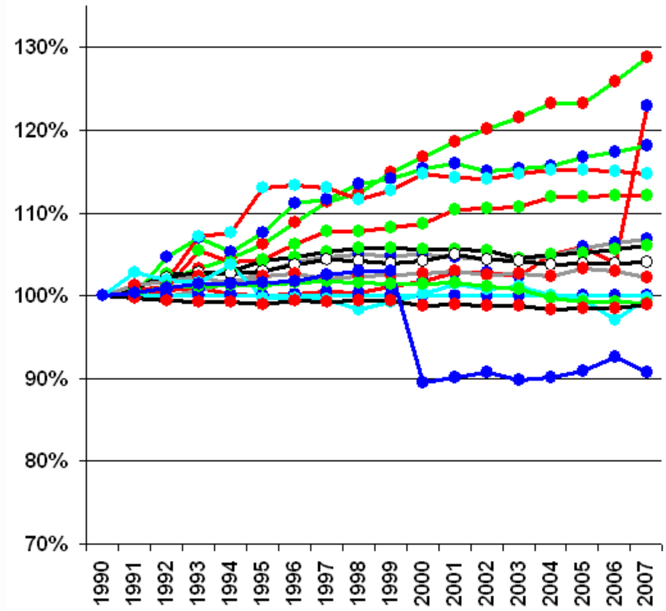


Figure 6.20: Trend of nitrogen excretion rates for non-dairy cattle:

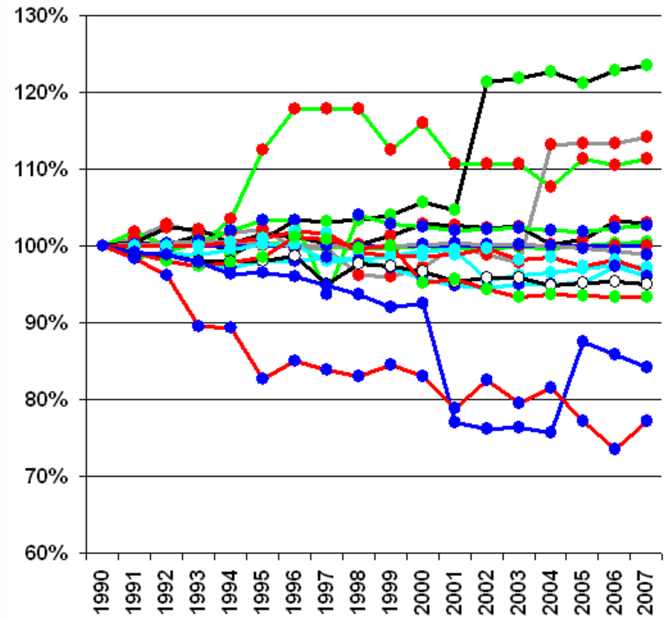
Non-dairy cattle: Nitrogen excretion (kg N/head/yr)



	1990	Trend (%) 1990-2007	2007
Finland	37.1	129%	47.8
Denmark	36.6	123%	44.9
Germany	42.6	118%	50.3
Austria	40.0	115%	45.9
Belgium	53.7	112%	60.1
Portugal	45.0	107%	48.1
Sweden	39.3	106%	41.7
EU-15	48.6	104%	50.5
Luxembourg	45.8	102%	46.8
Greece	50.0	100%	50.0
Ireland	65.0	100%	65.0
Italy	50.0	100%	49.8
France	57.8	99%	57.3
Spain	53.1	99%	52.5
United Kingdom	53.8	91%	48.9
Netherlands			

Figure 6.21: Trend of nitrogen excretion rates for swine

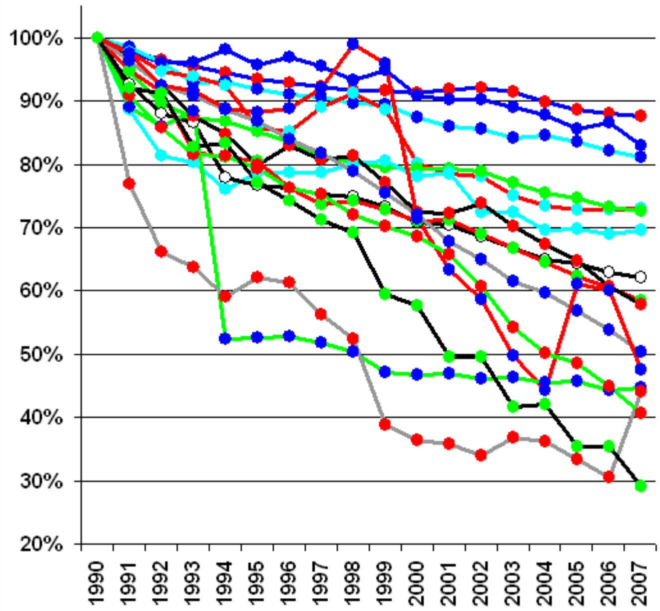
Swine: Nitrogen excretion (kg N/head/yr)



	1990	Trend (%) 1990-2007	2007
Sweden	7.4	123%	9.1
Luxembourg	10.2	114%	11.6
Finland	16.8	111%	18.7
Spain	9.1	103%	9.4
Germany	12.9	103%	13.2
France	16.3	101%	16.4
Greece	16.0	100%	16.0
Portugal	8.0	99%	7.9
Italy	12.0	97%	11.7
Austria	14.6	97%	14.1
Ireland	8.8	96%	8.4
EU-15	11.7	95%	11.1
Belgium	12.5	93%	11.7
United Kingdom	13.3	84%	11.2
Denmark	11.6	77%	9.0
Netherlands			

Figure 6.22: Trend of N managed in solid storage and dry lot, dairy cattle

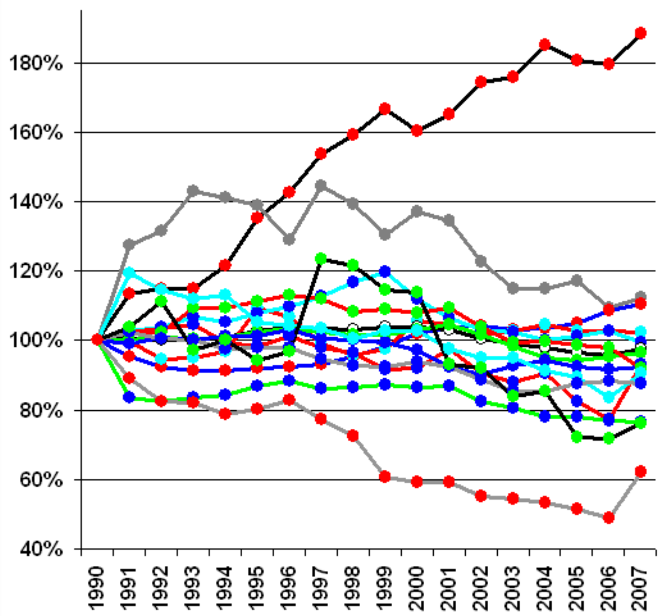
Dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2007	2007
Greece	15.5	88%	13.6
United Kingdom	24.5	83%	20.3
Ireland	3.1	81%	2.5
Austria	48.8	73%	35.6
France	225.1	73%	163.3
Italy	174.9	70%	121.7
EU-15	833.2	62%	517.0
Belgium	27.0	59%	15.8
Spain	64.3	58%	37.2
Portugal	12.1	50%	6.1
Denmark	14.6	48%	7.0
Germany	169.3	45%	75.5
Luxembourg	1.6	44%	0.7
Finland	20.9	41%	8.5
Sweden	31.4	29%	9.1
Netherlands			

Figure 6.23: Trend of N managed in solid storage and dry lot, non-dairy cattle

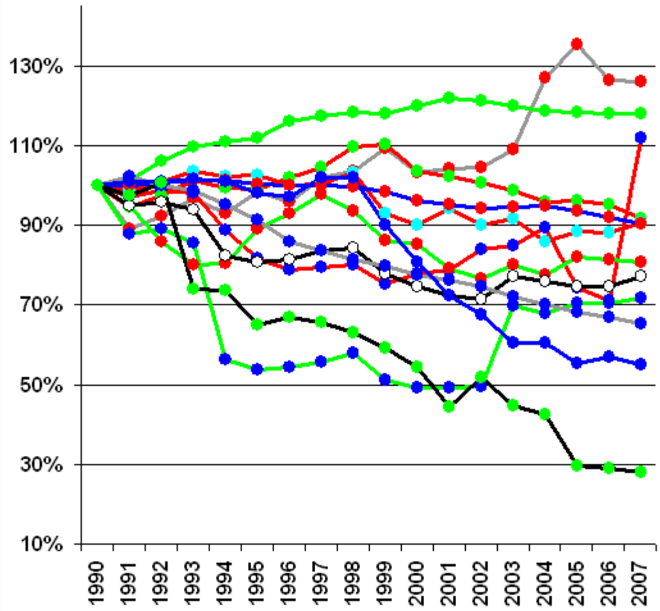
Non-Dairy cattle: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2007	2007
Spain	57.7	188%	108.7
Netherlands	5.1	112%	5.7
Greece	11.8	110%	13.0
Austria	43.0	103%	44.0
Ireland	23.2	99%	23.0
EU-15	851.4	98%	831.1
France	273.5	96%	263.5
Denmark	19.5	93%	18.2
United Kingdom	78.4	92%	72.5
Belgium	47.9	92%	44.1
Italy	101.8	90%	92.1
Portugal	12.9	87%	11.3
Germany	159.3	77%	122.1
Sweden	15.0	76%	11.4
Luxembourg	2.3	62%	1.4
Finland			

Figure 6.24: Trend of N managed in solid storage and dry lot, swine

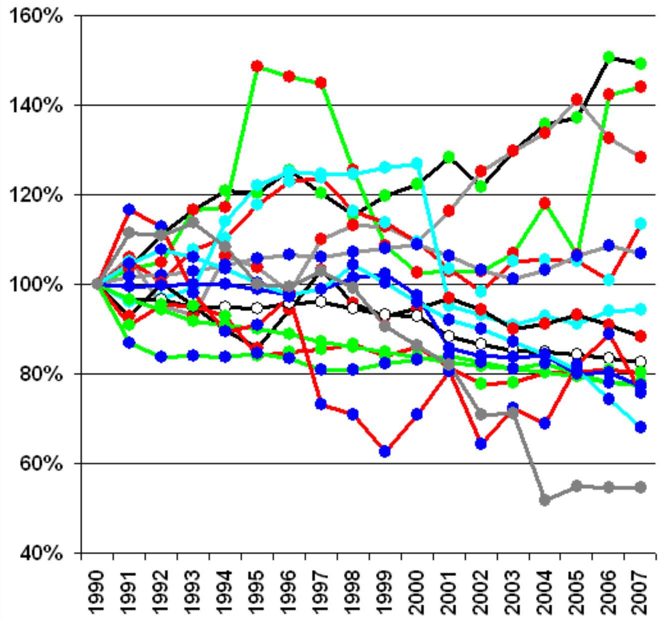
Swine: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2007	2007
Luxembourg	0.0	126%	0.0
France	27.1	118%	32.0
Denmark	12.0	112%	13.4
Belgium	6.4	92%	5.9
Austria	7.1	91%	6.5
Greece	1.6	90%	1.4
Finland	12.8	81%	10.3
EU-15	191.7	77%	147.9
Germany	71.6	72%	51.4
Portugal	0.6	65%	0.4
United Kingdom	43.9	55%	24.1
Sweden	8.6	28%	2.4
Spain			
Netherlands			
Ireland			
Italy			

Figure 6.25: Trend of N managed in solid storage and dry lot, sheep

Sheep: Nitrogen managed in solid storage systems (Gg N/yr)



	1990	Trend (%) 1990-2007	2007
Sweden	1.1	149%	1.6
Finland	0.5	144%	0.7
Luxembourg	0.0	128%	0.1
Austria	0.1	113%	0.1
Portugal	5.1	107%	5.5
Italy	14.2	94%	13.3
Spain	21.5	88%	19.0
EU-15	124.3	83%	102.8
Belgium	0.3	80%	0.2
France	63.0	78%	49.1
Germany	7.2	77%	5.6
United Kingdom	3.7	77%	2.9
Denmark	0.5	76%	0.4
Ireland	4.0	68%	2.8
Netherlands	3.1	54%	1.7
Greece			

6.3.3.3 Uncertainty and time series consistency

Activity data used for the estimation of N_2O emissions from manure management are generally analog to those used for the estimation of CH_4 emissions, and consequently also the uncertainty estimates are similar. The uncertainty of the emission factor is much higher than the uncertainty of the activity data, and only Germany has estimated an uncertainty lower than 50%. Generally an uncertainty of 100% is assumed, the United Kingdom assume high uncertainty with 414%.

Nevertheless, N_2O emissions from manure management are representing only a small fraction in most inventories, so that the contribution to the overall uncertainty remains in most cases small, i. e. 0.5% of total emissions or less. Only Austria and Finland report a higher contribution of N_2O emissions from manure management to the overall uncertainty with 1.2% and 0.9% of total emissions, respectively.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.51. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in Section 6.3.9. Table 6.52 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate N_2O emissions from manure management.

Table 6.51: Relative uncertainty estimates for activity data and implied emission factors in category 4B(b) (data from 2007 submission)

Member State 2006	AD	IEF
Austria	10.0	100.0
Belgium	10.0	90.0
Denmark	10.0	100.0
Finland	0.0	82.0
France	1.1	93.7
Germany		21.9
Greece	50.0	100.0
Ireland	11.2	200.0
Italy	20.0	100.0
Luxembourg		
Netherlands	10.0	100.0
Portugal		100.0
Spain	0.7	100.0
Sw eden	20.0	50.0
United Kingdom	1.0	414.0

Table 6.52: Member State's background information for uncertainty estimates in category 4.B(b)

Member State	Background information to uncertainy estimates
Austria	Emission Factor: Based on the identical animal numbers, uncertainties of emission factors for CH_4 from manure were assessed at 70% (AMON et al. 2002), and for N_2O emissions a lognormal distribution with a low at 50% and a high of 200% of the best estimate was chosen derived from IPCC, 2000.
Belgium	Emission Factor: The IPCC emission factors are used to calculate the emissions of N_2O. Consequently, the IPCC uncertainty in combination with information of the Finnish emission inventory, are used in the uncertainty calculation.
Denmark	Activity Data: The normative figures (Poulsen et al. 2001) are arithmetic means. Based on the feeding plans, the standard deviation in N-excretion rates between farms can be estimated to ±20 % for all animal types (Hanne D. Poulsen, FAS, pers. comm).
Finland	Activity Data: The amount of N excreted annually by the reindeer is very uncertain. Currently, because of lack of data, the value for goats has been used. Emission Factor: The uncertainty estimate for N_2O emissions from manure management used a negatively skewed distribution based on different studies (Amon et al., 2001; Huether, 1999). The uncertainty of the N_2O emission factor could probably be reduced by gathering more national data from gas flux measurements.
Portugal	Activity Data: The uncertainty in N-excretion rate was set at 37.5 per cent, considering an intermediate situation between the uncertainty values recommended by GPG for default N-excretion rates (50 per cent) and the lower uncertainty when country-specific values are based on accurate national statistics (25 per cent). Emission Factor: The uncertainty in N_2O emission factors was set in accordance with the maximum values, 100 per cent for all MMS.

The following issues related to time-series consistency are identified:

- *Italy, N-excretion in the category "Other" in the period 1990-1994*

  The chicken-dung drying process system, which is reported under "other" has been widely used only from 1995 onwards (IT-IR).

- *Denmark, N-excretion for non-dairy cattle and N managed in solid systems*

  The value of N-excretion rate in Denmark is increases from 2006 to 2007 by 18%. This increase in N-excretion is due to an adjustment of N-excretion rate for non-dairy cattle in 2007. The adjustment for the prior years to ensure time-series consistency will follow.

6.3.4 Rice Cultivation

6.3.4.1 Source category description

Anaerobic decomposition of organic material in flooded rice fields produces methane (CH_4), which escapes to the atmosphere primarily by transport through the rice plants. The annual amount emitted from an area of rice acreage is a function of rice cultivar, number and duration of crops grown, soil type and temperature, water management practices, and the use of fertilisers and other organic and inorganic amendments.

Rice cultivation is occurring in five EU-15 countries: France, Greece, Italy, Portugal, and Spain. All countries but Italy are reporting rice production under a continuously flooding regime, while in Italy the practice of multiple aeration is predominant. In Italy rice paddies are flooded with 15-25 cm of water usually from April-May to August. During this field submersion time two or three water drainage periods, 2 to 4 days each, can happen in 85% of rice paddies, a clearly uninterrupted submersion in 13-14% and about one month delayed submersion in 1-2%.

At EU-15 level, the implied emission factors amounts to 23 g m^{-2} in 2003 for continuous flooded rice fields, which represents an increase in the implied emission factor by 25% since 1990 (see Table 6.53), which can be explained by the higher contribution of Portugal with an implied EF of 69.4 g CH_4 m^{-2} in 200 compared to 31.9 g CH_4 m^{-2} in 1990. Note that the implied emission factors for intermittently flooded field are stemming from the Italian inventory only. Here it is smaller than the emissions from continuously flooded fields. At the EU-15 level and with the given choices of emission factors by the different countries, however, the average emission from continuous flooded fields appears to be only half of those from single-aerated rice fields.

Table 6.53: Total CH_4 emissions, area harvested and implied Emission Factor for category 4C at EU-15 level for 2007

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	1990		
Total Emissions of CH4 [Gg CH4]	29.7	0.6	73.8
Total Area harvested [10^9 m^2 y^{-1}]	1.64	0.02	2.13
Implied Emission Factor [g CH4 / m^2]	18	27	35

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2007		
Total Emissions of CH4 [Gg CH4]	40.7	12.9	59.6
Total Area harvested [10^9 m^2 y^{-1}]	1.80	0.53	1.80
Implied Emission Factor [g CH4 / m^2]	23	24	33

	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
	2007 value in percent of 1990		
Total Emissions of CH4 [Gg CH4]	137%	2127%	81%
Total Area harvested [10^9 m^2 y^{-1}]	109%	2359%	84%
Implied Emission Factor [g CH4 / m^2]	125%	90%	96%

6.3.4.2 Methodological Issues

Methods

A summary of the methodologies used for the calculation of CH_4 emissions from rice cultivation is given in Table 6.54. More detailed data are given in the section on the emission factors.

Table 6.54: Additional information in the methodology used for the calculation of CH_4 emissions in category 4.C in 2007

Member State	Method
France	Default EF, non key source, IPCC methodology. Statistic from the Ministry of Agriculture.
Greece	In order to estimate methane emissions from rice cultivation, the default methodology suggested by the IPCC Good Practice Guidance was followed. The cultivated areas provided by the NSSG and the default emission factor (20 g CH_4 / m^2) were used for the emissions calculation. Rice cultivated in Greece is grown in continuously flooded fields without the use of organic amendments and one cropping period is considered annually.
Italy	According to specific characteristics of rice cultivation in Italy, methane emissions from rice cultivation are estimated only for an irrigated regime, other categories suggested by IPCC (rainfed, deep water and “other”) are not present. Methane emission factor has been adjusted with the following parameters: daily integrated emission factor for continuously flooded fields without organic fertilisers, scaling factor to account for the differences in water regime in the rice growing season (SFw), scaling factor to account for the differences in water regime in the preseason status (SFp) and scaling factor which varies for both types and amount of amendment applied (SFo) (Yan et al., 2005). Futher, the following national cirumstances are considered: cultivation period of rice (days) and annual harvested area under specific condictions. In Italy, rice is sown from mid-April to the end of May and harvested from mid-September to the end of October; the only practised system is the controlled flooding system, with variations in water regimes (Tossato and Regis, 2002; Mannini, 2004; Confalonieri and bocchi, 2005; Regione Emilia Romagna, 2005) In Italy, three types of rice cultivation are distinguished: Wet-seeded "classic" cultivation, Wet-seeded "red rice control" cultivation and dry-seeded with delayed flooding. The wet-seeded cultivation methods fall into the IPCC category of 'multiple aeration' while the dry-seeded cultivation method is intermittently aerated one once. A detailed description of the management is given in the national inventory report.
Portugal	Methane emissions from rice production were estimated following the GPG, but simplified because there are no appreciable differentiation in Portugal in what concerns water management regimes or any other conditions that are known to affect emissions from this source sector. Rice cultivated area is available fromannual statistics from National Statistical Institute,
Spain	The rice cultivation is not key source, EFs: IPCC default, methodology default.

Activity Data

Italy is by far the largest producer of rice in Europe, with 2325 km^2 of rice cultivation, followed by Spain with an area of 1065 km^2 (200 data). The other three countries have rice producing areas around 200 km^2, as shown in Table 6.55 for the rice cultivation practices continuously flooded, intermittently flooded with single aeration, and intermittently flooded with multiple aerations.

Table 6.55: Harvested Area Rice in the Member States in 2007 and 1990

Member State	Harvested area in 2005 [10^9 m^2]		
2007	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.22	NO	NO
Greece	0.25	NO	NO
Italy	NO	0.53	1.80
Portugal	0.27	NO	NO
Spain	1.07	NO	NO
EU-15	1.80	0.53	1.80

Member State	Harvested area in 1990 [10^9 m^2]		
1990	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	0.24	NO	NO
Greece	0.16	NO	NO
Italy	NO	0.02	2.13
Portugal	0.34	NO	NO
Spain	0.90	NO	NO
EU-15	1.64	0.02	2.13

Information source: CRF Table 4.C for 2007 and 1990, submitted in 2009
Abbreviations explained in the Chapter 'Units and abbreviations'.

Emission Factors and other parameters

A summary of the implied emission factors used by these countries is given in Table 6.56. France and Greece are using IPCC default emission factors presented in the IPCC *Good Practice Guidance*. This value is the arithmetic mean of the seasonally integrated emission factors presented in Table 4-13 of the IPCC *Guidelines*. In this Table, a value from Schuetz et al (1989) is also presented (36 g m^{-2}, range 17-54 g m^{-2}, representing a seasonally averaged emission factor). In Italy, a daily integrated emission factor for continuously flooded fields without organic fertiliser (Schuetz et al., 1989; Leip et al., 2002) have been adjusted to account for differences for three different cultivation types (see Table 6.54) Spain uses a seasonal emission factor of 12 g m^{-2}, which has been obtained from Table 4-9 of the IPCC *Guidelines* reporting a study carried out in Spain (Seiler et al., 1984); the value used by Portugal in 1990 and 2007 are the above-mentioned value of 36 g m^{-2} measured by Schuetz et al. (1989).

Table 6.56: Implied Emission factors for CH_4 emissions from rice cultivation used in Member State's inventory

Member State 2007	Implied EF (g $CH_4 \cdot m^{-2}$)		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	20.00	NO	NO
Greece	20.00	NO	NO
Italy	NO	24.48	33.16
Portugal	69.4	NO	NO
Spain	12.00	NO	NO
EU-15	22.64	24.48	33.16

Member State 1990	Implied EF (g $CH_4 \cdot m^{-2}$)		
	Continuously Flooded	Intermittently flooded: single aeration	Intermittently flooded: multiple aeration
France	20.00	NO	NO
Greece	20.00	NE	NE
Italy	NO	27.14	34.60
Netherlands	NO	NO	NO
Portugal	31.9	NO	NO
Spain	12.00	NO	NO
EU-15	18.06	27.14	34.60

Information source: CRF Table 4.C for 2007 and 1990, submitted in 2009
Abbreviations explained in the Chapter 'Units and abbreviations'.

Trend

The trend in rice growing areas in these countries is divers: while in Italy, the area cultivated with rice fluctuated since 1990, its level was in 2003 was 8% larger than in 1990. The harvested area in Spain increased from 1990 to 2003 by 31%, but around 1993-1995 rice production was only half of the area in 1990; also Greece increased its rice production since 1990 by 52%. The trend was opposite in France with peaks in rice production during 1993-1995 and in 200 the level was about 10% lower than in 1990. Finally, Portugal saw a decline in rice production, amounting to 20% since 1990.

Figure 6.26: Trend of continuous flooded rice cultivation – area harvested

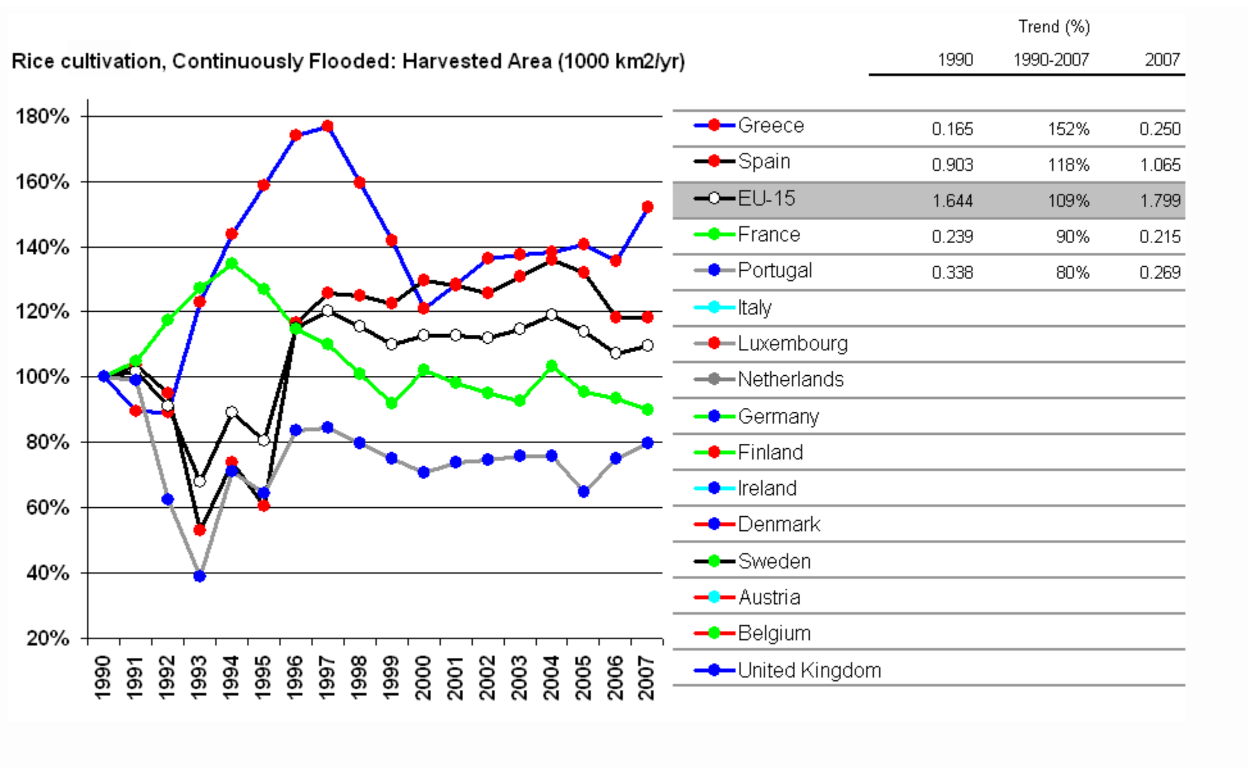


Figure 6.27: Trend of intermittently flooded (single aeration) rice cultivation – area harvested

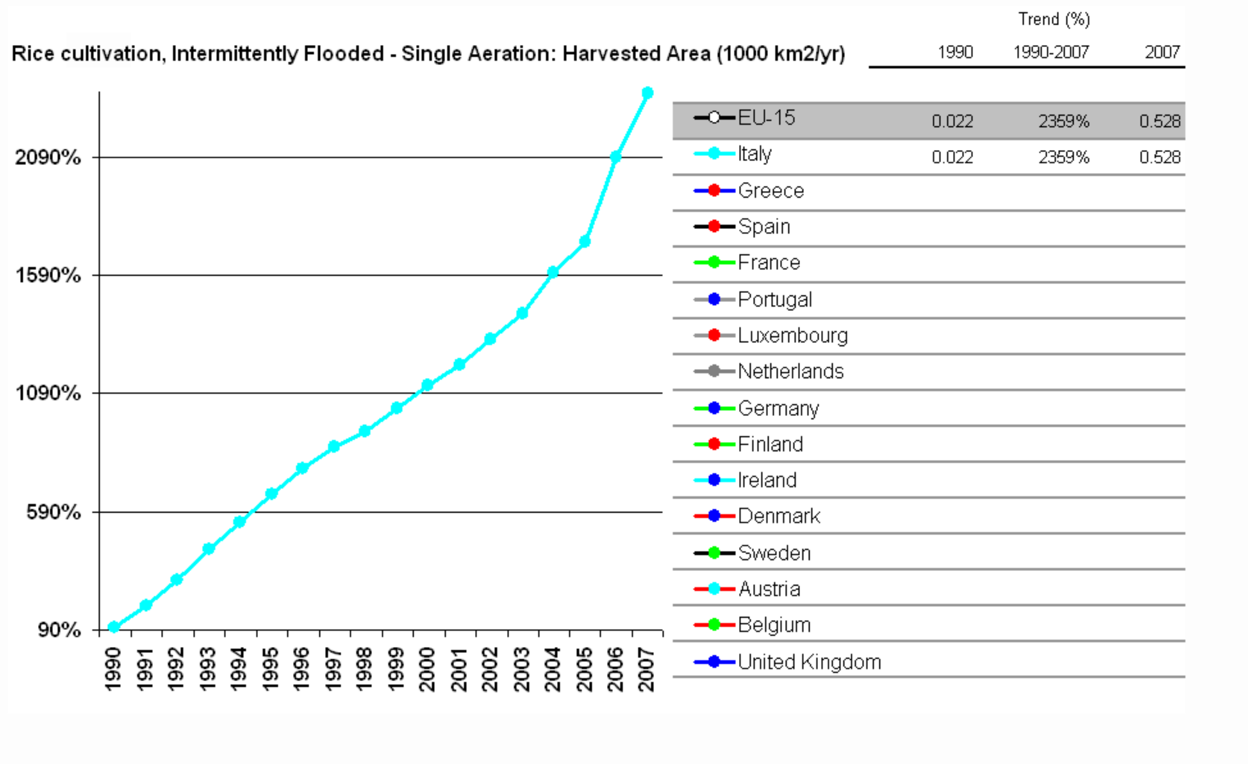


Figure 6.28: Trend of intermittently flooded (multiple aeration) rice cultivation – area harvested

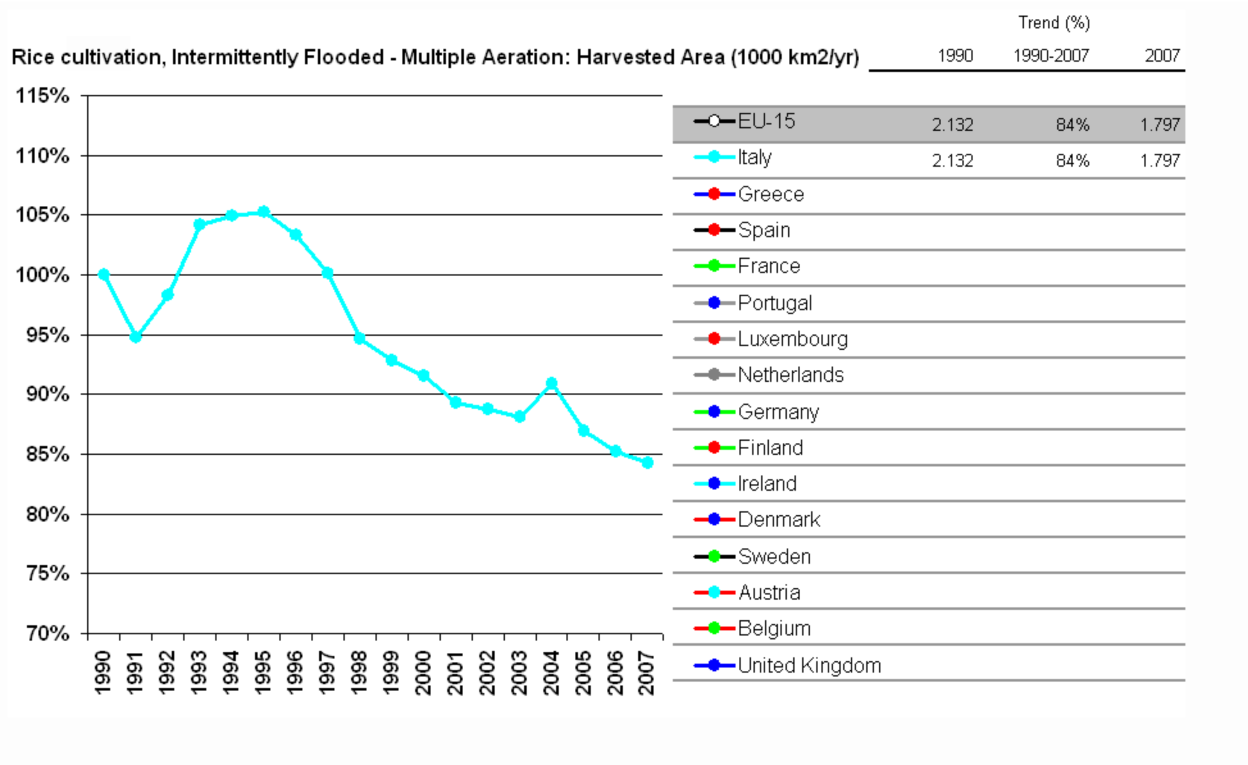


Figure 6.29: Trend of continuous flooded rice cultivation – implied emission factor

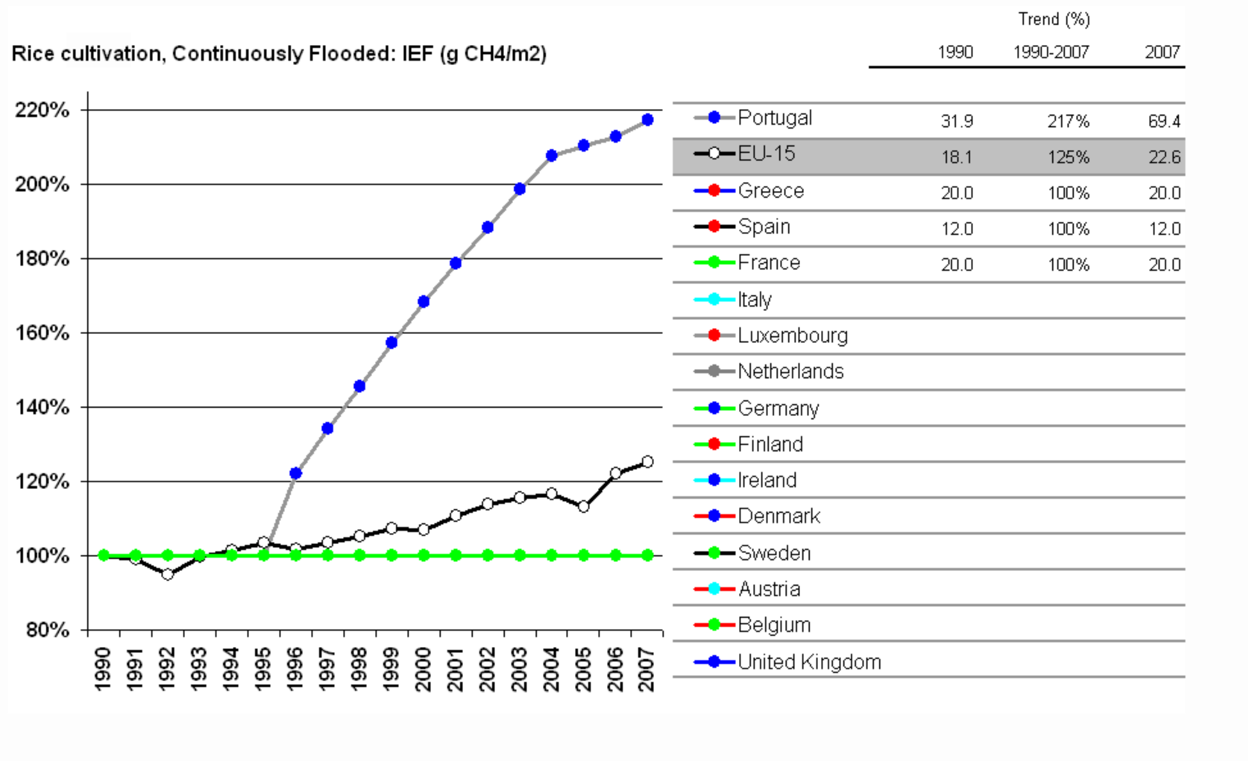


Figure 6.30: Trend of intermittently flooded (single aeration) rice cultivation – implied emission factor

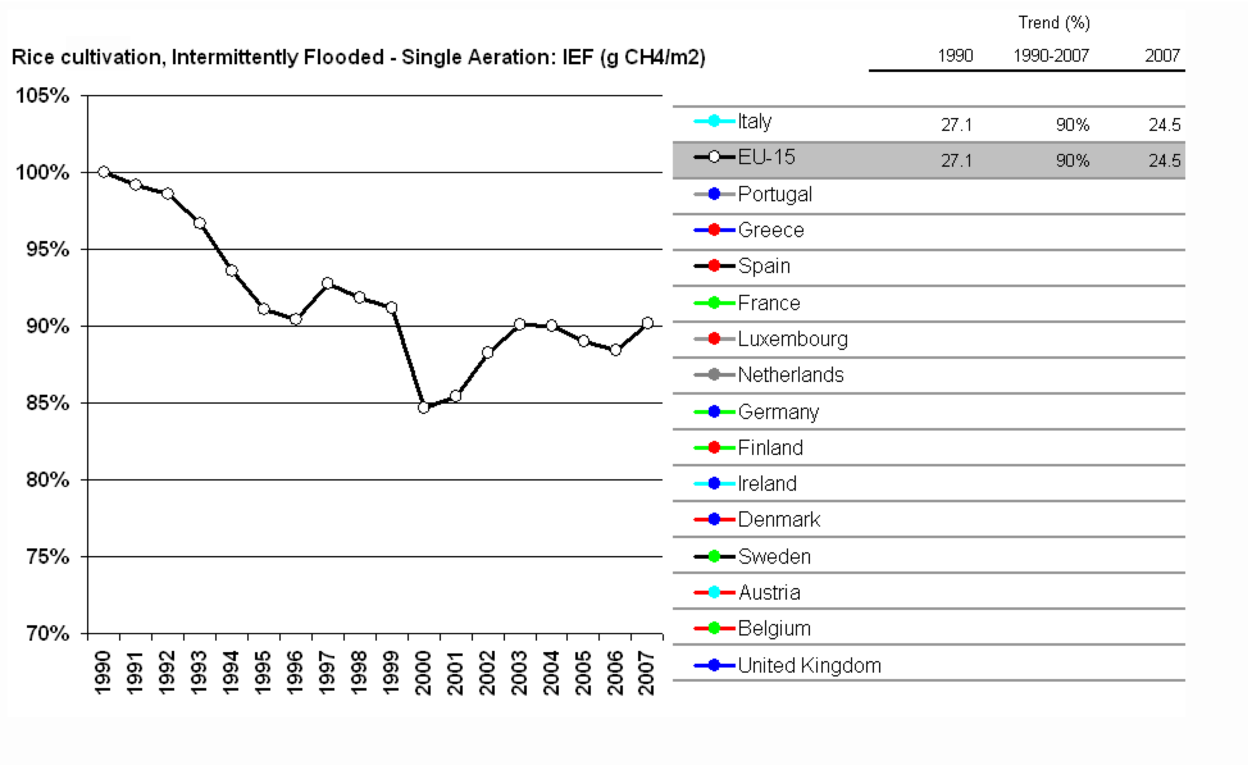
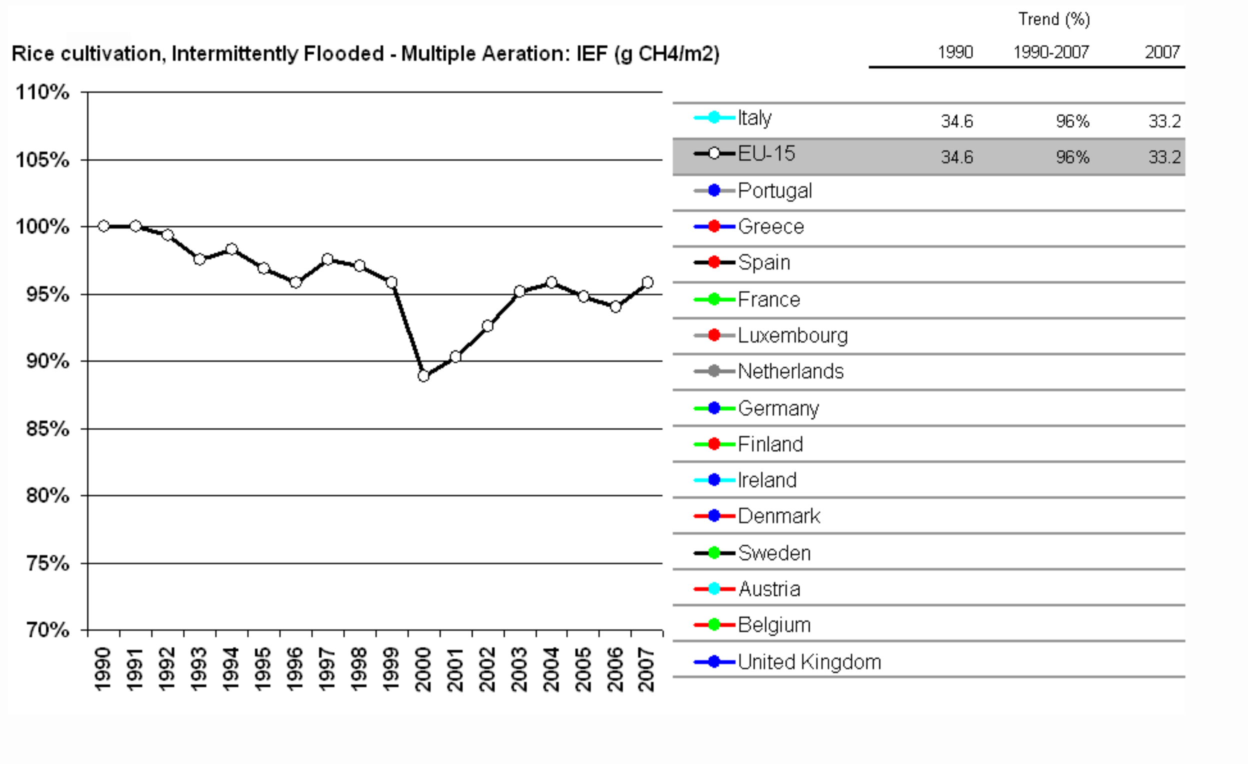


Figure 6.31: Trend of intermittently flooded (multiple aeration) rice cultivation –implied emission factor



6.3.4.3 Uncertainty and time series consistency

Uncertainty estimates for CH_4 emissions from rice cultivation are reported by three countries (Greece, Italy, and Portugal). The area used for the cultivation of rice is generally well known, only Portugal reports an uncertainty of 37.2%. The uncertainty of the implied emission factor is 40%, Italy uses a national methodology and estimates an uncertainty of 20%. An overview of the estimates is given in Table 6.57. Table 6.58 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate CH_4 emissions from rice cultivation.

Table 6.57: Relative uncertainty estimates for activity data and implied emission factors in category 4C (data from 2007 submission)

Member State 2006	AD	IEF
Greece	2.0	40.0
Italy	3.0	20.0
Portugal	37.2	40.0

Table 6.58: Member State's background information for uncertainty estimates in category 4.C

Member State	Background information to uncertainy estimates
Italy	Uncertainty of emissions from rice cultivation has been estimated equal to 20% as a combination of 3% and 20% for activity data and emissions factor, respectively.
Portugal	The uncertainty in the adjusted seasonally integrated emission factor was considered to be 40 per cent, according to the range proposed in table 4.22 of the GPG. For activity data, the standard deviation of inter-annual area under rice cultivation was considered, also 40 per cent.

6.3.5 Agricultural Soils - N_2O (Source category 4.D)

6.3.5.1 Source category description

Nitrous oxide is produced naturally in soils through the processes of nitrification and denitrification. Nitrification is the aerobic microbial oxidation of ammonium to nitrate, and denitrification is the anaerobic microbial reduction of nitrate to nitrogen gas (N2). Nitrous oxide is a gaseous intermediate in the reaction sequence of denitrification and a by-product of nitrification that leaks from microbial cells into the soil and ultimately into the atmosphere. One of the main controlling factors in this reaction is the availability of inorganic N in the soil. Therefore, N_2O emissions are reported separately for the main anthropogenic input pathways of nitrogen to the soil, i.e., application of mineral fertilizer nitrogen or nitrogen contained in applied manure, biological nitrogen fixation and nitrogen returned to the soil by the process of mineraliztion of crop residues. Additionally, the emissions of N_2O from manure deposited by grazing animals on pasture, range and paddock are reported here. The emissions of N_2O that result from anthropogenic N inputs or N mineralisation occur through both a direct pathway (i.e., directly from the soils to which the N is added/released), and through two indirect pathways: (i) following volatilisation of NH_3 and NOx from manure managegement and managed soils, and the subsequent redeposition of these gases and their products NH4 + and NO_3 - to soils and waters; and (ii) after leaching and runoff of N, mainly as NO_3 -, from managed soils.

For EU-15, emissions from all sub-categories in the category 4.D have decreased since 1990 (see Table 6.59). This was most significant for direct emissions from the application of synthetic fertiliser (-25%), followed by indirect emissions from leaching and run-off (-17%) and volatilisation of NH_3+NO_x (-16%). In the latter two cases, the reduction of emissions can be explained by a reduction of nitrogen input, as the implied emission factor was not or only slightly (leaching) changing during the reporting period. The reduction of animal manure applied to soils more than counterbalanced the increase in the implied emission factor for animal wastes application so that emission decreased by 1%.

At the aggregated EU-15 level, the implied emission factor for N_2O emissions from the application of manure increased by 5%, caused by a doubling of the implied emission factor for this source in the Netherlands during 1990 to 200. This increase is explained from a shift from surface spreading of manure to the incorporation of manure into the soil. In the inventory of the Netherlands, incorporation of manure into soils is accounted for with a higher emission factor of N_2O. Incorporation into the soil reduces NH_3 emissions.

The decrease in the input of nitrogen to agricultural soils was significant for all sub-categories and was 25% for synthetic fertilizer application, 6% for application of manure, 5% of the area of histosols cultivated and 10% of nitrogen excreted by grazing animals. This translated to a reduction of volatilized and re-deposited nitrogen by 16% and of the amount of nitrogen leached by 13%.

Table 6.59: Total N_2O emissions, Total Nitrogen input into agricultural soils and implied Emission Factor for category 4D at EU-15 level in 2007 and 1990 and relative changes

1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols 1)	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	190	82	27	93	47	189
Total Nitrogen input [Gg N]	10309	4397	22735	3163	3014	6799
Implied Emission Factor [kg N_2O-N / kg N]	1.17%	1.18%	7.5	1.87%	1.00%	1.77%

2007	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols 1)	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O [Gg N_2O]	143	81	25	82	40	156
Total Nitrogen input [Gg N]	7773	4148	21685	2841	2534	5898
Implied Emission Factor [kg N_2O-N / kg N]	1.17%	1.24%	7.5	1.84%	1.00%	1.69%

2005 value in percent of 1990	Synthetic Fertilizer	Animal Wastes appl.	Cultiv. of Histosols	Animal Production	Atmospheric Deposition	Nitrogen Leaching and run-off
	Direct				Indirect	
Total Emissions of N_2O	75%	99%	95%	89%	84%	83%
Total Nitrogen input	75%	94%	95%	90%	84%	87%
Implied Emission Factor	100%	105%	100%	99%	100%	95%

Source of information: Tables 4.D for 1990 and 2007, submitted in 2009

1) Histosols unit AD: km^2; Unit for IEF: kg N_2O-N/ha

6.3.5.2 Methodological Issues

Methods

Due to the large uncertainty associated with the emission factors in this category and the lack of well-established alternatives, most Member States rely on the IPCC default emission factors (see below). For other parameters used in the calculation of N_2O emissions from agricultural soils, however, many Member States use country-specific methodologies, linking the N_2O inventory with the CORINAIR NH_3 inventory or using simulation models. A more specific discussion of emission factors and parameters used is presented below.

Table 6.60 gives an overview of the total N_2O emissions in category 4D and the contribution of the main sub-categories. For direct N_2O emissions from the application of fertilizer and from emissions from animal production activity data are multiplied with the emission factor, which is for most countries the IPCC default factor. Thus, the vast majority of the emissions are calculated with the Tier 1 approach for the emission from synthetic fertilizer. However, emissions depend also the fraction of nitrogen that volatilises is subtracted from the applied nitrogen for the calculation of N_2O emissions and – for manure applied – also from the method that is used to estimate nitrogen excretion, which has already been discussed above. Additionally, nitrogen in crop residues and nitrogen fixed by biological nitrogen fixation might be estimated using country-specific data.

For each single sub-category we calculated a 'Tier-level' scoring between 1 and 2 according to the methodology described in6.4.1.5 (Table 6.94 through Table 6.97).

- The Tier level for direct N_2O emissions is calculated from the Tier level for emissions from mineral fertilizer input, manure application, crop residues and N-fixing crops on the basis of the MEAN rule. The Tier level for the estimation of N_2O emissions from mineral fertilizer is done by comparing the IEF with the IPCC default value. For emissions from manure applications, the Tier level of the nitrogen excretion rates estimated for N_2O emissions from manure management are combined with the Tier level of the IEF using the MEDIAN rule. The Tier level for N_2O emissions from crop residues and N-fixing crops are combined from the qulity level of the emission factor used and the Tier level of the N-input, which is done by expert judgement on the basis of the information contained in the national inventory reports (see Table 6.68 and Table 6.69). A “Tier 2” level has been assigned only if country-specific data have been used; the use of Tier 1b with default IPCC parameters counted as Tier 1 level. An analogue approach is followed to determine the Tier level for N_2O emissions from the cultivation of histosols.

- The Tier level of N_2O emissions from grazing animals is derived from the quality of N excretion factors, the implied emission factor, and a factor based on the information given in the national inventory report on the fraction of manure deposited to grazing land. The share of nitrogen that is deposited on pasture/range and paddock was only considered to be “Tier 2” if the estimate is based on a more is based on a more elaborate approach than purely the length of the grazing season.

- The Tier level for indirect N_2O emissions is a combination of the Tier levels for N_2O emissions from volatilised NH_3+NO_x and from leached/run-off nitrogen. In either case the Tier level is derived from the emission factor used and the respective fraction of nitrogen with weighing factors being 1/3 and 2/3. In the case of N-volatilization the Tier level of the amount of nitrogen is derived from both voliatilization of mineral nitrogen and manure nitrogen (MEAN rule), whereby the quality of the latter is obtained from $Frac_{GASM}$ and nitrogen excretion factors (equal weights) using the MEDIAN rule.

As a result, we estimate that a minimum of 41% of the emissions reported in category 4D are estimated with country-specific information. Highest quality was obtained for emissions from volatilised nitrogen (46%), which reflects the direct impact of the calculation of N-excretion rates and the fact that several countries link this calculation to the NH_3 inventory, where fertilizer-specific volatilisation fractions are given.

A summary of the main methodological issues, as presented in the respective national greenhouse gas inventory reports, is given in Table 6.61. Note however, that most information will be summarized in specific tables on the emission factors and parameters used.

Table 6.60: Total emissions and contribution of the main sub-categories to N_2O emissions in category 4D, methodology and key source assessment by Member States for the sub-categories direct emissions, animal production and indirect emissions for the year 2007.

	Total		Direct			Animal Production			Indirect			Volatilization		Leaching	
Member State	Gg CO_2-eq	b	a	b	c	a	b	c	a	b	c	a	b	a	b
Austria	2,961	Tier 1.3	55%	Tier 1.3	y	8%	Tier 1.4	y	37%	Tier 1.2	y	6%	Tier 1.6	31%	Tier 1.1
Belgium	3,693	Tier 1.4	56%	Tier 1.2	y	20%	Tier 1.4	y	25%	Tier 2.0	y	6%	Tier 2.0	19%	Tier 2.0
Denmark	5,652	Tier 1.4	52%	Tier 1.3	y	4%	Tier 1.4	y	42%	Tier 1.6	y	8%	Tier 1.4	35%	Tier 1.6
Finland	3,188	Tier 1.2	77%	Tier 1.1	y	5%	Tier 1.0	y	19%	Tier 1.6	y	6%	Tier 1.6	13%	Tier 1.6
France	47,362	Tier 1.3	47%	Tier 1.1	y	16%	Tier 1.3	y	37%	Tier 1.6	y	6%	Tier 1.6	31%	Tier 1.6
Germany	27,239	Tier 1.8	73%	Tier 1.9	y	5%	Tier 1.7	y	21%	Tier 1.7	y	9%	Tier 2.0	12%	Tier 1.6
Greece	7,444	Tier 1.1	20%	Tier 1.1	y	45%	Tier 1.1	y	35%	Tier 1.1	y	6%	Tier 1.0	29%	Tier 1.1
Ireland	6,365	Tier 1.3	39%	Tier 1.1	y	42%	Tier 1.4	y	19%	Tier 1.6	y	6%	Tier 1.6	13%	Tier 1.6
Italy	17,791	Tier 1.2	49%	Tier 1.1	y	9%	Tier 1.7	y	42%	Tier 1.2	y	9%	Tier 1.6	33%	Tier 1.1
Luxembourg	340	Tier 1.2	49%	Tier 1.1	y	16%	Tier 1.4	y	35%	Tier 1.2	y	6%	Tier 1.0	29%	Tier 1.2
Netherlands	8,599	Tier 1.9	57%	Tier 1.9	y	7%	Tier 1.7	y	36%	Tier 2.0	y	6%	Tier 2.0	31%	Tier 2.0
Portugal	2,489	Tier 1.4	32%	Tier 1.1	y	30%	Tier 1.4	y	38%	Tier 1.6	y	7%	Tier 1.6	30%	Tier 1.6
Spain	19,735	Tier 1.7	51%	Tier 1.8	y	8%	Tier 1.7	y	40%	Tier 1.6	y	5%	Tier 1.6	35%	Tier 1.6
Sweden	4,744	Tier 1.9	62%	Tier 1.9	y	7%	Tier 2.0	y	19%	Tier 1.7	y	4%	Tier 2.0	16%	Tier 1.6
United Kingdom	23,280	Tier 1.3	47%	Tier 1.1	y	18%	Tier 1.4	y	34%	Tier 1.5	y	7%	Tier 1.0	28%	Tier 1.6
EU-15	**180,882**	**Tier 1.4**	**52%**	**Tier 1.4**	**y**	**14%**	**Tier 1.4**	**y**	**34%**	**Tier 1.5**	**y**	**7%**	**Tier 1.6**	**27%**	**Tier 1.5**
EU-15: Tier 1	55%		59%			59%			46%			40%		46%	
EU-15: Tier 2	45%		41%			41%			54%			60%		54%	

a Contribution to N2O emissions from agricultural soils
b Tier 1: default methodology; Tier 2: country-specific methodology
c Source category is key in the Member State's inventory (y/n)

Table 6.61: Member State’s background information for the calculation of N_2O emissions in category 4.D

Member State	Methods

Member State	Methods
Austria	The IPCC Tier 1a and – where applicable – Tier 1b with Austria specific consideration of nitrogen losses (NH_3-N, NOx-N, N_2O-N). These losses are subtracted from the amount of mineral fertilizer N sales in the CRF table.
Denmark	The IPCC Tier 1a methodology is used to calculate the N_2O emission. Emissions of N_2O are closely related to the nitrogen balance (DIEMA). Indirect emissions from atmospheric deposition includes all emission sources of ammonia, i. e., livestock manure, use of synthetic fertilizer, crops, ammonia-treated straw used as feed, and sewage sludge and sludge from industrial production applied to agricultural soils.
Finland	The calculation methodology has been developed towards a mass-flow approach in order to avoid double-counting. The N lost as NH_3 and NOx ($Frac_{GASF}$, $Frac_{GASM}$) as well as N leached ($Frac_{LEACH}$) are subtracted from the amount on N in synthetic fertilisers, manure and sewage sludge applied to soils, as well from manure deposited on pastures.The N emitted and leached is used for calculating the indirect N_2O emissions from atmospheric deposition and leaching and run-off and the N remaining in the soil for calculating the direct N_2O emissions. (For the next submission, a new N_2O emission model will be developed, in which $Frac_{GASM}$ and $Frac_{GASF}$ will not be subtracted from N inputs before applying $Frac_{LEACH}$.
Germany	Nitrogen emissions are calculated with the mass-flow approach, taking generally the simple methodology of the CORINAIR guidebook (EMEP, 2003). Application rates are dis-aggregated to the district level on the basis of the acreage of crops in the districts and fertilizer recommendations (LWK-WE, 2003).
Irelands	Direct Soil Emissions: calculated in a Tier 1 approach take into account the nitrogen inputs from all these sources, except that due to the cultivation of organic soils. For N_2O emissions from manure applilcation, also N_2O emissions during housing and storage is subtracted from the N-input.
Italy	IPCC default Tier 1 methodology.
Luxembourg	Nitrous oxide emissions from agricultural soils are estimated by using emission factors in relation with the mass of fertilizers used. For fallows (cultures without fertilizer use) an area-based emission factor is used in relation with the respective agricultural surface areas.
Netherlands	The IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions for two soil types (organic and inorganic soils) and to estimate direct N_2O emissions from animal production. The IPCC Tier 1 method is used to estimate indirect N_2O emissions. For emissions from crop residues and N-fixing crops, only crops from arable farming and horticulture in the full soil (not in tubs) are included. All relevant documents concerning methodology, emission factors and activity data are published on www.greenhousegases.nl. The LEI (Dutch agricultural economic institute) performs these calculations based on the methodology described in Van der Hoek et al. (2007). Ammonia emissions are published by CBS/Statline (website www.cbs.nl). About 80–85% of the manure N collected in the stable and in storage is applied to soils. A small portion of the manure N (approximately 1–4%) is exported; while approximately 13-15% is emitted as ammonia during storage.
Portugal	Manure managed as liquid systems and solid storage is fully applied to agricultural soil as a fertilizer, irrespective of the animal species considered, whereas only 80% of manure handled in anaerobic lagoons is placed in soil (Bicudo & Albuquerque, 1995). The remaining 20 per cent wastewater flow and nitrogen is rejected directly to water systems. This fraction, however, is included in the determination of N_2O indirect emissions from agricultural soils.
Sweden	Background emissions from agricultural soils are reported both for organic and mineral soils in the Swedish inventory. For mineral soils, a national emission factor has been developed (Kasimir-Klemedtsson, 2001).
United Kingdom	Indirect emissions of N_2O from the atmospheric deposition of ammonia and NOx are estimated according to the IPCC (1997) methodology but with corrections to avoid double counting N.The sources of ammonia and NOx considered are synthetic fertiliser application and animal manures applied as fertiliser. The method used corrects for the N content of manures used as fuel but no longer for the N lost in the direct emission of N_2O from animal manures as previously.

Activity Data

For the estimation of N_2O emissions from N-fixing crops and crop residues, most Member States use the amount of N input (in Gg N) as activity data in the CRF table; but some countries give the emission factor in kilogram of nitrogen emitted per kg of dry crop production (N-fixing crop or other crops, respectively). Therefore, the data given in Table 6.62 in the respective columns are not comparable.

Additional background information on the source of the data used in the Member States's inventories is given in Table 6.63.

Table 6.62: Member State's activity data to calculate direct and indirect N_2O emissions in category 4D

Member States 2007	Synthetic Fertilizer (Gg N)	Animal Wastes appl. (Gg N)	N-fixing crops (Gg N)	Crop residue (Gg N)	Cultiv. of Histosols (km^2)	Animal Production (Gg N)	Atmosph. Deposition (Gg N)	Nitrogen Leaching and run-off (Gg N)
	Direct						Indirect	
Austria	100	104	23	40	NO	23	36	76
Belgium[1)]	146	135	2	52	25	75	44	57
Denmark	191	189	35	52	811	21	92	161
Finland	148	61	0.8	27	2,609	15	38	34
France	1,994	856	314	456	NO	764	590	1,221
Germany	1,600	888	83	564	12,936	181	511	863
Greece	171	38	1	24	67	347	98	175
Ireland	317	75	0	10	NO	275	85	67
Italy	689	448	161	124	90	161	330	486
Luxembourg	13	6	3	5	NO	6	4	8
Netherlands	248	299	4	30	2,230	75	100	216
Portugal	49	55	3	24	NO	77	38	62
Spain	954	548	187	113	NO	341	219	1,880
Sweden	167	63	33	52	2,526	41	36	61
United Kingdom	988	383	21	366	392	438	313	530
EU-15	7,773	4,148	911	2,025	21,685	2,841	2,534	5,898

Source of information: Tables 4.D for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.

1) Belgium uses as unit for N-fixing crops: kg of dry biomass pulses and soybeans produced and as unit for crop residues: kg of dry biomass of other crops produced. It has been excluded from the EU-15 data for these sub-categories

Table 6.63: Member State's background information on the activity data used for the calculation of N_2O emissions in category 4.D

Member State	Activity data
Austria	Mineral Fertilizer application detailed data about the use of different kind of fertilizers are available until 1994, because until then, a fertilizer tax („Düngemittelabgabe") had been collected. Data about the total synthetic fertilizer consumption are available for amounts (but not for fertilizer types) from the statistical office (Statistic Austria) and from an agricultural marketing association (Agrarmarkt Austria, AMA). The yearly numbers of the legume cropping areas were taken from official statistics (BMLFUW 2007). Harvest data were taken from (BMLFUW) and the datapool of (Bundesanstat fuer Agrarwirtschaft). Agriculturally applied Sewage sludge data were taken from Water Quality Report, 2000 (Philippitsch, 2001), For 2001 to 2006 data from the National Austrian Waste Water Database operated by the Umweltbundesamt was used.
Denmark	The amount of nitrogen (N) applied on soil by use of synthetic fertiliser is estimated from sale estimates by the Danish Plant Directorate, which is source to the FAO database. Data for crop yield is based on Statistics Denmark. For nitrogen content in the plants the data is taken from Danish feed stuff tables (Danish Agricultural Advisory Centre).
Finland	The amount of synthetic fertilisers sold annually has been received from the annual agricultural statistics of the Ministry of the Agriculture and Forestry. The amount of sewage sludge applied annually has been received from the VAHTI database of Finland's environmental administration. Area of cultivated organic soils are from MTT Agrifood Research Finland. Crop yields of cultivated plants have been received from agricultural statistics.
France	National statistics of fertilizer consumption are from UNIFA. Crop production statistics are obtained from the Ministry of agriculture (SCEES/ AGRESTE). For animal production, the difference between table 4.D and table 4B(b) is due to the oversea territories that are accounted separately in table 4D.
Greece	The data regarding the annual quantities of synthetic fertilizers consumed in the country derive from FAO. The data for the last two years result from extrapolation based on the trend of the last five years. Data on agricultural crop production used for the calculation of emissions was obtained from the annual national statistics of the NSSG.
Ireland	The annual statistics on nitrogen fertilizer use (Nfert) are obtained from the Department of Agriculture and Food.
Luxembourg	AD from national statistical data (Statistical Yearbook, tables C.2100 and C.2104) and ASTA (Administration des Services Techniques de l'Agriculture)
Portugal	Apparent Consumption of Fertilizers in the Agriculture activity (ACFA) by a simple mass balance, from sales and international market information data not accounting for losses and stock changes. The data are compared to the more complete time-series that is available at FAO (http://faostat.fao.org), with sales information for "Nitrogenous Fertilizers" from 1961 up to 2002. However, and although its completeness, the Ministry of Agriculture and the National Statistical Institute, shown concerns about the origin of the information behind the final time series, and consider that it did not reflect clearly the situation that existed in Portugal in the period. Nevertheless, both series agree quite well near the base year, although the values in this series appear to be over-estimating the rate of decrease of synthetic fertilizers in Portugal.

Sweden	Sales of fertilisers, recalculated into nitrogen quantities, are published annually by Statistics Sweden and the national estimates are considered to be accurate, according to the quality declaration in the statistical report.The fertiliser sales values are however a bit higher than the estimated use of fertilisers, which is estimated from telephone interviews with farmers. The difference can partly be explained by the use of fertiliser in other sectors such as in horticulture. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in the current submission of the GHG inventory. Estimated standard yields for different crops are published annually by the Swedish Board of Agriculture/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years.
United Kingdom	Annual consumption of synthetic fertilizer is estimated based on crop areas (Defra) and fertilizer application rates (BSFP, 2006). Crop production data are taken from Defra (2006).

Emission Factors and other parameters

Table 6.64 and Table 6.65 give an overview of the emission factors and other parameters used for the calculation of N_2O emissions from agricultural soil in 200. As discussed already above, emission factors are largely IPCC default, while other parameters are more frequently country-specific. Also, while the emission factors are static in the time series, some parameters are dynamically calculated on the basis of national input data, for example the mix of mineral fertilizer types with different volatilization fractions associated.

In the following, country-specific elements in the calculation of N_2O emissions from agricultural soils as reported in the National Inventory Reports are given in Table 6.67 for direct N_2O emissions from fertilizer application, Table 6.68 and Table 6.69 for N_2O emissions from N-fixing crops and crop residues, Table 6.70 for the N_2O emissions from animal production and Table 6.71 for N_2O emissions from cultivated histosols.

Furthermore, background information on the development of national parameters is given in Table 6.72 for $Frac_{GASF}$, Table 6.73 for $Frac_{GASM,}$ and Table 6.74 for $Frac_{LEACH}$.

Most Member States use the IPCC default emission factors for the calculation of N_2O emissions from the application of mineral and organic fertiliser. A differentiation between organic and inorganic fertiliser has been made by the Netherlands and Sweden. The Swedish EF of 0.8% is based on a study on N_2O emissions in Sweden and other countries of northern Europe and in Canada (Kasimir-Klemedtsson, 2001), supported by a study in Norway suggesting a lower emission factor for emitted fertiliser N than the IPCC default value (Laegreid and Aastveit, 2002). The Netherlands distinguish also between mineral fertiliser application on mineral soils and on organic soils, with the EFs being twice as high for the application on organic soils; for the application of manure, differentiation is made between surface spreading and incorporation of the fertiliser. As more nitrogen is locally available if the fertiliser is incorporated into the soil, this application system is assumed to result in higher emissions of N_2O in mineral soils. For organic soils, the same, higher, EF is applied for both application systems. An overview of the Dutch emission factors is given in Table 6.66. Additional background information on the emission factors used is given in Table 6.67.

All countries are reporting N_2O emissions from manure excreted by animals during grazing and the implied EF is the default factor of 2% N_2O-N per kg N excreted and year, except of the emission inventories of the Germany, Spain, Netherlands and Sweden, which use an EF of 1.7%, 1.0%, 1.6% and 1.6%, respectively.

Table 6.64: Implied Emission Factors for the category 4D - N_2O emissions from agricultural soils in 2007 (data for Italy and Spain for 2003)

Member States 2007	Synthetic Fertilizer	Animal Wastes appl.	N-fixing crops	Crop residue	Cultiv. of Histosols	Animal Production	Atmosph. Deposition	Nitrogen Leaching and run-off
	Direct						Indirect	
Austria	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Belgium	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Denmark	1.25%	1.25%	1.25%	1.25%	2.9	2.0%	1.00%	2.50%
Finland	1.25%	1.25%	1.25%	1.25%	7.9	2.0%	1.00%	2.50%
France	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Germany	1.00%	1.01%	NO	1.00%	8.0	1.7%	1.01%	0.75%
Greece	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Ireland	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Italy	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
Luxembourg	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Netherlands	1.06%	2.00%	1.00%	1.00%	4.7	1.6%	1.00%	2.50%
Portugal	1.25%	1.25%	1.25%	1.25%	NO	2.0%	1.00%	2.50%
Spain	1.17%	1.02%	1.25%	1.25%	NO	1.0%	1.00%	0.75%
Sweden	0.8%	2.50%	1.25%	1.25%	8.0	1.6%	1.01%	2.50%
United Kingdom	1.25%	1.25%	1.25%	1.25%	8.0	2.0%	1.00%	2.50%
EU-15	1.17%	1.24%	1.25%	1.17%	7.5	1.8%	1.00%	1.69%

Source of information: Tables 4.D for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.65: Relevant parameters for the calculation of N_2O emissions from agricultural soils in 2007

Member States	FracBURN	FracFUEL	FracGASF	FracGASM	FracGRAZ	FracLEACH	FracNCRBF	FracNCRO	FracR
Austria	0.26%		3.6%	20%	14%	30%	2.6%	0.9%	34%
Belgium	NO	NO							
Denmark	NO	NO	1.9%	20%	9%	33%	NE	NE	24%
Finland	0.19%	NA	0.6%	33%	20%	15%	4.2%	1.0%	45%
France	NA	NO	10.0%	20%	42%	30%	3.0%	NA	NA
Germany	NO	NO	5.5%	28%	12%	30%	1.1%	0.7%	57%
Greece	10%		10.0%	20%	88%	30%	1.4%	0.5%	52%
Ireland	NO	NO	1.5%	19%	66%	10%	NO	NO	NO
Italy	10%	NO	9.3%	29%	19%	30%	3.0%	1.5%	45%
Luxembourg	NO	NO	10.0%	20%	45%	30%	3.0%	1.5%	45%
Netherlands	NO	NO	NE	NE	NE	NE	NE	NE	NE
Portugal	5.0%	NO	5.7%	21%	47%	32%	2.3%	1.3%	71%
Spain	18.0%	NO	6.3%	34%	38%	30%	2.4%	0.5%	NA
Sweden			1.2%	33%	32%	23%	2.0%	0.5%	20%
United Kingdom			10.0%	20%	52%	30%	3.0%	1.5%	45%
EU-15[1)]	NA	NA	5.8%	25%	37%	27%	2.5%	1.0%	44%

Source of information: Tables 4.D for 2007, submitted in 2009. Abbreviations explained in the Chapter 'Units and abbreviations'.
[1)] Arithmetic average over the MS that reported.

Direct emissions from application of fertiliser

Only few countries use country-specific emission factors to estimate N_2O emissions caused by the application of mineral fertilizer. The reason is the extreme high spatial and temporal variability of this emission source, which makes the generation of a robust database with observations, based on which national emission factors can be derived, extremely difficult. National methodologies are summarized in Table 6.67. Table 6.68 through Table 6.70 give additional information on the methodologies used to estimate N_2O emissions from crop residues, biological N-fixation, and animal production.

Table 6.66 shows the methodology used in the Netherlands in detail.

Table 6.66: N_2O emission factors for agricultural soils used in Netherlands' inventory (from the NL protocol for direct N_2O emissions; www.greenhousegases.nl)

Supply source	EF (kg N_2O–N per kg N supply)		Reference
	Mineral soil	Organic soil	
Using fertiliser			
- ammonia-retaining (no nitrate)	0.005	0.01	2
- other types of fertiliser	0.01	0.02	1
Using animal manure			
- above-ground usage	0.01	0.02	1
- low-emission use	0.02	0.02	1
Grazing agricultural pets			
- faeces	0.01	0.01	1
- urine	0.02	0.02	1
Nitrogen fixation	0.01		1
Remaining crop residues	0.01		2
Agricultural use of histosols		0.02	2

references: 1= Kroeze, 1994; 2= Van der Hoek et al., 2005

Table 6.67: Member State's background information for the calculation of N_2O emissions from the application of fertilizer in category 4.D

Member State	Direct emissions from fertilizer application
Finland	IPCC default with the exceptoin of emission factors for organic soils on grass and other crops which are based on national data (Monni et al. 2007) (cereals 11.08 kg N_2O-N ha^{-1} y^{-1}, grass 5.7 kg N_2O-N ha^{-1} y^{-1}).
Netherlands	Distinction is made between fertiliser type (ammonia-retaining-no nitrate fertiliser and other fertiliser), application to mineral or organic soils, and manure incorporation. The country specific emission factors for mineral soils are lower than IPCC defaults and for organic soils they are higher. A fixed distribution of the total amount of nitrogen in fertiliser and animal manure is used over the Netherlands areas of mineral and organic agricultural soils. For fertiliser use, 90% is attributed to mineral soils, and 10% to organic soils; for animal manures this is 87% and 13% respectively (Kroeze, 1994). For incorporation into soil also a higher emission factor than the IPCC default is used. A recent survey on N_2O emission factors for the field-scale application of animal manure (Kuikman et al., 2006) showed that on the basis of available data it was not possible to make an update of the N_2O emission factors applied in the past (Kroeze et al., 1994). Very few comparative trials between surface spreading and incorporation have been carried out in The Netherlands to date, resulting in very low emission rates for both techniques. Field-scale comparative experiments carried out in other countries show that, in most cases, N_2O emissions increased and seldom were lower in comparison with surface application. However, it was not possible to deduce long-term average N_2O emission factor from these findings and to translate these to the Dutch circumstances. Therefore, it was not possible to underpin an update of the N_2O emission factor for the application of animal manure. More research is needed in order to be able to take the specific circumstances of The Netherlands into account.
Sweden	National emission factor for direct emissions based on a study by (Klemedtsson, 2001). For nitrogen supply from fertilizers, a national emission factor, 0.8% N_2O-N of N-supply, is used.For nitrogen supply from manure, a national emission factor of 2.5% emissions of N-supply is used.The background emissions from the cultivation of mineral soils have also been included in the inventory with the national emission factor of 0.5 kg N_2O-N ha^{-1}. For other direct soil emissions, default values from the IPCC Guidelines are used. The background emissions from organic soils vary with different crops. They are considered to be higher from ploughed soils than from pasture or lay lands and the suggested emission factors are 1 and 6 kg N_2O-N ha^{-1}, respectively. The IPCC guidelines' default value is implemented in the inventory since a Swedish/Finnish research group concluded that not enough data exists to generate different emission factors for different management and soil types (Klemedsson et al., 1999).

Table 6.68: Member State's background information for the calculation of N_2O emissions from crop residues in category 4.D

Member State	Direct emissions from crop residues
Austria	Country-specific data for average crop residues/crop products ratio, dry matter fraction, N in crop residues (Goetz, 1998) and fraction of crop residues removed (Loehr 1990).
Belgium	The dry matter content of the crops in Flanders are region specific.
Denmark	N_2O emissions from crop residues are calculated as the total above-ground amount of crop residues returned to soil. For cereals the aboveground residues are calculated as the amount of straw plus stubble and husks. The total amount of straw is given in the annual census and reduced with the amount used for feeding, bedding and biofuel in power plants. Straw for feeding and bedding is subtracted in the calculation because this amount of removed nitrogen returns to the soil via manure. Data for nitrogen content in stubble and husks are provided by the Danish Institute of Agricultural Sciences (Djurhuus,and Hansen, 2003). Burning of plant residues has been prohibited since 1990 and may only take place in connection with continuous cultivation of seed grass. It is assumed that the emissions are insignificant.
Germany	Germany makes use of statistically available nitrogen contents in crop residues. Factors used in the Tier 2 calculation for emissions from crop residues is given in (Daemmgen et al., 2007).
Italy	Country-specific methodology; N-content in crop residues calcualted using the protein content in dry matter, and dividing by the factor 6.25.
Netherlands	A fixed countryspecific value in kg N per hectare is used for the nitrogen content of the above-ground crop residues (Velthof and Kuikman, 2000). Country-specific values for removal of crop residues show that during the period 1990-2003, only grains and corn were removed (90%) from the fields (Van der Hoek et al., 2005).
Portugal	Crop residues not only annual crops were considered but also permanent crops, such as orchards and pastures. Crop residues are not used as combustible or building material in Portugal.
Sweden	N-content in crop residues from cereals are based on national measurement data (Mattson, 2005). For other crops, a combination of national factors and IPCC default values was used (Swedish EPA/SMED, 2005).
United Kingdom	Production data of crops are taken from Defra (2006a, 2006b).Field burning has ceased to be legal in the UK since 1993, and none is assume to occur after this date.For years prior to 1993, field-burning data were taken from the annual MAFF Straw Disposal Survey (MAFF, 1995).

Table 6.69: Member State's background information for the calculation of N_2O emissions from N-fixing crops in category 4.D

Member State	Direct emissions from N-fixing crops
Austria	Values for biological fixation for peas, soja beans adn horse/field beans (120 kg N/ha) and clover-hey (160 kg N/ha) are country-specific (Goetz, 1998); these values are constant over the time series.
Denmark	The estimates for the amount of fixed nitrogen in crops are estimated by Danish Institute of Agricultural Science (Swedish Board of Agriculture, 2005) from literature (Kristensen, 2003; Høgh-Jensen et al, 1998; Kyllingsbæk, 2000). Emissions from clover-grass are included (not mentionen in IPCC). Area with grass and clover covered approx.17% of the total agricultural area and represent thus a significant part of N-fixing crops emissions.
Finland	Vegetables grown in the open have been included into the emission estimate of crop residues for the first time in 2005 submission. Vegetable yields have been received from literature (Yearbook of Farm Statistics, 2006). Values for the residue/product fraction, dry matter content and nitrogen fraction are IPCC with amendments where appropriate values were missing (turnip rape/rape; sugar beet; clover seed) or where more values based on expert judgement were used (N-fraction for peas of 3.5%; DM and residue/product fraction from sugar beet used for vegetables).
Germany	The quantity of N fixes by leguminous crops is estiamted on the basis of cultivated area and national average N-fixing rates of 250 kg N ha^{-1} (pulses), 300 kg N ha^{-1} (alfalfa), and 200 kg N ha^{-1} (mixed alfalfa, clover; improved grassland)(DÄMMGEN et al., 2007).
Italy	Country-specific methodology considering also legume forage. Nitrogen fixed per hectare is taken from Erdamn, 1959 in Giardini (1983).
Netherlands	Country-specific value for nitrogen fixation per hectare (Mineralen Boekhouding, 1993) (Lucerne: 422 kg N per hectare; Green peas (harvested dry) and field peas, marrowfat peas en grey peas, brown beans, peas (harvested green): 164 kg N per hectare; Field beans: 325 kg N per hectare; Stem beans (harvested green), scarlet runner-/salad-/common beans: 75 kg N per hectare; Broad beans: 164 kg N per hectare.
Portugal	N fixed by crops includes both annual crops and a permanent crop (carob tree, Ceratonia siliqua) production. Factors are IPCC defaults and from other sources (Jarrige, 1988; INRA, AFRC).
Sweden	To estimate nitrogen fixation from the atmosphere, a model according to Høgh-Jensen has been used since submission 2006 The model covers fixation from root and stubble as well as trensmission to other plants. It has been adapted to Swedish conditions (Frankow-Lindberg, 2005). According to the model, the amount of fixed nitrogen is estimated as a part of the total amount of N in the plant's biomass, which varies depending on th ekind of leguminous plant, the age of the pasture, the number of harvests and, to some extent, the amount of fertiliser applied.
United Kingdom	The total nitrous oxide emission reported also includes a contribution from improved grass calculated using a fixation rate of 4 kg N/ha/year (Lord, 1997). Crop production data are taken from Defra (2006a, 2006b).

Table 6.70: Member State's background information for the calculation of N_2O emissions from animal production in category 4.D

Member State	Grazing animals
Austria	During the summer months, 14.1% of Austrian Dairy cows and Suckling cows are on alpine pastures 24 hours a day. 43.6 % are on pasture for 4 hours a day and 42.3 % stay in the housing for the whole year (Konrad, 1995).
Belgium	The nitrogen from grazing is estimated, taking into account the number of days in pasture and the nitrogen excreted by each animal category. Available nitrogen is the difference between the manure nitrogen content and the manure nitrogen volatilisation in NH_3 and NO form.
Denmark	FracGRAZ is based on expert judgement (DAAC - Poulsen et al., 2001) assuming that 5%, on average, of the nitrogen from dairy cattle and heifers is excreted on grass.
Finland	The length of pasture season has been estimated as 130 days for suckler cows, 120 days for dairy cows, heifers, calves, shepp, goats and horses, 365 days for reindeer, and 0 for bulls, swine, poultry and fur animals.
Germany	Grazing animals: N input calculated with the mass-flow approach taking into consideration all relevant housing systems occurring in Germany and is based on the length of the grazing period, the average time per day spent grazing and in milking yards. Emission factors for N_2O are distinguished between cattle, pigs and poultry (0.02 kg N/kg N for N_2O and NO, 0.14 kg N)/kg N for N2) and goat, sheep and horses (0.01 kg N/kg N for N_2O and NO and 0.07 kg N/kg N for N1). The emissions of influence the quantity of nitrogen input to the soil. The share of grazing varies with subcategory, region, and time.
Ireland	The amount of organic nitrogen input concerned from the equations above, is large in Ireland due to the relatively short period that cattle remain in housing and the contribution from large Sheep populations, the majority of which are not housed.
Netherlands	National emission factor. A distinction is made between nitrogen in urine and in faeces. The distribution of nitrogen over faeces and urine depends on the nitrogen content in the meadow grass, and in turn this depends on the fertilisation level. For the period 1990-1999 a distribution of 30/70 was assumed, and for the period from 2000 onwards, a ratio of 35/65 is used (calculated on the basis of Valk et al., 2002).For the calculation of N_2O emissions, the nitrogen excreted is corrected for NH_3 volatilization.

Member State	Grazing animals
Portugal	Emissions of N_2O due to the input of nitrogen to soils from pasture, range and paddock were estimated with a methodology similar to that used to estimate emissions of N_2O from Manure Management. The emission factor of N_2O for Pasture, Range and Paddock (EF3) was set at 0.02 kg N_2O-N/kg N which is the default IPCC96 emission factor.
Sweden	The fraction of manure deposited that volatilises as ammonia is model-based. A different fraction for manure deposited by grazing animals is used (FracGASG) then for manure applied to soils. FracGASG is time dependent. N_2O emissions from grazing animals are calculated after subtracting the nitrogen that volatilises as ammonia. Due to lack of data concerning reindeer, the nitrogen production by sheep is also applied to reindeer. Stable periods are obtained from Statistics Sweden per year and animal.
United Kingdom	The fraction of livestock N excreted and deposited onto soil during grazing is a country specific value of 0.52, much larger than the IPCC recommended value (0.23), based on country specific data.

Direct emissions from the cultivation of histosols.

N_2O emissions from the cultivation of histosols reported as not occurring in Austria, France, and Spain, and as not estimated in Portugal. Also, no emissions from the cultivation of histosols are reported by Ireland, because tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the middle and western part of the country. Consequently, nitrogen inputs due to the cultivation of organic soils have been taken as negligible.

The cultivation of histosols represents the biggest share of emissions from agricultural soils in Finland (31%), Sweden (24%) and a substantial source for N_2O emissions in Germany (19% - almost as large as emission from application of manure) and the Netherlands (7%). The emission factor proposed in the IPCC GPG of 8 kg N_2O-N per hectare and year (IPCC, 2000) is used in most countries. Netherlands uses 4.7 kg N_2O-N ha^{-1}; national emission factors are further used in Denmark (2.9 kg N_2O-N ha^{-1}) and Finland (7.9 kg N_2O-N ha^{-1}).

On absolute terms, the estimated emissions of N_2O from the cultivation of histosols are largest for Germany (16.3 Gg N_2O), followed by Finland (3.2 Gg N_2O) and Sweden (3.2 Gg N_2O).

Table 6.71: Member State's background information for the calculation of N_2O emissions from the cultivation of histosols in category 4.D

Member State	Histosols
Belgium	The area histosols is calculated on the basis of an intersection between the CORINE Land Cover Geodataset from 1990 and the Belgian 'Soilassociationmap'. The area is held constant for the entire time series. No histosol cultivation occurs in Wallonia, where the only recorded organic soils are part of a nature reserve.
Denmark	National IEF for histosols. N_2O emissions from histosols are based on the area with organic soils multiplied with a national emission factor for C, the C:N relationship for the organic matter in the histosols and an emission factor of 1.25 of the total amount of released N. Danish organic soils are defined as soils having >10% SOM in contradiction to the IPCC definition where organic soils has >20% SOM. For 1998 the distribution of the agricultural area between mineral soils and organic soils is subdivided into cropland and permanent grassland based on a GIS analysis. Set-a-side, grass in rotation and permanent grass is more common on organic soils than on mineral soils.
Finland	The area of cultivated organic soils has been received from MTT Agrifood Research Finland and has been updated for the 2006 submission on the basis of (Myllys, 2004; Kähäri, 1987). The area of cultivated organic soils is poorly known in Finland. Current area estimate is based on the results of soil analysis. The emission factors for organic soils on grass and other crops are based on national data (Monni et al. 2007). The emission factors were calculated on the basis of published results on annual fluxes measured with flux chambers on five different peat fields.
Germany	Estimation of the are of cultivated histosols on the basis of an overlay of a land-use map and a soil map (Daemmgen et al., 2006).
Greece	Data for the areas of organic soils derive from a relevant research conducted by the Soil Science Institute of Athens (SSIA, 2001).
Ireland	Not estimated. Tillage farming in Ireland is concentrated in the south-east of the country while the bulk of organic soils occur in the midlands and west. Consequently, nitrogen inputs due to the cultivation of organic soils can be taken as negligible.
Italy	Area of organic soils from the national soil map of the year 1961. These values have been verified with related data for Emilia Romagna region, where this type of soil is the most prevalent.
Netherlands	A fixed country-specific emission factor of 4.7 kg N_2O-N per hectare is used for this calculation. This value is based on an average mineralisation of around 235 kg N per hectare histosol (Kuikman et al., 2005). Using an emission factor of 0.02 (largely taken from Dutch research projects conducted in the first half of the 1990s and

Member State	Histosols
	reported in Kroeze, 1994), the laughing gas emission of histosols amounts to 4.7 kg N_2O–N per hectare.
Portugal	Histosols represent at most a negligible emission quantity in Portugal, and they may be reported as not occurring for all practical purposes.
Sweden	The area of organic soils is around 252 600 hectares according to a recent mapping of cultivated organic soils in Sweden (Berglund, 2005).
United Kingdom	The area of cultivated Histosols is assumed to be equal to that of eutric organic soils in the UK and is based on a FAO soil map figure supplied by SSLRC (now NSRI).

Indirect emissions.

All Member States report indirect emissions of nitrous oxide induced by the atmospheric deposition of NH_3 and NO_x volatilised and nitrate leached to the groundwater using the default IPCC emission factors. Only Germany and Spain use a smaller emission factor for N_2O from nitrogen leached or run-off (0.75%).

Country-specific methodologies, however, are used by most Member States for the calculation of nitrogen volatilisation and nitrate leaching, with only 3 Member States using the IPCC default values for the volatilisation fractions of mineral and organic fertilizer ($Frac_{GASF}$ and $Frac_{GASM)}$, respectively, and 8 countries are using the default IPCC values for the leaching fraction ($Frac_{LEACH}$). The Netherlands reports the fractions as NE.

While volatilisation of NH_3 and NO_x from the application of mineral fertiliser is considered by all Member States to be lower as the IPCC default values (range of national factors 0.6% to 10%, with 4 countries using the default value of 10%), most of the Member States with country-specific volatilisation rates for organic fertiliser are estimating larger losses of NH_3 + NO_x than proposed by the IPCC (range 20.2% to 34%) with 4 countries using the default $Frac_{GASM}$ of 20% and the lowest volatilization fraction used being 19%. The country-specific methodology for the estimation of NH_3 volatilization is in some cases based on the NH_3 inventory using the CORINAIR methodology thus differentiating between different kinds of synthetic fertilisers. Also, model-based estimations for the fraction of nitrogen volatilised from applied animal wastes have been used. The fraction of nitrogen lost by leaching ranges from 7% to 33% with 8 countries using the default FracLEACH of 30% andcountries using a smaller value. They are in some cases based on a nitrogen-leaching model (e.g., Denmark, Sweden) and in some cases based on national studies (e.g., Finland, Ireland).

Table 6.72: Member State's background information on the fraction of NH_3 and NOx volatilized from applied mineral fertilizer, $Frac_{GASF}$ for the calculation of N_2O emissions in category 4.D

Member State	$Frac_{GASF}$
Austria	$Frac_{GASF}$ 23% for mineral fertilizers and 15.3% for urea fertilizers (CORINAIR).
Belgium	$Frac_{GASF}$ 2.3% in Wallonia (recommended by IIASA for different fertiliser types); in Flanders an average rate for NH_3 volatilisation is calculated by the model that estimates the NH_3 emissions from synthetic fertiliser as developed by ILVO. The rate for NO volatilisation in Flanders is 1.5%.
Denmark	The Danish value for the $Frac_{GASF}$ is an average of national estimates of NH_3 emissions from each fertilizer type (Sommer and Christensen, 1992; Sommer and Jensen, 1994; Sommer and Ersbøll, 1996) in accordance with the CLRTAP guidebook. This average is with 0.02 considerably lower than given in IPCC, i.e. 0.10. The major part of the Danish emission is related to the use of calcium ammonium nitrate and NPK fertiliser, where the emission factor is 0.02 kg NH_3-N/kg N. The low Danish $Frac_{GASF}$ is also probably due to a small consumption of urea (<1%), which has a high emission factor.
Finland	The country-specific $Frac_{GASF}$ value is based on the NH_3 emission factor given in the report by (ECETOC, 1994) for NPK fertilisers, which is 1% of the nitrogen content in the fertilisers.In Finland, about 90% of the fertilisers are NPK fertilizers. Urea is used only in small amounts. 80% of the nitrogen in synthetic fertilisers in Finland is applied using the placement method - placing the fertilizer approximately 7-8 cm below the soil surface (urea application is place on the surface).A conservative estimate of 50% surface application has been used. A project to measure ammonia emissions from fertilisation may lead to a revision of the $Frac_{GASF}$ values.
Germany	$Frac_{GASF}$ dynamically calculated using default emission factors for the application of mineral fertilizers (EMEP/CORINAIR, 2003). NH_3 emissions consider different fertilizer types, temperature during fertilizer application, and make a distinction between arable and grassland. To this purpose, the total fertilizer application is distributed to grassland and arable land under the assumption that no preference for fertilizer types exists and under application of fertilizer application recommendations.

Member State	$Frac_{GASF}$
Ireland	The volatilization rates for Ireland are however determined from an elaborate new NH_3 inventory for agriculture and it is assumed that nitrogen lost as NOX is negligible in comparison to NH_3.
Netherlands	Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions. The extent of the NOx emission as a result of fertiliser and animal manure is estimated at 15% of the ammonia emission (De Vries et al., 2003). The supply source, deposits of NOx as a result of using fertiliser and animal manure, is not (yet) included in the annual calculations under the framework of the Emission Registration, and is therefore not included when determining the nitrogen balance.
Portugal	product specific volatilization rates from EMEP/CORINAIR (EEA,2003) were used for each nitrogen fertilizer type. The weighted average varies between 0.053 and 0.064 kg NH_3-N/kg N, and which are almost half the default value.
Sweden	The proportions of emitted N-content of fertilisers sold in different years varie because of changes in the sold quantities of different types of fertilisers. Ammonia emission fractions after CORINAIR.

Table 6.73: Member State's background information on the fraction of NH_3 and NOx volatilized from applied manure, $Frac_{GASM}$ for the calculation of N_2O emissions in category 4.D

Member State	$Frac_{GASM}$
Austria	The amount of manure left for spreading was calculated within source category 4B (Amon et al., 2002). With regard to a coprehensive treatment of the nitrogen budget, the emission inventory of N_2O is linked with the Austrian inventory of NH_3. This procedure enables the use of country specific data, which is more accurate than the use of the default value for $Frac_{GASM}$. Nitrogen left for spreading is calculated subtracting the following losses: N-excreted during grazing, NH_3-N losses from housing, NH_3-N losses during manure storage and N_2O-N losses from manure management. NH_3 emissions from housing: according to CORINAIR guidelines 1999 (Swiss or German default factors); NH_3 emissions from manure management: TAN content accroding to Schlechtner 1991 (cattle and pigs) + emissions factors default CORINAIR; other animals CORINAIR simple methodology; NH_3 emissions during manure application: CORINAIR default factors; NOX-emissions during manure application: a conservative emission factor for NOx-N of 1% was used (Fre
Belgium	In Wallonia and Flanders no animal manure is burned.In Flanders the animal manure nitrogen used as fertiliser is also corrected for the amount of manure transported outside Flanders or to a fertiliser processing company.
Denmark	The $Frac_{GASM}$ is estimated as the total N-excretion (N ab animal) minus the ammonia emission in stables, storage and application. They are based on national estimations and are calculated in the ammonia emission inventory. The $Frac_{GASM}$ has decreased since 1990 0.26 to 0.20. This is a result of an active strategy to improve the utilization of the nitrogen in manure.It is assumed that 1.9% of the N-input from sewage sludge or industrial sludge applied to soil volatilises as ammonia.An ammonia emission factor of 7% is used for all animal categories based on investigations from the Netherlands and the United Kingdom (Jarvis et al. 1989a, Jarvis et al., 1989b and Bussink 1994).
Finland	Value for $Frac_{GASM}$ has been obtained from the ammonia model of VTT Technical Research Centre of Finland (Savolainen, 1996). In the model, annual N excreted by each animal type has been distributed into different manure management systems typical for each animal group. Ammonia volatilisation during stable, storage and application were included with specific emission factor in each phase. $Frac_{GASM}$ is the proportion of total NH_3-N of the total N excreted. Emission factors for the amount of NH_3 volatilised in each phase has been taken from (ECETOC, 1994; Grönroos et al., 1998). References that support the values used are cited in the NIR. For grazing animals, an ammonia emission factor of 7% is used for all animal categories based on investigations from the Netherlands and the United Kingdom (Jarvis et al., 1989a; Jarvis et al., 1989b; Bussink 1994).
Germany	$Frac_{GASM}$ dynamically calculated using default emission factors for the application of organic fertilizers (EMEP/CORINAIR, 2003).Germany considers broadcasting, and for slurry additionally trailing hose and trailing shoe for slurry. Distinction is made between arable land and grassland. Incorporation timing is considered (< 1 h, < 4 h, < 6 h, < 12 h, < 24 h, and without incorporation)
Ireland	The volatilization rates for Ireland are however determined from an elaborate new NH_3 inventory for agriculture and it is assumed that nitrogen lost as NOX is negligible in comparison to NH_3. In addition, $Frac_{GASM}$ is split into $Frac_{GASM}1$ and $Frac_{GASM}2$ with $Frac_{GASM}1$ referring to NH_3-N losses from animal manures in housing, storage and landspreading and $Frac_{GASM}2$ being the proportion of nitrogen excreted at pasture that is volatilised as NH_3.

Member State	$Frac_{GASM}$
Italy	$Frac_{GASM}$ country-specific
Netherlands	Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions (estimated at a tier 3 level; LEI-MAM).
Portugal	The use of emission factors of ammonia volatilisation from EMEP/UNECE results, therefore, in obtaining a value for $Frac_{GASM}$ that is different and slightly higher than the default value for $Frac_{GASM}$. The resultant implied $Frac_{GASM}$ oscilates between 0.22 to 0.23 kg N-NH_3 + N-NOx/ kg of N excreted.
Spain	National $Frac_{GASM}$
Sweden	The estimates of the fraction of nitrogen supply in emitted as ammonium-N are model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers,was developed in the early 1990s.Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage. $Frac_{GASM}$ varies from year to year.

Table 6.74: Member State's background information on the fraction of nitrogen input leached or run-off, FracLEACH for the calculation of N_2O emissions in category 4.D

Member State	FracLEACH
Austria	Default value applied to nitrogen inputs from synthetic fertilizer use, livestock excretion, and sewage sludge application.
Belgium	FracLEACH is estimated from local studies (Pauwelyn, 1997) and falls into the IPCC range (0.17 kg N / kg N available). In Flanders, the nitrogen leaching (N_2O model) comes from the SENTWA model (System for the Evaluation of Nutrient Transport to Water) that is yearly updated.
Denmark	The amount of nitrogen lost by leaching and run-off from 1986 to 2002 has been calculated by FAS. The calculation is based on two different model predictions, SKEP/Daisy and N-Les2 (Børgesen and Grant, 2003) and for both models measurements from study fields are taken into account. The result of these two calculations differs only marginally. The average of these two model predictions is used in the emission inventory. The fraction of N input to soils that are lost through leaching and runoff (FracLEACH) used in the Danish emission inventory is higher than the default value given in IPCC (30%). High leaching values are partly due to the humid Danish climate, with the precipitation surplus during winter causing a downward movement of dissolved nitrogen. The generally accepted leaching values in Denmark are 0.3 for mineral nitrogen and 0.45 for organic-bound nitrogen. These values are based on numerical leaching studies. The data reflects the Danish conditions and are considered as best estimate.
Finland	It is estimated that nitrogen leaching is less than IPCC default value in Finnish conditions (Rekolainen, 1993) value is 15% and this has been used in the inventory).
Ireland	The expressions for N_2O indirect-dep and N_2O indirect-leach are slightly modified to be consistent with those for estimating direct emissions above and to account for the two separate volatilisation fractions $Frac_{GASM}$1 and $Frac_{GASM}$2. Estimates of the nitrogen loads in Irish rivers reported under the OSPAR Convention (NEUT, 1999) suggest that approximately 10 percent of all applied nitrogen in Irish agriculture is lost through leaching. This level of leaching is also indicated by farm budget studies where the nitrogen runoff equivalent to 60 kg N/ha has been measured in streams adjoining farmland receiving 200 kg N/ha from chemical fertilizer and 100 kg N/ha from animal manures per year. The value of 0.1 is considered to be a more realistic estimate of FracLEACH than the default value of 0.3.
Netherlands	Default $Frac_{GASM}$. Any manure that is exported to other countries is not included in the calculation. The nitrogen in exported manure is determined annually by CBS. The sewage sludge supply source is not included in the calculation of indirect N_2O emissions from agricultural soil. Indirect N_2O emissions resulting from leaching and run-off N emissions are estimated using country-specific data on total N-input into soil (estimated at a Tier 2 level). IPCC default values are used for the fraction of N-input to soil that leaches from the soil and ends up partly as N_2O emissions from groundwater and surface water (Fracleach) and for the N_2O emission factors.
Portugal	Default FracLEACH for nitrogen applied to soil. For 20% of manure managed in anaerobic lagoons, which are directly discharged to the wastewater system, with agreement of the ERT, the N_2O emissions are calculated directly from the total amount of manure discharged, without considering volatilization losses are a leaching fraction.

Member State	FracLEACH
Sweden	The national estimates of nitrogen leaching are calculated from the SOILNDB model, which is a part of the SOIL/SOILN model (Johnsson, 1990; Swedish EPA, 2002). The simulation model SOIL/SOILN was developed during the 1980s in order to describe nitrogen processes in agricultural soils.Since then the model has been developed and tested on data from controlled leaching experiments, and these tests show that the model estimates leachign from soils with good precision (Swedish EPA, 2002b). By using national data on crops, yields, soil, use of fertilizer/manure and spreading time, the leaching is estimated for 22 regions. These regions are based on similarities in agricultural production. For calculating nitrogen leaching in the inventory, the average N leaching per hectare, calculated by the SOILNDB model, is multiplied by the total Swedish area of agricultural soil. To estimate the implied FracLEACH,the leached nitrogen, according to the national model, is divided by the sum of nitrogen in fertilisers and anim
United Kingdom	Indirect emissions of N_2O from leaching and runoff are estimated according the IPCC methodology but with corrections for N_2O emissions to avoid double counting N.The sources of nitrogen considered, are synthetic fertiliser application and animal manures applied as fertiliser.

N_2O emissions from other sources.

Seven countries report emissions of N_2O from the application of sewage sludge, according to the IPCC GPG. The emission factors used are in six cases the IPCC default factor for direct N_2O emissions, one Member States used a different value. An overview of the emissions from sewage sludge and the specified other 'other' sources in category 4D is given in Table 6.75.

Table 6.75: Member State's emissions from "other" sources in category 4D

Member States 2005	Description	Value kg N/yr	IEF kg N_2O-N / kg N	EMISSIONS N_2O (Gg)	Value kg N/yr	IEF kg N_2O-N / kg N	EMISSIONS N_2O (Gg)
		1990			2007		
Belgium	Sludge Spreading	75,274	0.0125	0.0015	74,784	0.0125	0.0015
Denmark	Industrial w aste used as fertilizer	1,528,720	0.0125	0.0300	11,000,000	0.0125	0.2161
Denmark	Use of sew age sludge as fertilizers	3,056,917	0.0125	0.0600	3,536,033	0.0125	0.0695
Belgium	Sew age sludge on agriculture landfields	27,208,200	0.0100	0.4276	28,261,300	0.0100	0.4441
Netherlands	Sludge application on land	5,000,000	0.0100	0.0786	1,000,000	0.0100	0.0157
Portugal	Other non-specified	340,375	0.0125	0.0067	340,375	0.0125	0.0067
Spain	Domestic Wastew ater Sludge	8,321,005	0.0125	0.1630	28,687,920	0.0125	0.5618
Spain	Municipal Solid Wastes Compost	8,506,498	0.0125	0.1666	9,058,777	0.0125	0.1774
Sw eden	Cultivation of mineral soils	2,592,000	0.5000	2.0366	2,395,000	0.5000	1.8819
United Kingdom	Improved Grassland	27,689,300	0.0125	0.5439	28,563,703	0.0125	0.5611

Additional information on N_2O emissions estimated from the application of sewage sludge it given in Table 6.76.

Table 6.76: Member State's background information on N_2O emissions estimated under the category 'other' in category 4.D

Member State	FracGASF
Austria	Country-specific data on N-content (Scharf et al., 1997).
Denmark	The category, "Other", includes emission from sewage sludge and sludge from the industrial production applied to agricultural soils as fer-tiliser. Information about industrial waste, sewage sludge applied on ag-ricultural soil and the content of nitrogen is provided by the Danish Environmental Protection Agency.
Ireland	Published estimates of sludge production (Smith et al, 2007) and the proportion applied on agricultural lands are used to estimate FS on the basis of 3 percent nitrogen content in sewage sludge with typical dry solids content of 25 percent (Fehily Timoney, 1985). The estimate of FS is included in N_2Odirect without deduction for volatilisation and the value is added to FAM for reporting purposes.
Sweden	N_2O from sewage sludge used as fertiliser is a part of the N_2O emissions from agricultural soils and may be reported, according to the IPCC Good Practice Guidance, if sufficient information is available. Statistics on the use of sewage sludge have been published irregularly and in different reports, but a time series has been created through interpolation and the emissions are reported for the first time in submission 2006 of the GHG inventory.

Trends

Consistent with the decrease of animal numbers in Europe and the decrease of nitrogen in manure (see above), also the input of nitrogen to agricultural soils decreased considerably in the time between 1990 and 200, as shown in Table 6.62. The input of manure decreased by 6%, and the input of mineral fertilizer decreased even more, by 25%. Accordingly, also the amount of nitrogen volatilized or leached decreased by 16% and 13%, respectively.

Figure 6.32 through Figure 6.45 show the trend of direct N_2O emissions from the source categories mineral and organic fertilizer application and indirect emissions from atmospheric deposition and nitrogen leaching and run-off.

In several countries the fraction of mineral fertilizer that volatilises as NH_3 or NO_x is showing considerable fluctuation (see for example Sweden and Ireland). This is a direct consequence of the varying composition of the types of mineral fertilizer used and the NH_3 emission factors taken from the more detailed ammonia-inventory.

The fraction of livestock N excretion that volitilises as NH_3 or NO_x is reported to be more stable. A descreasing trend can be observed for Denmark and Belgium.

Table 6.77 gives additional information on the trend in category 4D as reported in the national inventory reports.

Table 6.77: Member State's background information on the trend for N_2O emissions in category 4D.

Member State	Trend in category 4B(b)
Austria	High inter-annual variations in N_2O emissions are caused by fluctuations in mineral fertilizer sales. These variations are caused by the effect of storage. As fertilizers have a high elasticity to prices, sales data are changing due to changing market prices very rapidly. Not the whole amount purchased is applied in the year of purchase. The fertilizer tax intensified this effect at the beginning of the 1990s. In the in-country review 2007 it was recommended to consider revising the time series by determining actual fertilizer use in accordance with the IPCC good practice guidance. Investigations showed that data on the actual fertilizer use are not available in Austria. Therefore it has been decided to continue to use the official fertilizer sales data as input data for the emission inventory.
Belgium	The fraction volatilised as NH_3 and NO in Flanders ($Frac_{GASM}$) decreased from a value of 0.36 kg(NH_3-N+NO-N)/kg Nex in 1990 to 0.20 kg(NH_3-N+NO-N)/kg Nex in 2006 due to the implementation of different successive Manure Action Plans in Flanders.
Denmark	The decrease in total emissions in Denmark can largely be attributed to the decrease in N_2O emissions from agricultural soils – the total N_2O emission from 1990-2006 has decreased by 24%. This reduction is due to a proactive national environmental policy over the last twenty years. The national emission from crop residues has decreased 12% since 1990, which is a result of a decrease in the cultivated area of beets for feeding, which has been replaced by cultivation of green maize. Another reason is a fall in the agricultural area and a greater part of the straw is harvest (52% in 1990 and 60% in 2007). FracLEACH is decreasing since the 1990s, when manure was often applied in autumn. The decrease in FracLEACH over time is caused by sharpened environmental requirements, banning manure application after harvest. The major part of manure application is made in spring and summer, where there is a precipitation deficit.
Finland	The emissions have decreased by 25%, from 13.9 Gg in 1990 to 10.4 Gg in 2006. The main reasons causing this reduction are the reduction in animal numbers, which affects the amount of nitrogen excreted annually to soils, the fall in the amount of synthetic fertilisers sold annually and the decrease in the area of cultivated organic soils. Some parameters, such as the annual crop yields affecting the amount of crop residues produced, cause the fluctuation in the time series but this fluctuation does not have much effect on the overall N_2O emissions trend.
Netherlands	Total N_2O emissions from Agricultural soils decreased significantly since 1990. Direct emissions increased, while indirect emissions and emissions from animal manure produced in the meadow decreased, respectively. This decrease is caused by a relatively high decrease in N-input to soil (from manure and chemical fertilizer application and animal production in the meadow) partly counteracted by the increased IEF in this period that resulted from a shift from the surface spreading of manure to the incorporation of manure into soil as a result of ammonia policy driving a shift from surface spreading of manure to the incorporation of manure into the soil. The decrease in indirect N_2O emissions is fully explained by the decrease in N lost by atmospheric deposition and by leaching and run-off. The decrease in N_2O emissions from animal manure produced in the meadow is also entirely reflected in the decrease in N-input to soil by this source.The increase in direct N_2O emissions can mainly be explained by thedecrease in the direct N-input to soil by manure and chemical fertilizer application in combination with an increase of the IEF. For (direct) soil emissions by manure application to soil an increase of the IEF is caused by a ammonia policy driven shift from the surface spreading of manure to the incorporation of manure into the soil.
Portugal	Time series shows an abrupt decrease until 1992 and thereafter a lighter reduction: total synthetic nitrogen fertilizer use in 2003 is 22% less than in 1990. Nitrogen in fertilizers is the first source of nitrogen to soils in Portugal just above nitrogen in animal manure applied to soil. Interannual changes of emissions (2002/2003 16%, 2003/2004 6%, 2004/2005 8%, 2005/2006 11%, fluctuation from 2003) can be explained from variations of emissions from N applied as synthetic fertilizers. During this period a severe drought occured which caused

Member State	Trend in category 4B(b)
	reduction in the sales and use of fertilizers.
Sweden	Estimated standard yields for different crops are published annually by SJV/Statistics Sweden and are a function of crop yields estimated by surveys conducted over the last 15 years.By using standard yields instead of actual yields in the calculations, the time series becomes more regular. **Frac$_{GASF}$**: variations in Frac$_{GASF}$ are a direct consequence of the varying composition of types of mineral fertilizers (Swedish Board of Agriculture, Statistics Sweden) and the NH_3 emission factors from CORINAIR (1998) (see inventory report Sweden). **Frac$_{GASM}$**: The fraction of nitrogen supply emitted as ammonium-N is model-based and take into account many factors that influence gas emissions. The methodology, based on data collected on the use of manure from telephone interviews with farmers, was developed in the early 1990s. Later, the methodology was extended to take into account more detailed information on the use of manure and manure storage.
United Kingdom	Direct N_2O emissions from soil are decreasing of N_2O emissions in 2006 by 8%, due to a decrease in inorganic fertiliser by 9%

Figure 6.32: Trend of N_2O emissions for mineral fertilizer – N-input

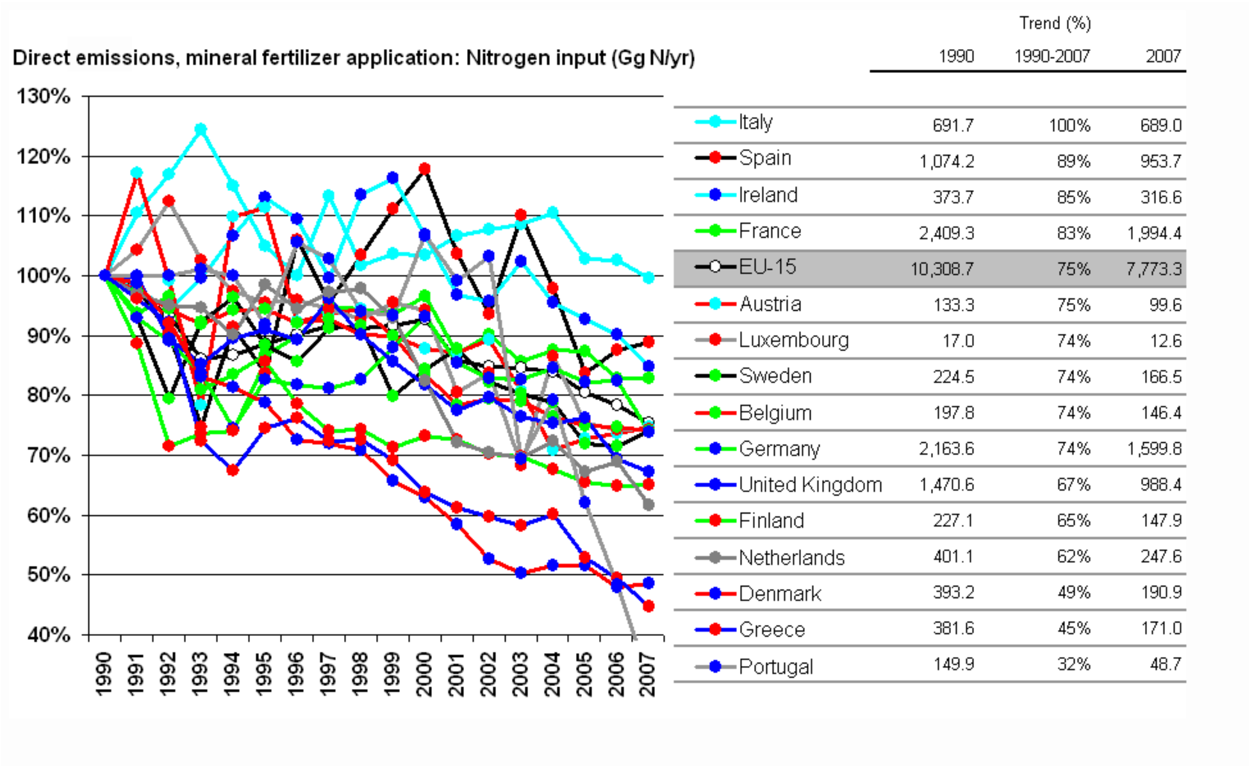
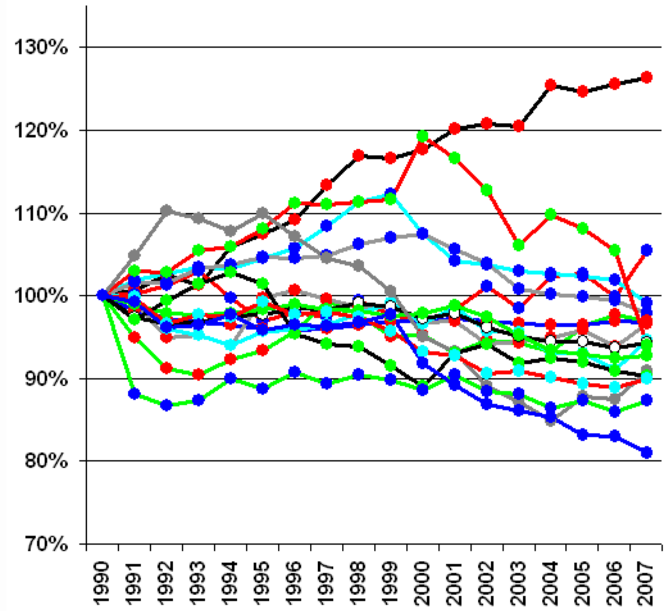


Figure 6.33: Trend of N_2O emissions for organic fertilizer – N-input

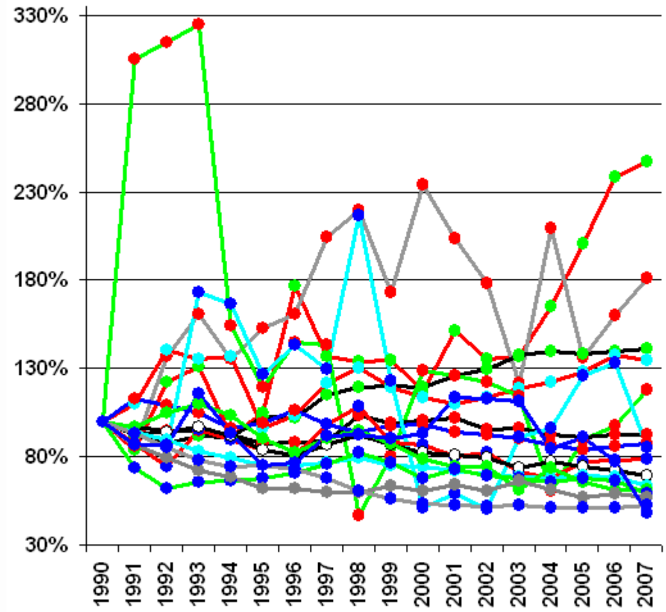
Direct emissions, manure application: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2007	2007
Spain	433.5	126%	547.8
Denmark	178.9	105%	188.7
Ireland	76.2	99%	75.4
Portugal	56.4	98%	55.2
Finland	63.0	97%	61.1
Greece	39.5	97%	38.2
Luxembourg	5.8	97%	5.6
Italy	473.8	95%	448.0
EU-15	4,397.3	94%	4,147.7
Belgium	143.4	94%	134.7
France	923.9	93%	856.5
Netherlands	328.4	91%	298.6
Sweden	69.7	90%	63.0
Austria	115.8	90%	104.2
Germany	1,016.9	87%	888.2
United Kingdom	472.0	81%	382.6

Figure 6.34: Trend of N_2O emissions from crop residues – N-input

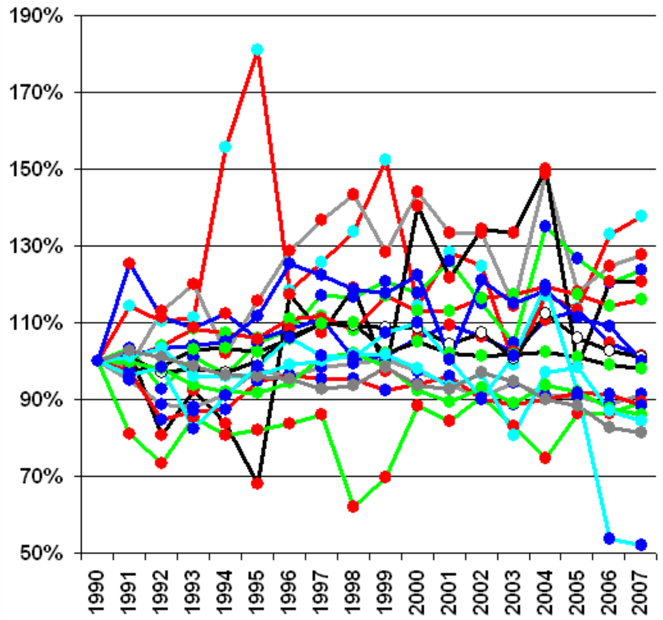
N-fixing crops: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2007	2007
Belgium	0.8	247%	1.9
Luxembourg	1.9	181%	3.5
Sweden	23.6	141%	33.3
Austria	16.8	135%	22.6
Finland	0.7	118%	0.8
Spain	203.1	92%	187.2
Greece	1.1	88%	1.0
Ireland	0.5	85%	0.4
Denmark	44.3	79%	34.8
EU-15	1,259.6	69%	871.4
Italy	254.7	63%	160.6
France	515.7	61%	314.0
Germany	140.4	59%	83.2
Netherlands	7.8	57%	4.5
Portugal	5.0	53%	2.7
United Kingdom	43.2	48%	20.8

Figure 6.35: Trend of N_2O emissions from N-fixing crops – N-input

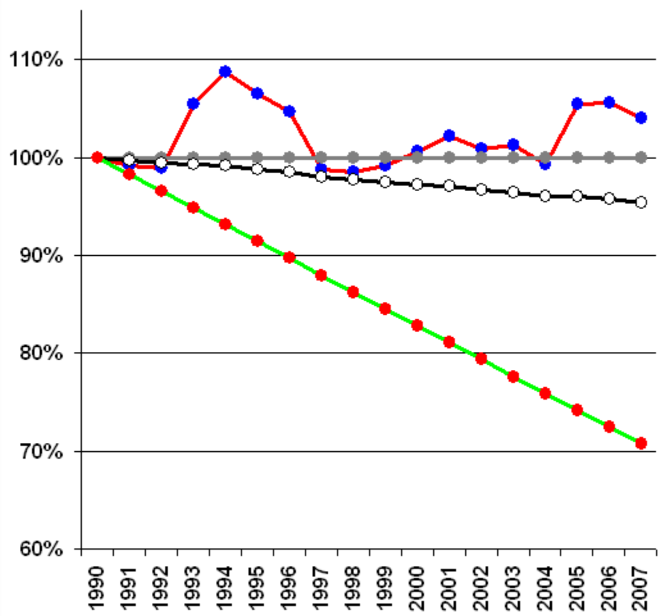
Crop residues: Nitrogen input (Gg N/yr)



	1990	Trend (%) 1990-2007	2007
Austria	29.2	138%	40.2
Luxembourg	4.1	128%	5.2
Germany	456.1	124%	563.8
Spain	93.4	121%	112.8
Belgium	45.1	116%	52.3
Greece	23.6	101%	23.9
EU-15	1,921.5	101%	1,941.2
United Kingdom	365.2	100%	365.8
Sweden	53.4	98%	52.3
Portugal	26.6	91%	24.3
Finland	30.7	89%	27.4
Denmark	59.3	88%	52.4
France	531.2	86%	456.5
Italy	147.5	84%	124.4
Netherlands	36.4	81%	29.6
Ireland	19.7	52%	10.2

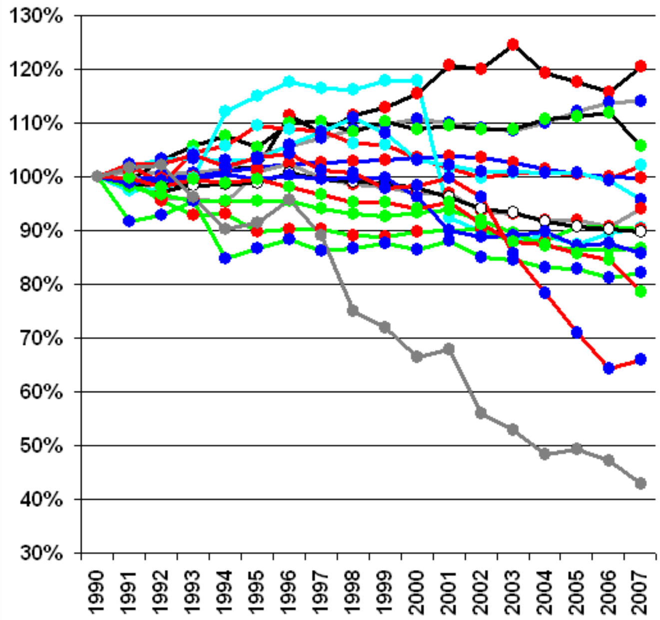
Figure 6.36: Trend of N_2O emissions from cultivated histosols – Cultivated area

Cultivation of histosols: Cultivated area (km2/yr)



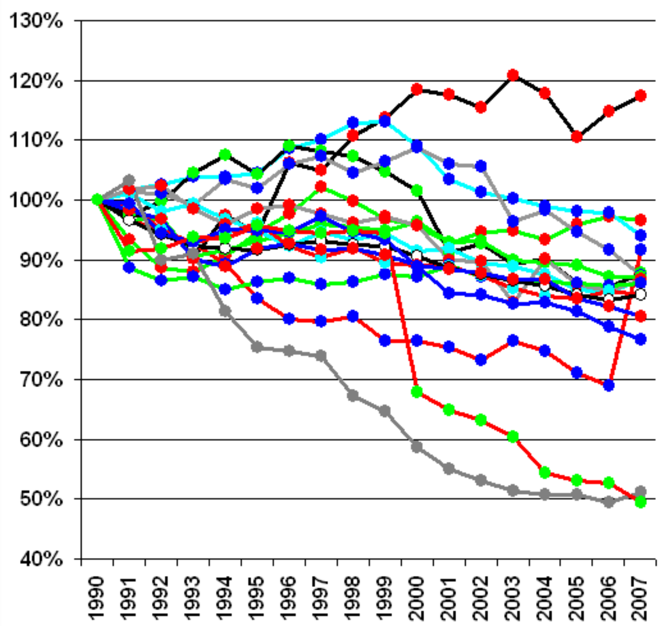
	1990	Trend (%) 1990-2007	2007
Denmark	780	104%	811
Germany	12,936	100%	12,936
Belgium	25	100%	25
Greece	67	100%	67
United Kingdom	392	100%	392
Sweden	2,526	100%	2,526
Italy	90	100%	90
Netherlands	2,230	100%	2,230
EU-15	22,735	95%	21,685
Finland	3,689	71%	2,609
Austria			
Luxembourg			
Spain			
Portugal			
France			
Ireland			

Figure 6.37: Trend of N_2O emissions from pasture, range, and paddock – N-input



	1990	Trend (%) 1990-2007	2007
Spain	282.9	121%	341.0
Portugal	67.9	114%	77.4
Sweden	38.9	106%	41.1
Austria	22.4	102%	22.9
Greece	347.3	100%	346.8
Ireland	287.6	96%	275.1
Luxembourg	6.0	94%	5.7
Italy	178.2	90%	161.1
Finland	16.9	90%	15.2
EU-15	3,162.8	90%	2,840.5
France	880.4	87%	763.5
United Kingdom	511.2	86%	438.2
Germany	220.0	82%	180.9
Belgium	96.0	79%	75.4
Denmark	32.1	66%	21.1
Netherlands	175.0	43%	75.0

Figure 6.38: Trend of N_2O emissions for atmospheric deposition – N-input



	1990	Trend (%) 1990-2007	2007
Spain	187.2	117%	219.5
Finland	39.9	96%	38.5
Ireland	90.2	94%	84.9
Denmark	99.9	92%	91.5
Sweden	41.5	88%	36.4
Portugal	43.4	87%	37.9
France	676.8	87%	590.5
Italy	380.0	87%	329.9
Luxembourg	4.6	87%	4.0
Germany	594.0	86%	510.8
Austria	42.5	84%	35.8
EU-15	3,014.4	84%	2,534.5
Greece	121.7	80%	97.9
United Kingdom	408.2	77%	312.8
Netherlands	195.9	51%	100.3
Belgium	88.6	49%	43.7

Figure 6.39: Trend of N_2O emissions for nitrogen leaching and run-off – N-input

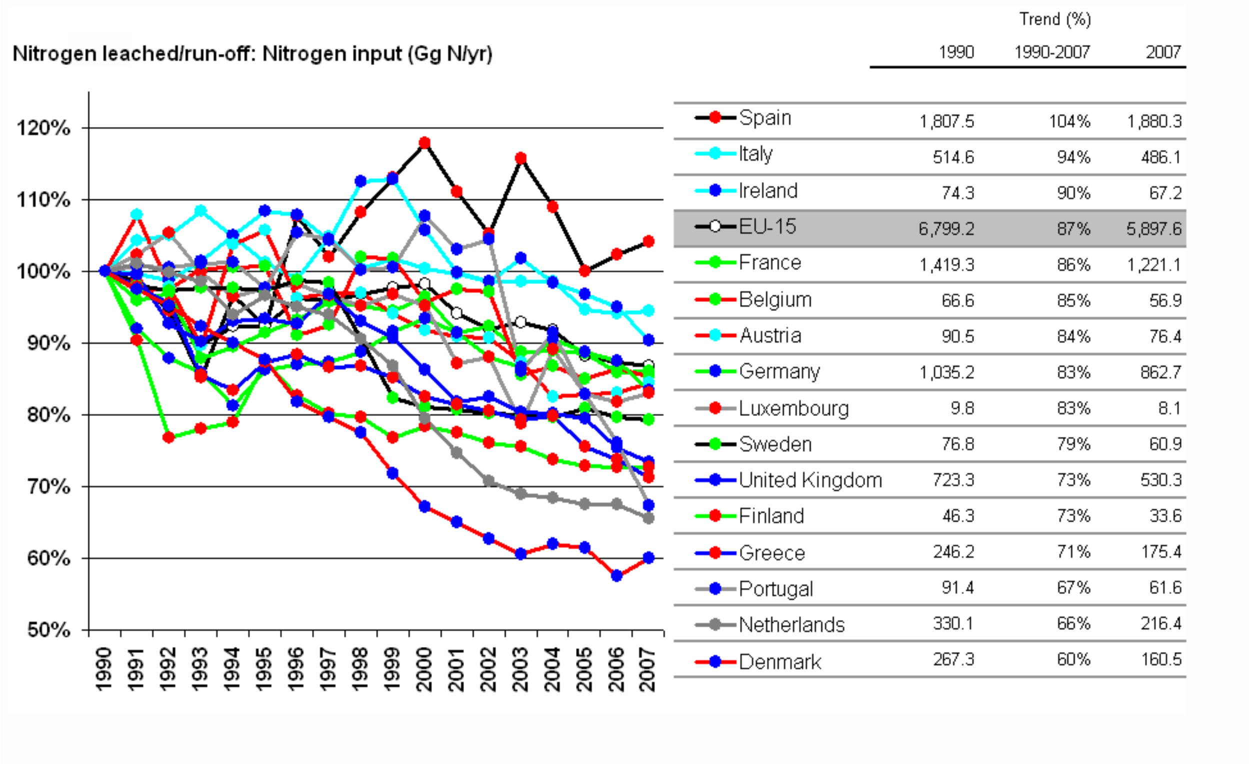


Figure 6.40: Trend of $Frac_{GASF}$

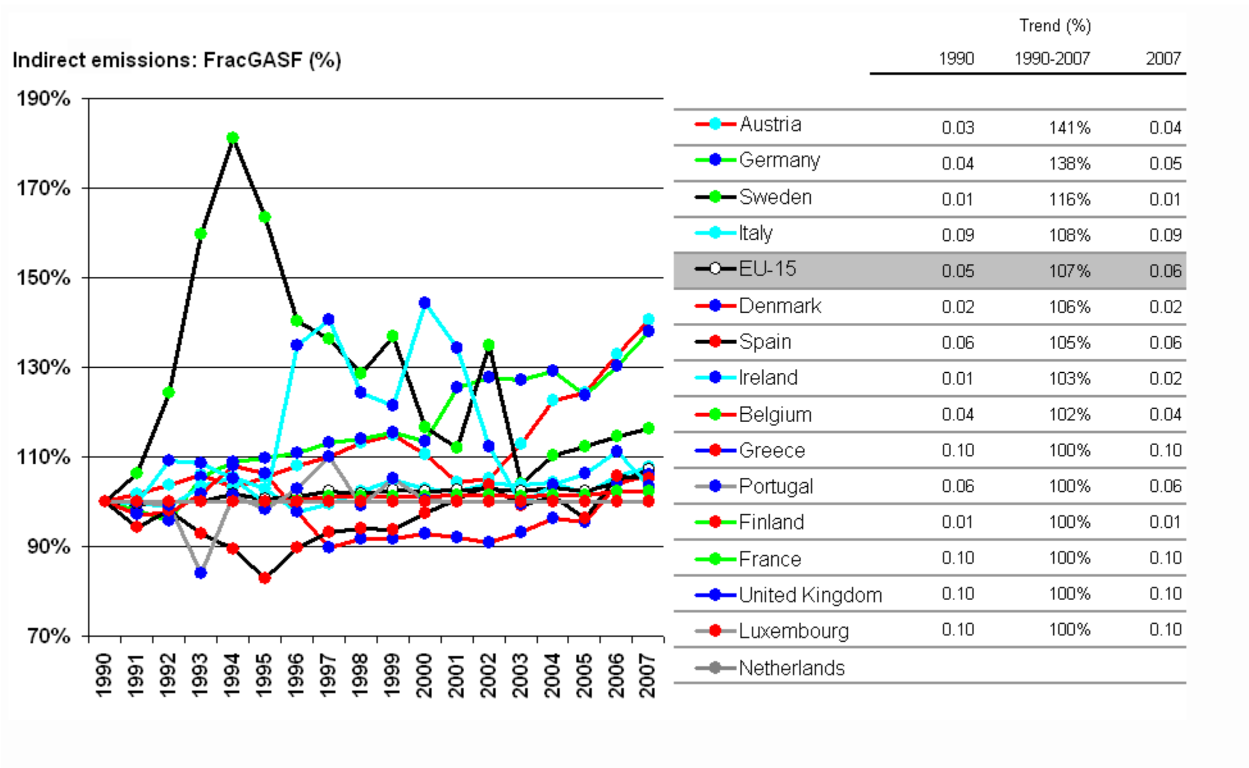
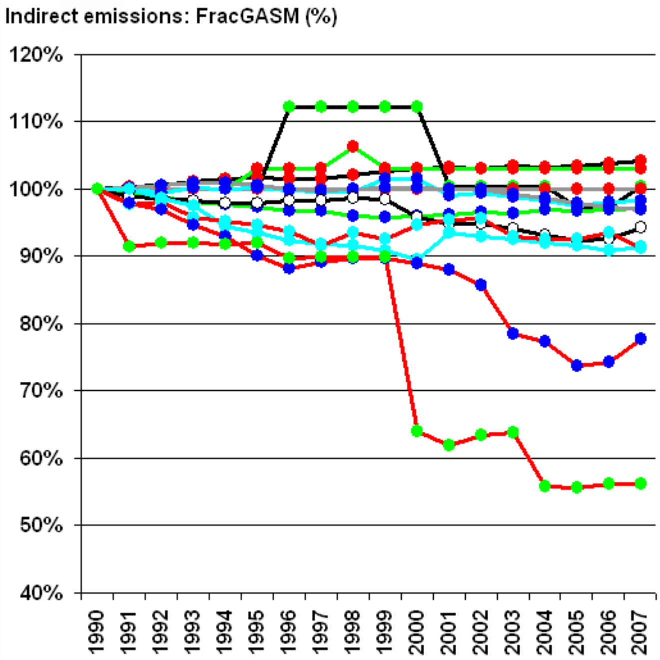
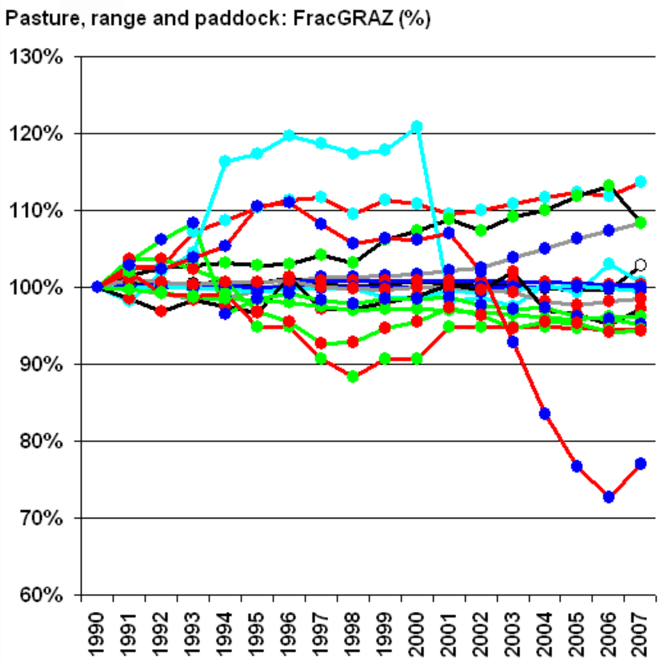


Figure 6.41: Trend of Frac$_{GASM}$



	1990	Trend (%) 1990-2007	2007
Spain	0.33	104%	0.34
Finland	0.32	103%	0.33
Sweden	0.33	100%	0.33
Greece	0.20	100%	0.20
France	0.20	100%	0.20
United Kingdom	0.20	100%	0.20
Luxembourg	0.20	100%	0.20
Ireland	0.19	98%	0.19
Germany	0.29	97%	0.28
Portugal	0.22	97%	0.21
EU-15	0.26	94%	0.25
Italy	0.32	91%	0.29
Austria	0.22	91%	0.20
Denmark	0.26	78%	0.20
Belgium	0.36	56%	0.20
Netherlands			

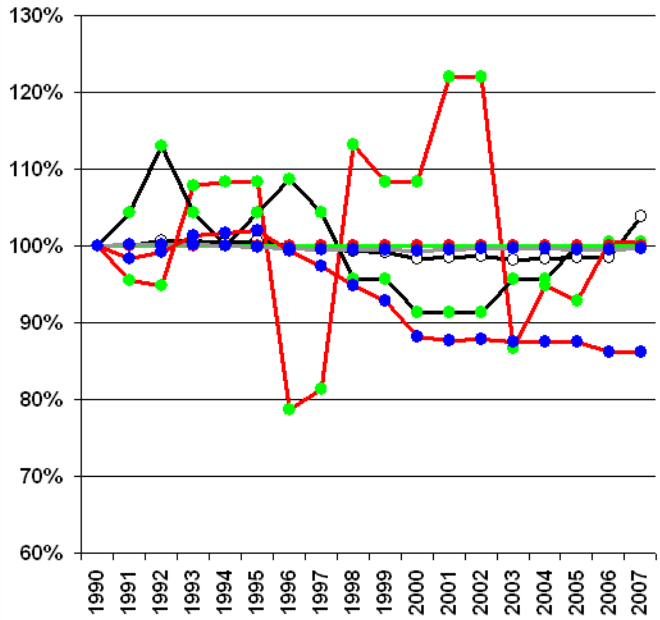
Figure 6.42: Trend of Frac$_{GRAZ}$



	1990	Trend (%) 1990-2007	2007
Austria	0.13	114%	0.14
Portugal	0.43	108%	0.47
Sweden	0.30	108%	0.32
EU-15	0.36	103%	0.37
Italy	0.19	101%	0.19
Greece	0.88	100%	0.88
United Kingdom	0.52	100%	0.52
Ireland	0.66	100%	0.66
Luxembourg	0.45	99%	0.45
Spain	0.39	97%	0.38
France	0.43	96%	0.42
Germany	0.13	95%	0.12
Belgium	0.23	95%	0.22
Finland	0.21	94%	0.20
Denmark	0.12	77%	0.09
Netherlands			

Figure 6.43: Trend of FracLEACH

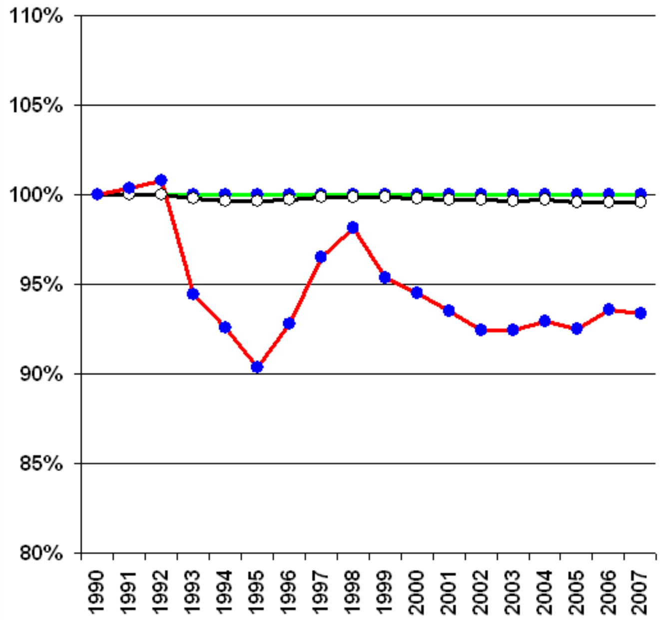
Indirect emissions: FracLEACH (%)



	1990	Trend (%) 1990-2007	2007
EU-15	0.26	104%	0.27
Belgium	0.07	100%	0.07
Austria	0.30	100%	0.30
Sweden	0.23	100%	0.23
Italy	0.30	100%	0.30
Greece	0.30	100%	0.30
United Kingdom	0.30	100%	0.30
Ireland	0.10	100%	0.10
Luxembourg	0.30	100%	0.30
Spain	0.30	100%	0.30
France	0.30	100%	0.30
Germany	0.30	100%	0.30
Finland	0.15	100%	0.15
Portugal	0.32	100%	0.32
Denmark	0.38	86%	0.33
Netherlands			

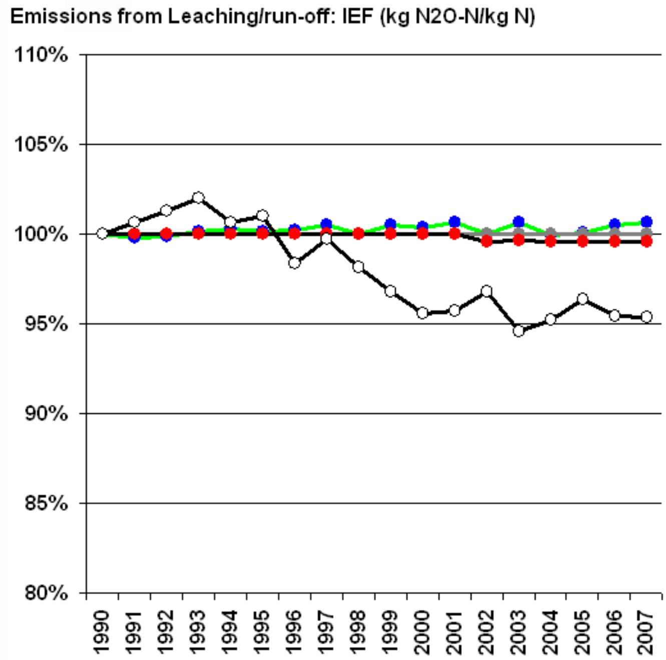
Figure 6.44: Trend of direct emissions from the cultivation of histosols - IEF

Cultivation of histosols: IEF (kg N2O-N/ha)



	1990	Trend (%) 1990-2007	2007
Finland	7.84999	100%	7.85000
Belgium	8.00000	100%	8.00000
Italy	8.00000	100%	8.00000
Netherlands	4.70000	100%	4.70000
Greece	8.00000	100%	8.00000
Sweden	8.00000	100%	8.00000
United Kingdom	8.00000	100%	8.00000
Germany	8.00000	100%	8.00000
EU-15	7.48274	100%	7.45050
Denmark	3.06678	93%	2.86338
Spain			
Ireland			
Luxembourg			
France			
Austria			
Portugal			

Figure 6.45: Trend of indirect emissions from leaching/run-off - IEF



	1990	Trend (%) 1990-2007	2007
Germany	0.00750	101%	0.00755
France	0.02500	100%	0.02500
Sweden	0.02500	100%	0.02500
Denmark	0.02500	100%	0.02500
Ireland	0.02500	100%	0.02500
Belgium	0.02500	100%	0.02500
Greece	0.02500	100%	0.02500
United Kingdom	0.02500	100%	0.02500
Luxembourg	0.02500	100%	0.02500
Austria	0.02500	100%	0.02500
Finland	0.02500	100%	0.02500
Portugal	0.02500	100%	0.02500
Italy	0.02500	100%	0.02500
Netherlands	0.02500	100%	0.02500
Spain	0.00750	100%	0.00747
EU-15	0.01768	95%	0.01686

6.3.5.3 Uncertainty and time series consistency

As described above, N_2O emissions from agricultural soils belong to the most uncertain source categories of national GHG inventories. For direct N_2O emissions, the highest uncertainty is attributed to the emission factor, which ranges up to 400% Greece relative uncertainty (expressed in 2•standard_deviation) and even 500% for each sub-category in Portugal. For indirect emissions, both the activity data and the emission factors are considered equally uncertain, which stems from the fact that a most uncertain parameter, the fraction of nitrogen leached, must be applied to determine the activity data. Thus, uncertainties of indirect N_2O emissions are estimated as up to more than 200% (Finland, Netherland, Portugal).

This large spread of the uncertainty estimates does generally not reflect real differences in the uncertainties, but rather differences in the interpretation of the available data:

- In the United Kingdom, the uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high.Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA (per. comm.).
- The estimate of Portugal is based on the Good Practice Guidance that presents a possible variation from one-fifth to 5 times the default emission factor of 1.25 per cent. From that range an uncertainty of 500 per cent was assumed in uncertainty analysis.

An overview of the uncertainty estimates for activity data and emission factors are given in Table 6.78 and Table 6.79. An overview of uncertainty estimates for agriculture at country and EU15 levels will be given in section 6.3.9

Table 6.76 compiles some background information on the estimates of the uncertainty of the values used as activity data and emission factors to estimate N_2O emissions from agricultural soils.

Table 6.78: Relative uncertainty estimates for activity data in category 4D (data from 2007 submission)

Member State 2006	Total	Direct	Animal Production	Indirect
Austria		5.0	5.0	5.0
Belgium	30.0			
Denmark	7.4			
Finland		0.0	0.0	0.0
France	8.7			
Germany		0.0	0.0	0.0
Greece		20.0	50.0	20.0
Ireland		11.2	11.2	11.2
Italy		20.0	20.0	20.0
Luxembourg		5.0	5.0	20.6
Netherlands		10.0	10.0	50.0
Portugal[1,2]		31.9	39.0	78.2
Spain		2.2		1.7
Sw eden				
United Kingdom	1.0			

1) Portugal, direct N2O emissions. Mineral fertilizer: 17%; Manure application: 107%; Crop residues: 25%; N-fixation: 25%

2) Portugal, indirect N2O emissions. Mineral fertilizer: 82%; Manure application: 118%; Crop residues: 63%; N-fixation: 63%

Table 6.79: Relative uncertainty estimates for implied emission factors in category 4D (data from 2007 submission)

Member State 2006	Total	Direct	Animal Production	Indirect
Austria		150.0	150.0	150.0
Belgium	250.0			
Denmark	22.9			
Finland		70.8	70.8	248.3
France	52.4			
Germany		409.6	30.0	736.1
Greece		400.0	100.0	50.0
Ireland		100.0	100.0	50.0
Italy		100.0	100.0	100.0
Luxembourg		300.0	500.0	300.0
Netherlands		60.0	100.0	200.0
Portugal[1,2]			500.0	
Spain		400.0		50.0
Sw eden				
United Kingdom	424.0			

1) Portugal, Mineral fertilizer: 500%; Manure application: 500%; Crop residues: 510%; N-fixation: 510%

2) Portugal, Mineral fertilizer: 100%; Manure application: 100%; Crop residues: 100%; N-fixation: 100%

Table 6.80: Member State's background information for uncertainty estimates in category 4.D

Member State	Background information to uncertainy estimates
Austria	Mineral Soils – EF: Revision of the uncertainty estimate of N_2O from soils. A detailed investigation revealed that the source of the 48% uncertainty presented was a statement in an IPCC report (2000) referring to a measurement uncertainty. Here we have to deal with an emission factor uncertainty, which is estimated much higher, at an order of magnitude (IPCC, 2006). This higher number is still much smaller than the two orders of magnitude recommended by IPCC (2000). The latter was considered in part systematic uncertainty, however (the random uncertainty was considered smaller than the range now used) - this is still in part true, but only reflects our lack of knowledge on soil processes. Choosing to aply a quasi-standardized value conforms to the claim of (Winiwarter,

	2007) that application of similar parameters between countries allows for a smaller error in an inter-comparison, even if the difference to a "true value" might be larger.In the latest Austrian study (WINIWARTER 2008) for the emission factor of N_2O from soils an uncertainty of 150% was applied. Uncertainty contributions of the activity (combined from agricultural area and average N-fertilizer input) at about 5% is almost negligible in this context. It is virtually N_2O alone that determines the uncertainty.
Belgium	Mineral soils - AD: N_2O emissions from soils involves the use of more AD (mineral fertilisers, atm. deposition and runoff, manure application, ...) Consequently the uncertainty on AD is estimated at 30% , which seems in line with the values applied by other parties. Mineral soils – EF: The uncertainty of N_2O from agricultural soils is crucial for the determination of the overall uncertainty. Although most countries use the IPCC default values, the uncertainty on emission factors varies widely : 2 orders of magnitude (Norway), 509 % (UK, in IPCC Good Practice Guidance), 200 % (France and the Netherlands, NIR 2003), 100 % (Ireland, NIR 2003), 75 % (Finland, overall uncertainty for AD*EF, [40]), 24 % (Austria, NIR 2003). For the time being, a more or less average value of 250 % is used for this uncertainty calculation.
Denmark	Mineral soils – AD: Both farmers and suppliers of mineral fertilisers are obliged to report to the Plant Directorate. The total sold to farmers is very close to the amount imported by the suppliers, corrected by storage. The total amount of mineral fertiliser in Denmark is, therefore, a very precise estimate for the mineral fertiliser consumed. This is also valid for N-excretion in animal manure.
Finland	The uncertainty estimate for N_2O emissions from agricultural soils is very high due to both lack of knowledge of emissions generating process and high natural variability and was estimated at -60 to +170% (direct) and -60 to +240% (indirect). For the 2005 inventory submission, uncertainty estimates were revised based on measurements data. The range of annual average emission factors obtained from different soils reveale that uncertainty may be larger than previously estimated. Mineral soils - AD: The most effective way to reduce uncertainty would be case D, i.e., the use of the climate-specific emission factors for N_2O from agricultural soils (Monni et al., 2007). On the basis of this study, at this stage the national field data does not enable the development of a reliable national emisison factor for mineral soils. The ntioal emission factor for N_2O emission from cultivated organic soils would be 7.9 kg ha-1 a-1 with an uncertainty of -114 to +187%, which is very close to the IPCC default value... These results from the field monitoring indicated that even if large national measurement campaigns are introduced, this source will still remain very uncertain. (Monni et al., 2007) Organic soils: The accuracy of the emission estimate for organic soils could be further improved by adopting separate emission factors for grass and cereals since emisisons from grass fields are consistently lower due to less frequent tillage of the soil and a longer period of nitrogne uptake of the grass compared to cereals (Monni et al., 2007)
Germany	The detailed discussion in this source indicates that the error for relevant areas is on the order of 10 % and that the error for emissions is on the order of 50%.
Ireland	Large uncertainties still remain in relation to the N_2O emissions from the agricultural sector. These uncertainties are the main determinant behind uncertainty in total national emissions
Italy	Uncertainty for N_2O emissions from agricultural soils (direct soil emissions, indirect soil emissions and animal production) has been estimated to be 102%, as combination of 20% and 100% for activity data and emission factor, respectively.
Luxembourg	Arable land crops, used to estimate soil emissions, are on the high end at 10%, just the “fallows” (which is the basis for calculating indirect soil emissions) is considered statistically dependent, but twice as high. Most similar analyses of uncertainties of national GHG inventories have already shown previously that N_2O emissions from soils are poorly understood and are the highest priority for methodological improvement. Mineral soils – EF: Manure application emission factor follow a 70% uncertainty for CH_4 and a range from 50% to 200 % (lognormal distribution) for N_2O. The CH_4 emission factor for soil emissions is considered uncertain by +/-100%, the N_2O emission factor is within a factor of 10 (lognormal distribution, from 30% to 300% of the best estimate) following IPCC (2006).
Netherlands	The uncertainty in direct N_2O emissions from Agricultural soils is estimated to be approximately 60%. The uncertainty in indirect N_2O emissions from N used in agriculture is estimated to be more than a factor of 2 (Olivier et al.,2009).
Portugal	Mineral soils – AD: Comparing the values of nitrogen in synthetic fertilizers form these independent data sources between 1995 and 2000 a maximum uncertainty value of 17 per cent was obtained. Mineral soils – EF: From that range an uncertainty of 500 per cent was assumed in uncertainty analysis for nitrogen applied as synthetic fertilizers, manure, crop residues and nitrogen fixed by n-fixing crops. Considering that in the cases of nitrogen added to soil from n-fixing crops and crop residues, an additional 100 per cent uncertainty was added to take into account errors in the determination of nitrogen content of crops and residues from production.
Sweden	Mineral soils – EF: Direct N_2O emissions from agricultural fields are calculated with an error of about 80% in the emission factor. The disaggregating of direct emissions from manure and mineral fertilisers, respectively, in the Swedish inventory may reduce some of the variability but direct emissions from agricultural soils are still one of the most uncertain in the inventory.
United Kingdom	Emissions from agricultural soils were correlated. The uncertainty assumed for agricultural soils uses a lognormal distribution since the range of possible values is so high. Here it is assumed that the 97.5 percentile is greater by a factor of 100 than the 2.5 percentile based on advice from the Land Management Improvement Division of DEFRA (pers. comm.). Mineral soils – EF: The overall uncertainty quoted is calculated using the first method in order that uncertainties

	should not be underestimated in sectors showing a skewed distribution such as agricultural soils and N_2O as a whole.

The following issue related to time-series consistency has been identified:

- *Sweden. Frac$_{GASM}$.*

  An inconsistent time series is used by Sweden, which report a higher Frac$_{GASM}$ for the years 1996-2000 due to changes in the methodology. Sweden did not yet have the possibility to carry out a revision of the older data.

6.3.6 Agricultural Soils – CH_4

Only a few countries report CH_4 fluxes from agricultural soils. Table 6.81 shows that the values spread over a large range and are reported under different sub-categories and thus not comparable.

Explanation on the methodology is given in Table 6.82. While Austria and Belgium relates CH_4 emissions to the sewage sludge and manure that is spread in soils, respectively, Germany calculates a sink for methane in soils as aerobic soils are consuming CH_4 from the atmosphere. Arable soils are known to have smaller sink strength than forest or grassland soils.

Table 6.81: CH_4 Emission from agricultural soils in 2007

Member States	D. Agricultural Soils	1. Direct Soil Emissions	2. Animal Production	3. Indirect Emissions	4. Other
Austria	0.42	0.42		NA	
Belgium	NA				
Denmark	NE,NO	NE		NE	
Finland	NE	NE		NE	
France	NA	NA		NA	
Germany	-30.16	IE		NO	
Greece	NE,NO	NE		NE	
Ireland	NE,NO	NE		NO	
Italy	NA	NA		NA	
Luxembourg	NA,NE	NE		NE	
Netherlands	NE,NO	NO		NO	
Portugal	NE,NO	NE		NE	
Spain	IE	IE		IE	
Sweden	NO	NO		NO	
United Kingdom	NA,NE	NA		NE	
EU-15	-29.74	0.42	NO	NO	NO

Source of information: Tables 4.D for 2007, submitted in 2009
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.82: Methodologies used to calculate CH_4 Emission from agricultural soils in 2007

Member States	
Austria	CH_4 emissions from Agricultural Soils originate from sewage sludge spreading on agricultural soils. They contribute only a negligible part of Austria's total methane emissions.The average carbon content of sewage sludge amounts to 300 kg C/t (Detzel et al., 2003; Schaefer 2002); 52% of the carbon is emitted to air from which 5% as methane.
Belgium	Wallonia calculates the CH_4 emissions on the basis of the manure applied during grazing. In both regions, this source is very small compared to enteric fermentation and manure management. In the Flemish region the emissions of CH_4 originating from the manure applied during grazing are allocated to the category 4Ba.
Germany	The calculation of CH_4 emissions from agricultural soils is based on the approach of Boeckx and Van Cleemput (2001), compiling the available observations in Europe. Emissions are differentiated for grassland ($EFCH_4$ = -2,5 kg ha^{-1} a-1CH_4) and cropland ($EFCH_4$ = - 1,5 kg ha^{-1} a-1 CH_4).

6.3.7 Field burning of crop residues – CH_4 and N_2O (CRF source category 4.F)

Burning of crop residues on the field gives rise to emissions of various compounds, including aerosols and trace gases. Field burning of crop residues is forbidden in Europe. Most countries therefore do not report CH_4 and N_2O emissions from this source category. Also at European level, this source category contributes only insignificantly to total emissions from agriculture. We therefore present only limited information, including total CH_4 and N_2O emissions and emissions from the two most important crop groups (cereals and 'other') (Table 6.83) and methodological information as described in the national GHG inventory reports (
Table 6.84). The trend of CH_4 and N_2O emissions from field burning of crop residues is shown in Figure 6.46 and Figure 6.47. In many countries, field burning of crop residues has become illegal since 1990 so that the emissions show a significant decline by almost one order of magnitude. Only Greece and Italy report stable emissions from this source category.

Table 6.83: CH_4 and N_2O Emission from burning of crop residues in 2007

	Total Gg CO2-eq		Cereals Gg CO2-		Other Gg CO2-eq	
	CH4	N2o	CH4	N2o	CH4	N2o
Austria	1.2	0.0	0.9	0.0	0.4	0.0
Belgium						
Denmark						
Finland	0.6	0.0	0.6	0.0		
France						
Germany						
Greece	26.9	0.7	25.9	0.7		
Ireland						
Italy	12.8	0.3	12.8	0.3		
Luxembourg						
Netherlands						
Portugal	19.7	1.1	4.9	0.1	14.7	1.0
Spain	359.6	4.4			359.6	4.4
Sw eden						
United Kingdom						
EU-15	**420.9**	**6.5**	**45.2**	**1.1**	**374.7**	**5.4**

Table 6.84: Methodologies used to calculate CH_4 and N_2O Emission from field burning of crop residues in 2007

Member States	
Austria	Burning agricultural residues on open fields in Austria is legally restricted by provincial law and since 1993 additionally by federal law and is only occasionally permitted on a very small scale. According to the Presidential Conference of the Austrian Chambers of Agriculture, about 0.3% of total area under cereals is burned.
Finland	Default. The share of straw burned in 2007 (0.25%) is an estimate made by several experts on crop cultivation in different parts of Finland. The trend of residue burning is assumed to follow the trend of

Member States	
	rye crop yield as rye is the most common straw burned on fields. The share of burned residue from total cereal residue on the fields for the years 1990-2006 is estimated on the basis of the annual rye yield.
Greece	IPCC default
Italy	Emissions from fixed residues,stubble (stoppie), burnt on open fields, are reported in this category (4F) while emissions from removable residues (asportabili) burnt off-site, are reported under the waste sector. The following data are used: (a) annual crop production, removable residues/product ratio, and "fixed" residue/removable residues ratio; (b) dry matter fraction; (c) fraction of the field where "fixed" residues are burned, and fraction of residues oxidized during burning; (d) fraction of carbon and nitrogen from the dry matter of residues; (e) default emissions rates for C-CH_4 and N-N_2O.
Portugal	In-site burning of agricultural residues is still practiced nowadays in Portugal, being however forbidden by law-decree during the Forest Fire Season from May to September. Burning of residues from vineyards and olive oil are the most significant sources. Methodology according to IPCC, except for the fact that residue biomass is not estimated from crop production but from residue production quantities by cultivated area. Quantity of residues and actually burnt fraction from expert opinion from the Agriculture Ministry (Seixas et al., 2000). Only for rice a detailed and time-series could be developed following the information received from the agriculture experts from the Portuguese Ministry of Agriculture: (i) traditionally, stubbles and straw were burnt between crops, as the use of rice straw as fodder or bedding is not significant, and is not removed from field; (ii) more recently the agricultural practices have changed. It became more common to left the straw on ground and incorporate it into soil by plowing (only procedure allowed in the area subject to the "Techniques of Integrated Production and Protection", which is about 50 per cent of rice paddies in 2004). It may be assumed that, in 1990, 100 per cent of rice paddies were burnt and no organic amendments were added to soil. Today thea area subjected to burning is between 30 and 40%.
United Kingdom	The estimates of the masses of residue burnt of barley, oats, wheat and linseed are based on crop production data (e.g. Defra, 2006a) and data on the fraction of crop residues burnt (MAFF, 1995; ADAS, 1995b).Field burning ceased being legal in 1993 in England and Wales.Burning in Scotland and Northern Ireland is considered negligible, so no estimates are reported from 1993 onwards.

Figure 6.46: Trend of N_2O emissions from field burning of crop residues

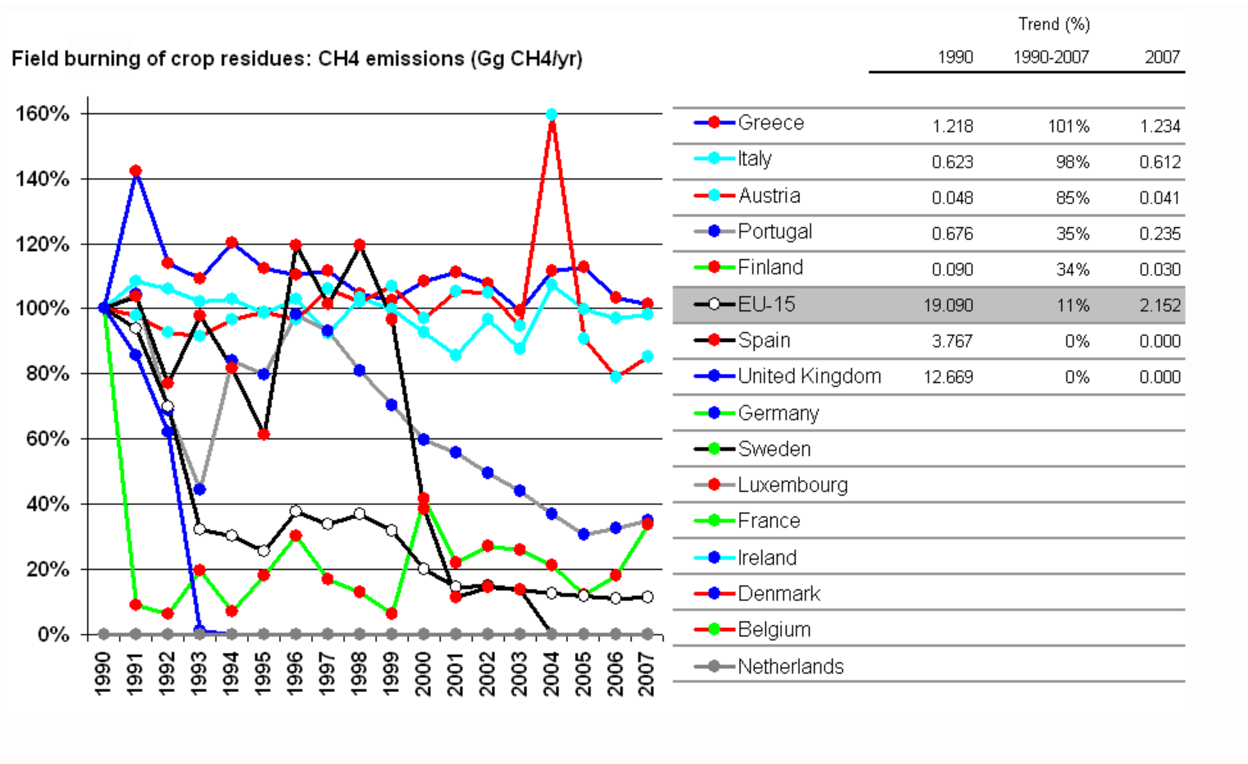
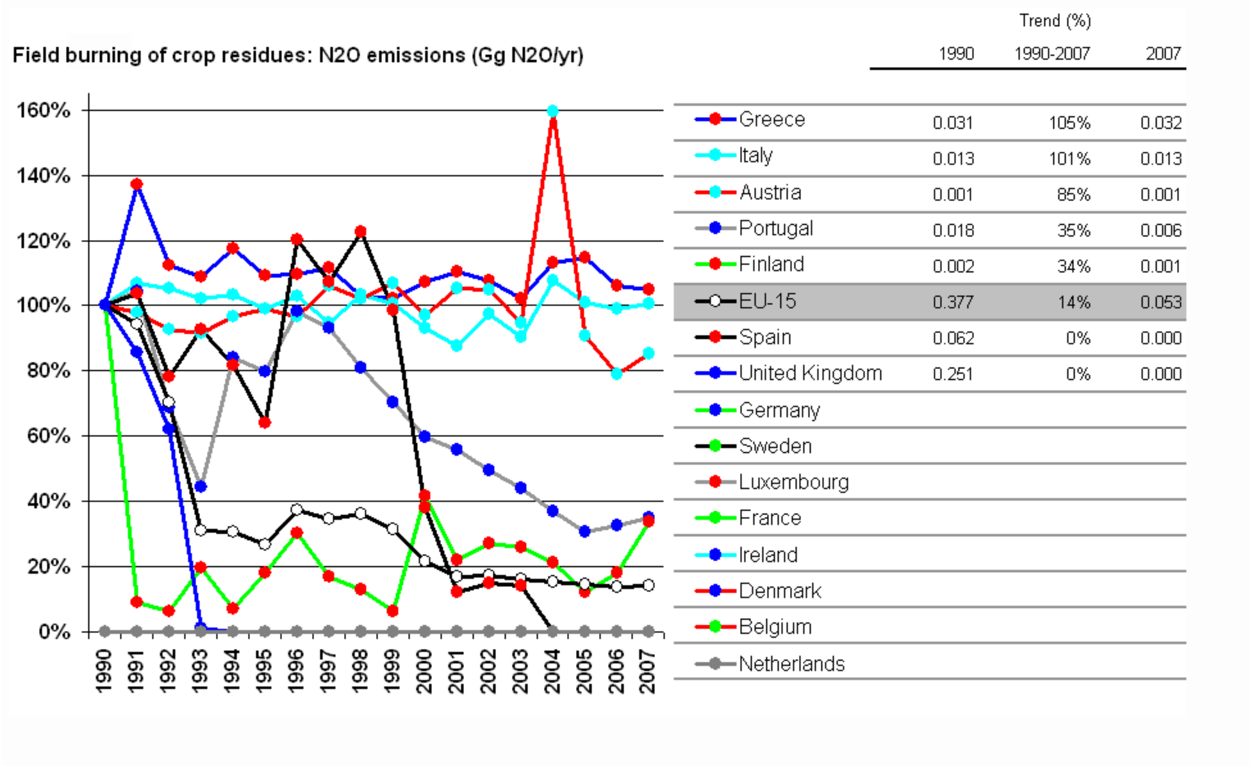


Figure 6.47: Trend of N_2O emissions from field burning of crop residues



6.4 Sector-specific quality assurance and quality control

6.4.1 Determination of the Tier level

The IPCC methodology estimates emissions Es from a certain source category s as

$$E_s = IEF_s \cdot AD_s \qquad (1)$$

where ADs are the activity data for the source category s and IEFs is the implied emission factor for this category. There are three levels for estimating the emissions, called Tier 1, Tier 2, and Tier 3, moving from the use of default values over the inclusion of national information to the application of modeling tools. In order to define an EU-wide Tier level per source category and sector, two criteria must be met:

1. For each source category and Member State a Tier level must be assigned.
2. To assess the Tier level of aggregated emissions derived at different quality, the Tier levels must be measured on an interval scale, allowing 'intermediate' Tier levels.

To do so, we developed standard procedures for each source category. These are based on the following principles:

i. However, the flow of nutrients in agriculture implies that the emission in one category can serve as activity level in another, for example, nitrogen excretion can be regarded as an emission of nitrogen in livestock production systems. According to the IPCC the amount of nitrogen excreted is an activity data for estimating N_2O emissions from manure management. Thus, in contrast to the IPCC definitions, we define as activity data only this information that must be obtained using statistical surveys (e.g., population data, distribution of animal manure systems etc.) and regard everything else as parameters (emission factors and other factors).

ii. A Tier level is assessed for each parameter by comparing the IPCC default value with the value used by the countries. If the default IPCC value is used, the Tier level is set to Tier 1 and otherwise the Tier level is set to Tier 2. Caution must be taken if country-specific data are identical to the default values.

iii. An appropriate estimation of the basic activity data (animal numbers, mineral fertilizer consumption, allocation of manure to the manure management systems) is regarded as basic requirement for the estimation of the source strength and is not considered in the calculation of the overall Tier level. Note however, that

Tier levels are aggregated applying different aggregation rules.

1. The MEDIAN-rule should be applied where the Tier level of a product of different parameters Pi is to be evaluated. For example the emission factor for CH_4 emissions from manure management is calculated from the CH_4 production potential, the methane conversion factor, and the volatile solid excretion. The aggregation of the Tier level of these parameters to estimate the level of quality of the emission factor should follow the following principles. (i) If parameters with very different quality are multiplied, the higher quality should get more weight; (ii) if parameters with different uncertainty are multiplied, it should be good practice to estimate the parameter which is associated with the higher uncertainty at a higher Tier level. Thus, the aggregation rule should reward if efforts have been made to improve uncertain parameters. However, with the lack of a comprehensive set of relative uncertainty estimates for the individual parameters, in the following equation an arbitrary weighting factors $w_{p,j}$ has been introduced, based on expert judgment.

$$Q_{\prod_i P_i} = 3 - \prod_i \left[\left(3 - Q_{P_i}\right)^{\frac{w_{p,i}}{\sum_j \{w_{p,j}\}}} \right] \qquad (2)$$

with i and j indicating the individual parameters to be multiplied. The term (3-Q_i) assures that a higher weight is given to the parameter estimated with the higher Tier.

In some cases, when there is clear domination of one multiplicative parameter, the median rule simplified and the Tier level of the product is approximated with that Tier level. This simplified rule has been applied to estimate the Tier level of CH_4 emissions from enteric fermentation, which is in many cases based or validated with direct measurements.

2. The MEAN-rule if an emission estimate is calculated as the sum of two or more sub-categories. In this case, the Tier levels of the individual estimates are aggregated using an emission-weighted average. E.g., the Tier level of indirect N_2O emissions from agriculture Q4D3 is calculated from the Tier levels calculated for indirect emissions through volatilization of nitrogen gases Q4D3a and leaching/run-off of nitrate Q4Db according to:

$$Q_{A+B} = \frac{Q_A \cdot E_A + Q_B \cdot E_B}{E_{A+B}} \qquad (3)$$

It must be noted, however, that a higher Tier-level does not automatically mean that also the emission estimate is more accurate. The relationship holds however, if (i) inherent links between processes are reflected in the methodology; (ii) parameters are based on statistically representative sample of measurements or carefully with experimental data validated models.

6.4.1.1 CH_4 emissions from enteric fermentation

The Tier level for CH_4 emissions from enteric fermentation is determined by comparison the Implied Emission Factor with the IPCC default emission factors. The Tier level for cattle, sheep, goats, swine, and reindeer is shown in Table 6.85

Table 6.85: Tier level of IEFs for CH_4 emissions from enteric fermenations

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Swine	Reindeer
Austria1)	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.0	
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	
Greece	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Netherlands	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	
Portugal1)	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	
Sweden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 1.7**	**Tier 1.1**	**Tier 1.3**	

1) Non-dairy cattle for Austria and Portugal: IEF equals default IPCC EF, however Tier 2 has been used according to the national inventory reports.

6.4.1.2 CH_4 emissions from manure management

The determination of the Tier level for the estimation of CH_4 emissions from manure management is done in four steps

1. "Default" CH_4 conversion factors for each manure management system are calculated on the basis of the allocation of manure to the different AWMS
2. The results are compared with the used MCF and a Tier 2 level assigned if the two numbers differs (see Table 6.86).

Table 6.86: Tier level of MCF for CH_4 emissions from manure management

MCF	Dairy	Non-dairy	Sheep	Goats	Sw ine	Poultry
Austria	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Denmark	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
France	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Greece	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg [1)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Portugal	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sw eden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
EU-15	**Tier 1.6**	**Tier 1.8**	**Tier 1.0**	**Tier 1.0**	**Tier 1.5**	**Tier 1.0**

Sheep and goats get Tier 1 for MCF!

3. The data used for B_0 and VS are compared with IPCC default values.

Table 6.87: Tier level of B_0 for CH_4 emissions from manure management

B0	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Denmark	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Finland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands [2)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Portugal	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Spain	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Sw eden	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.3**	**Tier 1.3**	**Tier 1.0**	**Tier 1.0**	**Tier 1.1**	**Tier 1.1**

Table 6.88: Tier level of VS for CH_4 emissions from manure management

VS	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Belgium	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Finland	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0
France	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0
Netherlands [2)]	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Sw eden	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.6**	**Tier 1.4**	**Tier 1.1**	**Tier 1.1**	**Tier 1.7**	**Tier 1.2**

4. The final Tier level is obtained using the MEDIAN rule from the Tier levels of MCF, B0, and VS, using the following weigths: w_{MCF}=0.13; wB_0=0.13; w_{VS}=0.75. The highest weight is given to the Volatile solid excretion factor because it can and should be based on the detailed characterization of the animal performance.

Table 6.89: Tier level of the IEFs for CH_4 emissions from manure management

	Dairy Cattle	Non-dairy cattle	Sheep	Goats	Sw ine	Poultry
Austria	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.8	Tier 1.0
Belgium	Tier 1.3	Tier 1.3	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Denmark	Tier 1.9	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Finland	Tier 1.9	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.8
France	Tier 1.2	Tier 1.2	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 1.2	Tier 1.8	Tier 2.0	Tier 1.9
Greece	Tier 1.2	Tier 1.2	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.0
Ireland	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.2	Tier 1.0
Italy	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.0
Luxembourg	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.0
Netherlands [1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 1.9	Tier 1.8	Tier 1.8	Tier 1.8	Tier 1.9	Tier 1.8
Spain	Tier 1.8	Tier 1.8	Tier 1.0	Tier 1.0	Tier 1.8	Tier 1.0
Sw eden	Tier 1.9	Tier 1.9	Tier 1.2	Tier 1.9	Tier 1.9	Tier 1.9
United Kingdom	Tier 1.8	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.2	Tier 1.0
EU-15	**Tier 1.8**	**Tier 1.5**	**Tier 1.1**	**Tier 1.1**	**Tier 1.7**	**Tier 1.2**

[1)] Netherlands does not give background data in Table 4B(a), how ever according to the national inventory report a Tier 2 methodology is used.

6.4.1.3 N_2O emissions from manure management

The determination of the Tier level of the estimate of N_2O emissions from manure management is done in four steps

i. The comparison of the N-excretion rates used with the IPCC default valuees (see Table 6.90)

ii. The determination of the Tier level of manure allocated to the manure management systems based on the Tier level of the N-excretion rate by animal type and the allocation of manure-nitrogen to the manure management systems reported in Table 4B(b) (see Table 6.91)

iii. The comparison of the N_2O emission factor used with the IPCC default values (see Table 6.92)

iv. The calculation of the overall Tier level on the basis of the MEDIAN rule by using the Tier level of the IEF (with a weight of 0.33) and the Tier level of the allocated manure nitrogen to the manure management systems (with a weight of 0.67).

Table 6.90: Tier level of the N-excretion rates for N_2O emissions from manure management

	Dairy	Non-Dairy	Sheep	Swine	Poultry	Buffalo	Goats	Horses	Mules and Asses
Austria	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Denmark	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
Finland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
France	Tier 1.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0		Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	
Greece	Tier 1.0	Tier 1.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Italy	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0		Tier 2.0	Tier 2.0	Tier 2.0
Netherlands [1)]	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Portugal	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Spain	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 1.0	Tier 1.0
Sweden	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0		Tier 2.0	Tier 2.0	
EU-15	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**	**Tier 2.0**

[1)] Netherlands does not give N-excretion data in Table 4B(b), however according to the national inventory report a Tier 2 methodology is used.

Table 6.91: Tier level of the allocation of manure-nitrogen to the manure management systems for N_2O emissions from manure management

Member State	Liquid system[1)]	Daily Spread	Solid storage and dry lot	Pasture range paddock	Other
Austria	Tier 2.0		Tier 2.0	Tier 2.0	Tier 2.0
Belgium	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
Denmark	Tier 1.9		Tier 2.0	Tier 2.0	
Finland	Tier 1.6		Tier 1.1	Tier 1.0	
France	Tier 1.7		Tier 1.6	Tier 1.7	
Germany	Tier 2.0		Tier 2.0	Tier 2.0	
Greece	Tier 2.0	Tier 1.0	Tier 1.1	Tier 1.3	Tier 1.0
Ireland	Tier 2.0		Tier 2.0	Tier 2.0	
Italy	Tier 2.0		Tier 1.9	Tier 2.0	Tier 2.0
Luxembourg	Tier 2.0		Tier 1.9	Tier 2.0	Tier 2.0
Netherlands	Tier 2.0		Tier 2.0	Tier 2.0	
Portugal	Tier 2.0		Tier 1.9	Tier 2.0	
Spain	Tier 2.0	Tier 1.9	Tier 1.9	Tier 2.0	
Sweden	Tier 2.0		Tier 2.0	Tier 1.9	Tier 2.0
United Kingdom	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0
EU15	**Tier 2.0**	**Tier 2.0**	**Tier 1.9**	Tier 2.0	**Tier 2.0**

[1)] including anaerobic lagoon

Table 6.92: Tier level of the IEFs for N_2O emissions from manure management

	Liquid system[1)]	Solid storage and dry lot	Other
Austria	Tier 1	Tier 1	Tier 1
Belgium	Tier 1	Tier 2	Tier 1
Denmark	Tier 2	Tier 1	NO
Finland	Tier 1	Tier 1	NE
France	Tier 1	Tier 1	NA
Germany	Tier 1	Tier 2	NO
Greece	Tier 1	Tier 1	Tier 1
Ireland	Tier 1	Tier 1	NO
Italy	Tier 1	Tier 1	Tier 1
Luxembourg			Tier 1
Netherlands	Tier 1	Tier 1	NO
Portugal	Tier 1	Tier 1	NO
Spain	Tier 1	Tier 1	NO
Sw eden	Tier 1	Tier 2	Tier 1
United Kingdom	Tier 1	Tier 1	Tier 1
EU15	**Tier 1.0**	**Tier 1.3**	**Tier 1.0**

Table 6.93: Tier level of the estimation of N_2O emissions from manure management

	Liquid system[1)]	Solid storage and dry lot	Other	Total
Austria	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
Belgium	Tier 1.7	Tier 2.0	Tier 1.7	Tier 1.8
Denmark	Tier 1.9	Tier 1.7	NO	Tier 1.9
Finland	Tier 1.4	Tier 1.1	NE	Tier 1.4
France	Tier 1.5	Tier 1.4	NA	Tier 1.5
Germany	Tier 1.7	Tier 2.0	NO	Tier 1.8
Greece	Tier 1.7	Tier 1.0	Tier 1.0	Tier 1.7
Ireland	Tier 1.7	Tier 1.7	NO	Tier 1.7
Italy	Tier 1.7	Tier 1.6	Tier 1.7	Tier 1.7
Luxembourg	Tier 2.0	Tier 2.0	Tier 1.7	Tier 2.0
Netherlands	Tier 1.7	Tier 1.7	NO	Tier 1.7
Portugal	Tier 1.7	Tier 1.7	NO	Tier 1.7
Spain	Tier 1.7	Tier 1.7	NO	Tier 1.7
Sw eden	Tier 1.7	Tier 2.0	Tier 1.7	Tier 1.8
United Kingdom	Tier 1.7	Tier 1.7	Tier 1.7	Tier 1.7
EU15	**Tier 1.7**	**Tier 1.6**	**Tier 1.7**	**Tier 1.7**

[1)] including anaerobic lagoon

6.4.1.4 CH_4 emissions from rice cultivation

No combination of information is required.

6.4.1.5 N_2O emissions from agricultural soils

The determination of the Tier level of N_2O emissions from agricultural soils is done in four steps:

1. The comparison of the used emission factors (for direct N_2O emissions induced by the application of synthetic fertilizer, animal wastes, nitrogen from crop residues and N-fixing crops

and by the cultivation of histosols; for N_2O emissions from manure deposited by grazing animals; for indirect N_2O emissions induced by volatilization of NH_3+NO_x from synthetic fertilizer and from applied manure, and induced by leaching/run-off of nitrogen from the fields) with the respective IPCC default values.

2. With the exception of direct N_2O emissions induced by the application of mineral fertilizer, a Tier level has been considered for the nitrogen input data.

   (a) For the application of animal waste the Tier levels of N allocation to liquid systems (incl. anaerobi lagoons), solid storage and dry lot, and other systems has been combined using the MEAN rule.

   (b) For N-fixing crop, crop residues and cultivated area of histosols, the Tier level has been estimated from the information reported in the national inventory reports

   (c) For nitrogen deposited by grazing animals, the Tier level calculated under category 4B(b) for pasture, range, and paddock is used.

3. The Tier level of the N_2O emission estimate is calculated on the basis of the above-obtained information:

   (a) Application of synthetic fertilizer the Tier level of the emission factor is used

   (b) Direct emissions from other nitrogen sources using the MEDIAN rule with equal weights for the Tier level of the nitrogen input and the emission factor

   (c) N_2O emissions from grazing animals using the MEDIAN rule for N-input, $Frac_{GRAZ}$, and the emission factor using equal weights. The Tier level for $Frac_{Graz}$ has been determined on the basis of the information given in the national inventory reports

   (d) N_2O emissions from volalised nitrogen using the MEDIAN rule for the amount of volatilised nitrogen, which is calculated from the Tier levels for volatilised synthetic fertilizer and manure nitrogen using the MEAN rule, and the emission factor using equal weights. The Tier level for volatilised synthetic fertilizer is obtained by comparing $Frac_{GASF}$ with the IPCC default value. The Tier level for volatilised manure nitrogen is obtained using the MEDIAN rule on the basis of $Frac_{GASM}$ (comparing with the IPCC default value) and the Tier level of applied nitrogen manure using equal weights.

   (e) N_2O emissions from leached/run-off nitrogen using the MEDIAN rule for N-input, FracLEACH and the emission factor giving higher weight to FracLEACH and the emission factor (0.43 each) than to the N-input (0.14)

Table 6.94: **Tier level of the estimation of direct N_2O emissions from agricultural soils**

Member States	Synthetic fertilizer	Animal Wastes appl.			N-fixing crops			Crop Residues			Cultivation of Histosols		
	N2O emis.	N input	EF	N2O emissions	N input	EF	N2O emissions	N input	EF	N2O emissions	N input	EF	N2O emissions
Austria	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Belgium	Tier 1.0	Tier 1.8	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Denmark	Tier 1.0	Tier 1.9	Tier 1.0	Tier 1.5	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Finland	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.2	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.0	Tier 1.5	Tier 1.0	Tier 1.3	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Germany	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.6
Greece	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Italy	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.6
Portugal	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
Spain	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 2.0	Tier 1.6
Sweden	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 1.0	Tier 1.6	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
EU-15	**Tier 1.4**			**Tier 1.6**			**Tier 1.1**			**Tier 1.2**			**Tier 1.5**

Table 6.95: **Tier level of the estimation of N_2O emissions from pasture, range and paddock**

Member States	Animal Production			
	N-input	FracGRAZ	EF	N2O emissions
Austria	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Belgium	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Denmark	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Finland	Tier 1.0	Tier 1.0	Tier 1.0	Tier 1.0
France	Tier 1.7	Tier 1.0	Tier 1.0	Tier 1.3
Germany	Tier 2.0	Tier 2.0	Tier 1.0	Tier 1.7
Greece	Tier 1.3	Tier 1.0	Tier 1.0	Tier 1.1
Ireland	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Italy	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Netherlands	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Portugal	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
Spain	Tier 2.0	Tier 1.0	Tier 2.0	Tier 1.7
Sweden	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 2.0	Tier 1.0	Tier 1.0	Tier 1.4
EU-15				**Tier 1.4**

Table 6.96: Tier level of the estimation of indirect N_2O emissions from nitrogen volatilised from agricultural soils

Member States	$Frac_{GASF}$	Manure application	$Frac_{GASM}$	Volatilized Manure	Volatili-zation	Emission Factor	N2O emissions from volatilised nitrogen
Austria	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Belgium	Tier 2.0	Tier 1.8	Tier 1.0	Tier 1.4	Tier 1.7	Tier 1.0	Tier 1.4
Denmark	Tier 2.0	Tier 1.9	Tier 1.0	Tier 1.5	Tier 1.8	Tier 1.0	Tier 1.4
Finland	Tier 2.0	Tier 1.4	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.0	Tier 1.6
France	Tier 1.0	Tier 1.5	Tier 1.0	Tier 1.3	Tier 1.0	Tier 2.0	Tier 1.6
Germany	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0
Greece	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0
Ireland	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Italy	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Luxembourg	Tier 1.0	Tier 2.0	Tier 1.0	Tier 1.6	Tier 1.0	Tier 1.0	Tier 1.0
Netherlands	NE	Tier 1.7	NE	NE	NE	Tier 1.0	Tier 1.0
Portugal	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Spain	Tier 2.0	Tier 1.7	Tier 2.0	Tier 1.9	Tier 2.0	Tier 1.0	Tier 1.6
Sweden	Tier 2.0	Tier 1.8	Tier 2.0	Tier 1.9	Tier 2.0	Tier 2.0	Tier 2.0
United Kingdom	Tier 1.0	Tier 1.7	Tier 1.0	Tier 1.4	Tier 1.0	Tier 1.0	Tier 1.0
EU-15							**Tier 1.5**

Table 6.97: Tier level of the estimation of indirect N_2O emissions from nitrogen leached/run-offfrom agricultural soils

Member States	N input	$Frac_{LEACH}$	Emission factor
Austria	Tier 1.7	Tier 1.0	Tier 1.0
Belgium	Tier 1.8	Tier 2.0	Tier 1.0
Denmark	Tier 1.9	Tier 2.0	Tier 1.0
Finland	Tier 1.4	Tier 2.0	Tier 1.0
France	Tier 1.5	Tier 1.0	Tier 2.0
Germany	Tier 1.8	Tier 1.0	Tier 2.0
Greece	Tier 1.7	Tier 1.0	Tier 1.0
Ireland	Tier 1.7	Tier 2.0	Tier 1.0
Italy	Tier 1.7	Tier 1.0	Tier 1.0
Luxembourg	Tier 2.0	Tier 1.0	Tier 1.0
Netherlands	Tier 1.7	NE	Tier 1.0
Portugal	Tier 1.7	Tier 2.0	Tier 1.0
Spain	Tier 1.7	Tier 1.0	Tier 2.0
Sweden	Tier 1.8	Tier 2.0	Tier 1.0
United Kingdom	Tier 1.7	Tier 1.0	Tier 2.0
EU-15			

6.4.2 Uncertainty

Quantitative estimates of the contribution of agriculture to the overall uncertainty of the national GHG inventories are reported in Table 6.103. These data are calculated from the information on the uncertainty of activity data and implied emission factors (see sections above and Table 6.99 through Table 6.101 summarizing all categories in agriculture) and the emissions data. For several countries, N_2O emissions from agricultural soils are by far dominating the uncertainty of national inventory. The uncertainty estimate for this source category ranges from 2.0% of total national GHG emissions (excl. LULUCF, Denmark) to 17.9% of total national GHG emissions (United Kingdom). Overall, the estimate for the uncertainty range is relatively stable since the last years.

Table 6.98: Range of contribution of category 4D to overall GHG uncertainty. Minimum and maximum values since 2005 submission

	Minimum uncertainty	Maximum uncertainty
2005	0.7% (Austria)	20.9% (France)
2006	1.5% (Austria)	17.6% (France)
2007	1.9% (Denmark)	19.9% (France)
2008	1.7% (Denmark)	20.1% (France)
2009	2.0% (Denmark)	17.9% (France)

The contribution of the whole agricultural sector to the overall uncertainty is very similar to the contribution of agricultural soils (2.4% to 18.1%), highlighting again the dominance of this category.

Some countries allocate the biggest contribution to the direct emissions and others to the indirect emissions of N_2O. For example, the uncertainty of direct N_2O emissions is estimated in the Greece inventory of being ±400% (4.4% of the national total) versus ±54% (1.1% of the national total) of the indirect emissions. On the other hands, the Netherlands estimate an uncertainty of ±61% and ±206% for direct and indirect N_2O emissions agricultural soils, respectively (corresponding to 1.4% and 3.1% of the national total uncertainty, respectively).

CH_4 emissions from enteric fermentation are less uncertain (0.1% to 2.2% of total national GHG emissions) and manure management contributes with less than 1.6% uncertainty.

An overview of the estimated total GHG inventory uncertainty carried out with the Tier 1 methodology and the contribution of the agricultural sector to the overall uncertainty (calculated from reported relative uncertainties for activity data and emission factors, and the reported emissions) is given in Table 6.103. The corresponding uncertainties for activity data and emission factors are given in Table 6.99 and Table 6.100, and the combined uncertainty (Tier 1 approach) is given in Table 6.101. The data for the combined uncertainty are "gap-filled" at the category-level, if required, to allow a meaningful comparison of the uncertainty estimates at EU-level, using information reported at the level below the categories.

A table summarizing background information on the uncertainty estimates is given in Table 6.102.

It is interesting to note that combined relative uncertainty of agriculture in some cases is higher than the overall uncertainty of the greenhouse gas inventory (for example in Austria and Spain). This is due to the fact that the combined uncertainty is calculated neglecting any other contribution to the uncertainty. As uncertainties are assumed to be uncorrelated between the different sectors, the consideration of more sectors can thus lead to the partial compensation of the individual uncertainties.

Some countries have carried out also a Monte Carlo uncertainty assessment. In most cases, both the input data and also the results do not deviate much from the Tier 1 analysis. Main differences between both methods are (i) the possibility to assess emission sources where the distribution of the uncertainty is non-normal and (ii) the consideration of correlation between source categories, which tends to reduce the compensation effect.

Table 6.99: Member States's uncertainty estimates for Activity Data used in the agriculture sector

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	*(1)	*(6)	10	0	5	5	5
Belgium	5	10	10	30			
Denmark	10	10	10	7			
Finland	0	0	0	0	0	0	0
France	5	3	1	9			
Germany	*(2)	*(7)	0	0	0	0	0
Greece	5	5	50	0	20	50	20
Ireland	*(3)	*(8)	11	0	11	11	11
Italy	20	20	20	0	20	20	20
Luxembourg					5	5	
Netherlands	*(4)	*(9)	10	0	10	10	50
Portugal	*(5)	*(10)	0	0	32	39	78
Spain	3	2	1	0	2		2
Sweden	5	20	20	0			
United Kingdom	10	10	1	1			

*(1)- Cattle: 10%

*(2)- Dairy and non-dairy cattle, sheep and horses: 0.0001%; swine: 0%

*(3)- Dairy and non-dairy cattle and other animals: 1%

*(4)- Cattle, swine and other animals: 5%

*(5)- Dairy and non-dairy cattle: 6%; Sheep: 19%; goats: 19%; horses: 71%; mules and asses: 272%; poultry: 11%; other animals: 771%

*(6)- Cattle and swine: 10%

*(7)- Dairy and non-dairy cattle, sheep, horses, swine and poultry: 0.0001%

*(8)- Dairy and non-dairy cattle and other animals: 1%

*(9)- Cattle, swine, poultry and other animals: 10%

*(10)- Dairy and non-dairy cattle: 6%; Sheep: 19%; goats: 19%; horses: 71%; mules and asses: 272%; poultry: 11%

*(11)- Portugal, direct N2O emissions. Mineral fertilizer: 17%; Manure application: 107%; Crop residues: 25%; N-fixation: 25%

*(12)- Portugal, indirect N2O emissions. Mineral fertilizer: 82%; Manure application: 118%; Crop residues: 63%; N-fixation: 63%

Table 6.100: Member States's uncertainty estimates for Emission Factors used in the agriculture sector

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	*(1)	*(6)	100		150	150	150
Belgium	40	40	90	250			
Denmark	8	100	100	23			
Finland	32	16	82		71	71	248
France	69	83	94	52			
Germany	*(2)	*(7)	22		410	30	736
Greece	30	50	100		400	100	50
Ireland	*(3)	*(8)	200		100	100	50
Italy	20	100	100		100	100	100
Luxembourg					300	500	
Netherlands	*(4)	*(9)	100		60	100	200
Portugal	*(5)	*(10)	100		*(11)	500	*(12)
Spain	11	11	100		400		50
Sweden	25	50	50				
United Kingdom	20	30	414	424			

*(1)- Cattle: 20%
*(2)- Dairy and non-dairy cattle, sheep and horses: 10.0000000083301%; swine: 0%
*(3)- Dairy and non-dairy cattle and other animals: 15%
*(4)- Cattle: 15%; swine: 50%;other animals: 30%
*(5)- Dairy and non-dairy cattle: 20%; Sheep: 20%; goats: 20%; horses: 50%; mules and asses: 50%; poultry: 20%; other animals: 20%
*(6)- Cattle and swine: 70%
*(7)- Dairy and non-dairy cattle, sheep, horses, swine and poultry: 20%
*(8)- Dairy and non-dairy cattle: 15%; other animals: 30%
*(9)- Cattle, swine, poultry and other animals: 100%
*(10)- Dairy and non-dairy cattle: 61%; Sheep: 59%; goats: 58%; horses: 61%; mules and asses: 61%; poultry: 91%
*(11)- Mineral fertilizer: 500%; Manure application: 500%; Crop residues: 510%; N-fixation: 510%
*(12)- Mineral fertilizer: 100%; Manure application: 100%; Crop residues: 100%; N-fixation: 100%

Table 6.101: Member States's uncertainty estimates for agriculture (combined uncertainty calculated from the given uncertainty of AD and EF)

Member State	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
				total	direct	animal prod.	indirect
	CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
Austria	22	50	100	101	150	150	150
Belgium	40	41	91	252			
Denmark	13	100	100	24			
Finland	32	16	82	71	71	71	248
France	69	83	94	53			
Germany	6	12	22	355	410	30	736
Greece	30	50	112	100	400	112	54
Ireland	11	11	200	58	101	101	51
Italy	28	102	102	67	102	102	102
Luxembourg					300	500	
Netherlands	15	71	100	83	61	100	206
Portugal	14	82	100	231	505	502	127
Spain	11	11	100	223	400		50
Sweden	25	54	54	0			
United Kingdom	22	32	414	424			

Table 6.102: Member State's background information on the uncertainty estimates in the sector of agriculture

Member State	Uncertainties
Austria	Separate uncertainty calculations, albeit with the same (as much as possible) input information was performed using a spreadsheet prepared specifically according to the Tier 1 approach (IPCC 2000), and with a Monte Carlo approach fully considering statistical dependence of detailed input data (Tier 2). Since the first detailed uncertainty analysis (Winiwarter and Rypdal, 2001) the Austrian inventory compilers have spent considerable effort to also obtain uncertainties from individual contributors to the inventory. Studies on methane emissions reported also uncertainty in emission factors (Amon et al. 2002, Gebetsroither et al. 2002).
Belgium	In Flanders, a complete study of the uncertainty was conducted in 2004 by an independent consultant, Det Norske Veritas, both on Tier 1 and Tier 2 level. The uncertainties were determined for the emission level 2001 and for the 1990-2001 trend in emissions for all source categories comprising emissions of CO_2, CH_4 and N_2O. These results are available in the technical report 'Quantification of Uncertainties – Emission Inventory of Greenhouse Gases of the Flemish Region of June 2004'.
Denmark	The uncertainty estimates are based on the Tier 1 methodology in the IPCC Good Practice Guidance (GPG) (IPCC, 2000). Uncertainty estimates for the all sectors are included in the current year. The estimated uncertainties for some of the emission sources, based on expert judgement (Olesen et al. 2001, Gyldenkærne, pers. comm., 2005). The uncertainties for the number of animals and the number of hectares with different crops under cultivation are very small.
Finland	Uncertainty is quantified with a Tier 2 approach (KASPER model, developed by VTT Technical Research Centre of Finland). A simulation model was constructed for uncertainty analysis using Monte Carlo simulation and sensitivity analysis using an extended version of Fourier Amplitude Sensitivity Test (FAST, Saltelli et al. 2005). In agriculture, an uncertainty estimate was given for each calculation parameter of the calculation model at a detailed level. A detailed description of the uncertainty analysis has been presented in Monni & Syri (2003), Monni (2004) and Monni et al. (2007).
France	Uncertainty calculation according to Tier 1 methodology. Strongest impact on total uncertainty arises from the category of N_2O emissions from agricultural soils.
Ireland	Tier 1 method. In some of the most important emissions sources in Agriculture (such as enteric fermentation and agricultural soils) and Waste (solid waste disposal, for example) the activity data or emission factors ultimately used are determined by several specific component inputs, which are all subject to varying degrees of uncertainty. The uncertainty estimates used for both activity data and emission factor for these sources have been derived by assigning uncertainties to the key component parameters and combining them at the level of activity data or emission factors, as appropriate, for each activity for input to the Tier 1 uncertainty assessment.
Italy	Tier 1 approach. In addition, a Tier 2 approach, corresponding to the application of Monte Carlo analysis, has been applied to specific categories of the inventory but the results show that, with the information available at present, applying methods higher than the Tier 1 does not make a significant difference in figures. For N_2O emissions from agricultural soils, a Montecarlo analysis was applied assuming a normal distribution for activity data and two tests one with a lognormal and the other with a normal for emission factors; the results with the normal distribution calculated an uncertainty figure equal to 32.44, lower than the uncertainty by the Tier 1 approach which was 102; in the case of the lognormal distribution there were problems caused by the formula specified in the IPCC guidelines which is affected by the unit and needs further study before a throughout application.
Luxembourg	In December 2007, the Environment Agency contracted Austrian Research Centers GmbH - ARC28 for performing a detailed uncertainty analysis of Luxembourg's GHG inventory. Monte-Carlo approach were used to calculate overall uncertainty. Within this project, we use the software "@RISK" from Palisade Co. (www.palisade.com).
Netherlands	Tier 1 method for base year and last reported year – for both the annual emissions and the emission trend for the Netherlands. All uncertainty figures should be interpreted as corresponding to a confidence interval of 2 standard deviations (2?), or 95%. In cases where asymmetric uncertainty ranges were assumed, the largest percentage was used in the calculation. Furthermore, a Tier 2 uncertainty assessment was carried out in 2006 (Ramirez, 2006). The study used the same uncertainty assumption as the Tier 1 study but accounted for correlations and non-Gaussian distributions. Results are at the same order of magnitude for the level assessment, although a higher uncertainty is found for the trend analysis. As part of the above mentioned study, the expert judgments and assumptions made for uncertainty ranges in emission factors and activity data for the Netherlands have been compared to the uncertainty assumptions (and their underpinnings) used in Tier 2 studies carried out by other European countries.
Sweden	During 2005, a SMED study was carried out to improve tranparency and quality in the uncertainty estimates of the Swedish National Greenhouse gas inventory (Gustafsson, 2005). Although much activity data in the agricultural sector is estimated from extensive surveys, with high quality estimates at national level, the sector contributes to a large part of the total estimated uncertainty.
United Kingdom	Both the Tier 1 and Tier 2 uncertainty estimates. The Tier 2 approach provides estimates according to GHG (1990, base year and latest reporting year) and has now been extended to provide emissions by IPCC sector and is based on a background paper (Eggleston et al., 1998). An internal review was completed of the Monte Carlo analysis was completed in 2006 (Abbott et al., 2006). The uncertainty of the majority of the sectors was assumed to be normally distributed; for certain sectors where data are highly correlated or the distributions non-normal, custum corrleations or fuctions have been used (landfill, sewage sludge distributions calculated from a known data series; agricultural soils lognormal distribution with the 97.5%il being 100 times the 2.5%il). Calculations are carried out using the @RISK software.

The uncertainties estimates are combined to the EU-15 level for source categories in the agriculture sector and for the sector as a whole are combined with a Tier 1 approach considering an assumed degree of dependence between each pair of countries. The quantitative assessment of the quality-levels outlined above helps to derive a reasonable estimate for the correlation coefficient ρ_{XY} between two countries X and Y. To this purpose, the Tier levels Q_X and Q_Y are transformed with the following equation:

$$\rho_{X,Y} = \sqrt{(2 - Q_X) \cdot (2 - Q_Y)} \qquad (4)$$

Equation (4) leads to the situation of no correlation $(\rho_{X,Y} = 0)$ for two countries with a Tier 2 approach and full correlation $(\rho_{X,Y} = 1)$ if both countries used a Tier 1 approach. A correlation coefficient can be calculated for any intermediate situation. This information is further processed within the standard IPCC Tier 1 method for both level and trend uncertainty.

Table 6.103: Member States's uncertainty estimates for agriculture expressed in percent of total GHG emissions. The table shows three "scenarios" for the uncertainty at EU-15 level, i.e., (i) with the correlation between MS uncertainty estimates as quantified with equation (4); (ii) under the assumption of no correlation and (iii) under the assumption of full correlation between the uncertainty estimates of MS. Scenario (i) is considered to be the most realistic case, and scenarios (ii) and (iii) are giving the range of uncertainty at EU-15 level.

Member State	Total agriculture	Enteric ferment. (4A)	Manure Managem. (4B)		Agricultural soils (4D)			
					total	direct	animal prod.	indirect
		CH_4	CH_4	N_2O	N_2O	N_2O	N_2O	N_2O
	uncertainties expressed as % of total GHG emissions							
Austria	4.4	1.0	0.6	1.2	4.0	3.3	0.4	2.2
Belgium	7.3	1.0	0.6	0.6	7.2			
Denmark	2.6	0.5	1.5	0.8	1.9			
Finland	5.1	1.1	0.1	0.9	4.9	3.7	0.2	3.2
France	7.2	4.1	2.4	1.2	5.3			
Germany	13.6	0.1	0.1	0.1	13.9	10.1	0.0	9.5
Greece	6.2	0.7	0.2	0.3	6.1	5.3	2.9	1.2
Ireland	5.9	1.5	0.4	1.2	5.6	3.8	4.0	1.0
Italy	2.9	0.7	0.7	0.8	2.6	2.0	0.3	1.7
Luxembourg	3.9			0.2			2.0	2.7
Netherlands	3.6	0.5	0.8	0.4	3.4	1.4	0.3	3.1
Portugal	9.7	0.6	1.2	0.8	9.6	8.0	4.9	2.0
Spain	10.9	0.4	0.3	0.7	10.8	9.8		1.0
Sweden	6.5	2.6	0.9	1.0				
United Kingdom	15.7	0.6	0.1	0.9	15.6			
EU15	**5.6**	**0.6**	**0.4**	**0.4**	**6.0**			
EU15 no corr	**4.7**	**0.5**	**0.3**	**0.2**	**4.7**			
EU15 full corr	**9.5**	**0.9**	**0.6**	**0.6**	**9.5**			

Uncertainties calculated from information contained in NIR on uncertainty of activity data and emission factors, and emission data, using the Tier 1 approach.

6.4.3 Improvements since last submission

A major revision of the present chapter on methodological issues and uncertainty in the sector agriculture has been done for the submission in 2006. The chapter gives now a complete overview of all relevant parameters required for the estimation of GHG emissions in this sector. This has been done in parallel to the calculation of all background parameter in the CRF tables for agriculture.

The changes are partly due to a "natural evolution" of the inventory generation over the years and partly motivated by recommendations made by the UNFCCC review team on the occasion of the in-country review in 2005. The main issues raised by the Expert Review Team in 2005 and the major changes include (i) more transparent overview tables on methodological issues; (ii) better presentation of trend development; (iii) streamlining information contained in CRF and NIR; (iv) continuous working with Member States in order to improve the inventory and allowing the quantification of all background data; (v) including a summary of workshops.

For the submission in 2007, few improvements have been added, mainly regarding the calculation of the quality of the EC estimate. Several errors that were identified in the background tables of the Member States could be eliminated, such as the inconsistent use of units or implied emission factors. These corrections did not have an impact on the calculated emissions, but made the aggregation of background information difficult and the comparison impossible.

For the submission in 2008, based on recommendations by the Expert Rview Team of the in-country review in 2007, several improvements were implemented, including higher transparency in describing the aggregation of animal numbers presented under Option B into Option A (which is used at EC level), time series consistencies and trends (including epidemic diseases and issues raised by the ERT, such as the buffalo population in Germany and the goat population in Luxembourg, manure managed in 'other' systems in Italy, or $Frac_{GASM}$ used in Sweden), and outliers.A discussion on the main policies driving the level of GHG emissions in Europe was introduced.

Further a novel approach to calculate uncertainties at the EC level including the assessment of the quality of the emission estimates at MS and EC level has been implemented and described in the NIR. This method was presented during the in-country-review in 2007 and its implementation in the EC-IR was suggested by the ERT. This is complemented by a series of tables giving background information for the estimates of the uncertainty levels for activity data and emission factors.

Emission sources reported by a few MS only (such as CH_4 emissions from enteric ferementation of poultry, reported by Austria and Luxembourg only) will still lead to a discrepancy between the IEF for EU-15 reported in the CRF-tables and the NIR. This is because our principle to not change the category MS report emissions (with the above-mentioned exception of the shift from Option B to Option A for cattle). In the annex to the NIR a weighted average of the IEF for poultry is calculated instead giving the IEF of those animals for which emissions have been quantified and included into the EC total. This is documented also in the CRF tables in a transparent way.

For the submission in 2008 and the current submission,, background information was further developed, in particular with regard to the general development and policy drivers in the countries. A new section was introduced giving most important information on the source category 'Field Burning of Agricultural Residues' and information on the methodology and trends of emissions in this category has been added. Continuous work with MS helps to identify and correct errors; and justifications for un-documented national emission factors have been requested (for example, for the use of IPC2006 default values). Even though **the number of errors could be significantly reduced with regard to previous submissions** a few errors remain and have been requested to be corrected by the MS:

a. wrong distribution of manure over climate regions and AWMS (giving 100% per climate region or AWMS rather than 100% total);

b. a few (remaining) mistakes in the units reported (e.g. fraction instead of precent) etc.;

c. identification of inconsistencies between the product of animal numbers and N-excretion rates on one side and the reported total amount of manure-nitrogen on the other side and incorrect unit for N-excretion one MS

The MS CRF tables are carefully checked on these errors and corrected before calculating the background data for the European Union.

6.4.4 Activities to improve the quality of the inventory in agriculture

As a first activity to assure the quality of the inventory by Member States, a workshop on "Inventories and Projections of Greenhouse Gas Emissions from Agriculture" was held at the European

Environment Agency in February 2003. The workshop focused on the emissions of methane (CH_4) and nitrous oxide (N_2O) induced by activities in the agricultural sector, not considering changes of carbon stocks in agricultural soils, but including emissions of ammonia (NH_3). The consideration of ammonia emissions allows the validation of the N_2O emission sources and it further strengthens the link between greenhouse gas and air pollutant emission inventories reported under the UNFCCC, the EC Climate Change Committee, the UNECE Long-Range Transboundary Air Pollution Convention, and the EC national emission ceiling directive. Objectives of the workshop were to compare the Member States' methodologies and to identify and explain the main differences. The longer term objective is to further improve the methods used for inventories and projections in the different Member States and to identify how national and common agricultural policies could be integrated in EU-wide emission scenarios.

Regarding the quality of national greenhouse gas inventories for the agricultural sector, the participants of the workshop expressed concern in the areas of the consistent assessment of the nitrogen balance in agricultural livestock production systems (source category. 4B), the quality of CH_4 emission estimates from enteric fermentation (source category 4A), and the comprehensive treatment of greenhouse gas emissions from agricultural soils (source category 4D). The workshop recommended, amongst other, to continue the exchange of experience between countries, to coordinate the input of MS into the revision of the IPCC *Guidelines*, and to involve European research projects. It was decided to focus on category 4D due to its dominant role in the total uncertainty of European GHG inventories.

Therefore, an expert meeting of the working group on "improving the quality for greenhouse gas emission inventories for category 4D" was held in October 2004 at the Joint Research Center in Ispra, Italy with the participation of experts from 14 countries and six international organizations / projects.

The objectives of the workshop were:

- To assess the current state of reporting of emissions from agricultural soils;
- To highlight gaps in the availability of data;
- To report on national activities for the generation of national emission factors and other parameters;
- To discuss the link between different source categories in agriculture and with the inventory for ammonia emissions;
- To discuss the use of Tier 3 approaches (process-based models);
- To make recommendations to improve comparability, transparency and completeness of reporting of N_2O emissions from agricultural soils.

The workshop's participants formulated general recommendations for the improvement of the quality of greenhouse gas emission inventories for category 4D as well as a series of specific recommendations, directed both at European Member States in order to improve GHG inventories under the current Guidelines and suggestions beyond the current guidelines addressing the IPCC process for revision of the Guidelines. These recommendations have been forwarded to the secretariat of the IPCC and most of the issues addressed are being updated in the 2006 guidelines.

These recommendations were discussed in a wider audience at scientific conferences, such as the Non-CO_2 greenhouse gas conference (NCGG-4) in Utrecht (see Leip, 2005a) and discussed for their scientific relevance in Leip et al. (2005). The proceedings of the workshop have been published as a EUReport (Leip, 2005b).

Recommendations

The participants of the workshop valued the concept and the quality standards as they are currently defined in the Guidelines for reporting to the respective conventions, and felt that some methodologies can indeed be improved.

The workshop's participants formulated general recommendations for improvement of the quality of greenhouse gas emissions for category 4D as well as a series of specific recommendations.Specific recommendations are directed both towards European Member States in order to improve GHG inventories under the current ***Guidelines*** and suggestions beyond the current guidelines addressing the IPCC process for revision of the ***Guidelines***.

General recommendations

Coherent reporting

The participants recognized that, for reporting N-emissions, the existence of the two conventions is complementary rather than competitive and that mutual benefits can be achieved by combining the respective efforts and exchange of information.

Despite the differences in target and scale between the two conventions, the participants urge to a unified concept for reporting. Synergies and coherence with other directives (e.g., nitrate directive) should be considered. Inventory generation requires interdisciplinary expertise.

Comprehensive reporting

Emissions of air pollutants, greenhouse gases and inert gases from agricultural systems are closely interrelated. To avoid that a certain mitigation measure leads to a simple shift in emissions, it is important to have a comprehensive and integrated assessment of all emissions. This assessment could eventually be used for reporting requirements.

The guidance needs to be user-friendly and unequivocally, and stimuli for countries to actually improve reporting quality would help. The IPCC is offering methodologies and invites countries to use improved methodologies. One is the use of the CORINAIR guidebook for NH_3 calculations.

Stakeholders

The assessment of the environmental impact of agricultural activities in Europe is relevant at different levels, i.e., at the European level, at national and regional (e.g., drainage basins) level and at the farm level.

Each of them requires its own level of detail in the methodological approach (reporting, budgeting, process understanding) and is associated with a different degree and definition of uncertainty. Also, it is helpful to develop a communication tool between the levels.

Mitigation

Mitigation of emissions from agriculture is achieved at the farm and regional level. The processes involved in the formation of emission fluxes in agricultural systems are extremely difficult and complex. There is a need to allow in the reporting methodologies for mitigation measures other than changing N input. Methodologies should also encourage operating in a country-specific way. Process understanding should be incorporated in order to allow for (convincing) mitigation measures at the farm level.

Activity Data

There is (still) a lack (and uncertainty) in activity data. There is need of management data as input data for the guidelines in order to enable to make projection.

Emission Factors

Emission factors and other parameters used in the calculation of emission fluxes are associated with a large degree of uncertainty. The emissions of nitrous oxide from soils are affected by both variability in space and time and by inaccuracy. Deeper process knowledge is required to separate them. This can be achieved by a combination of well conceptualized experiments and (process) modeling.

There is a body of evidence that default Emission Factors can be revised on the basis of recent data. In some cases, there is less uncertainty associated with relative than with absolute emissions (e.g. nitrate ammonium > urea). Such knowledge could be better exploited.

Countries are encouraged to develop and use national data provided these are documented, validated and made available. Regionalization of emission factors is required. Additional information is needed in particular for Southern and Eastern European climate regions. Resources should be allocated with preference into the development of national estimates for indirect N_2O emissions (volatilization, leaching and run-off), which are most uncertain.

In some cases, there might be a need to find a compromise between comparability and accuracy. Existing national data are in some cases not yet used for reporting. Comparability can not be achieved by using the same factor.

Projections

An integrated research approach is required in order to enhance process understanding, to improve biogeochemical models and finally to narrow the uncertainty range in emission projections. Components of an integrated research approach must be field measurements accompanied by laboratory studies and model improvement and validation.

The workshop's participants see need for action at the EC level

There is value in exchanging ideas in the frame of a workshop especially as national data and methodologies are developed[30]. Particularly, the involvement of New Member States and Candidate Countries is needed.

Data requirements for the second commitment period (2006 guidelines) and negotiations/ preparations under COP/SBSTA

Process models are continuously evolving and improving. Their potential use for GHG inventories should be re-assessed in two years time.

There is the need to better assess the uncertainty associated with N_2O emissions from soils and to take action for reducing the uncertainty range.

Specific recommendations

General issues

Recommendations for current reporting

(1) Member States are encouraged to develop national emission factors or parameters required for the calculation of N_2O emissions, which are essential for reducing uncertainty of GHG inventories, provided these are documented, validated and made available. Priority areas are:

- (a) Direct emission factors
- (b) Leaching fraction
- (c) N_2O emissions from groundwater
- (d) Nitrogen fraction in crop residues
- (e) Volatilization fraction for synthetic fertilizer and applied animal wastes.

(2) Member States are required to appropriately disaggregate key source categories according to the *Guidelines*.

(3) Member States are encouraged to collect farm management information, which is still scarce and is required for N_2O emission estimates and projections.

Direct emissions of N_2O

Emission Factors

Recommendations for current reporting

(4) Member States are encouraged to develop regional emission factors/parameters. Eco-systemical stratification of emission factors by main ecological drivers is essential for reducing the uncertainty in national greenhouse gas inventories. Priority areas are:

- o Effect of soil type/climate (wetness/freeze-thaw events/rewetting of dry soils)
- o Effect of type of N applied (mineral / organic)
- o Effect of crop type (classes)

Recommendations for the revision of the Guidelines

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30 The participants of the workshop welcomed the project carried out in Italy for comparison of methodologies used in Mediterranean countries.

(5) There is a basis for differentiating N_2O emission factors between the type of nitrogen input, in relationship to land use and soil conditions. In particular, specific EFs could be adopted, for

(a) the manure N deposited in situ, taking into account the state of the soil under the grazing regime; and

(b) the manure from animal housing etc. spread on the fields.

(6) Mitigation measures should be visible in the *Guidelines* for higher Tier methods as emissions of N_2O are a non-linear function of N input. Efficient use of nitrogen given to the crop is a function of both crop type and local conditions. Application rates in relation to crop needs and timing of management activities are key driver for avoiding excess input of nitrogen.

(7) Emissions of N_2O induced by different forms of nitrogen input are non-linearly interacting. The interdependency between forms of N-input should be reflected in the *Guidelines* for higher Tier methodologies, e.g. as an EF-matrix (total input vs. percent animal waste).

N_2O emissions from crop residues and from N-fixing crops

Recommendations for current reporting

(8) Member States should use Table4.F for reporting of parameters relevant for N_2O emissions from crop residues, even in case no burning of crop residues occurs in their country, to enhance transparency.

(9) Member States are required to estimate crop residues from all major crop types occurring in their country.

Recommendations for the revision of the Guidelines

(10) A separate calculation for forage legumes such as alfalfa and clover-grass mixtures should be included in the *Guidelines*. The role of rotational renewal of grass/clover leys by ploughing and reseeding every few years also needs attention.

(11) The methodology for reporting of emissions from crop residues needs revision. In particular:

(c) There are possible risks of double counting when background emissions from the cultivation of mineral soils are included in the inventory. Guidance on background emissions should be given.

(d) Default values for the nitrogen fraction need to be streamlined. Particular attention should be paid to the physiological part of the crop the parameters are referring to (crop product, crop residue, and total aboveground crop).

(e) The C/N ratio of crop residues appears to be a key variable in determining the amount of N_2O produced during winter and could be included in the methodology.

(12) An alternative and simpler method for estimating N_2O emissions could be based on area-based quantities of nitrogen in crop residues by crop type, which are more readily available in some countries.

Background emissions

(13) Reporting of background emissions from cultivation of mineral soils seems appropriate as long as nitrogen in roots is not accounted for and with regard of long-term effects of manure applications. However, reporting of background emissions bears the risk of double accounting. It would be helpful if the *Guidelines* address this issue.

Nitrogen balance in agricultural systems

Recommendations for current reporting

(14) Member States should link NH_3 and N_2O inventories as far as possible in order to enable the assessment of mitigation measures for its impact on both air pollution and climate change related policies.

(15) Member States should apply a mass-flow approach wherever possible, provided that appropriate factors are available (related to Total Ammoniacal Nitrogen for NH_3 and total nitrogen for N_2O). If possible, also emissions of N_2 should be reported wherever relevant.

(16) Member States are encouraged to differentiate between NH_3 volatilization from animal housing systems, manure storage systems and volatilization from soils. Information on NH_3 emission rates from housing and manure could be included in background Table4.B(b) as shown in the following example, indicating emissions of NH_3, NO_x, and N2 in columns $L to $N and differentiation between systems in rows #12ff.

(17) Member States should correct the amount of nitrogen deposited on pasture, range, and paddock (Equation 2 of p. 4.98 of the IPCC *Guidelines*) for the fraction of nitrogen volatilized in analogy to the calculation of direct emissions from applied manure (see equation 4.23 on page 4.56 if the IPCC *Good Practice Guidance*), as volatilization of NH_3 from pasture, range, and paddock occurs before N_2O production takes place. The Fraction of livestock N excreted and deposited onto soil during grazing that volatilizes as NH_3 and NO_x could be reported in cell J16 of the table “Additional information” of background Table4.D. A possible acronym is “$Frac_{GASP}$”

Recommendations for the revision of the Guidelines

(18) The *Guidelines* should apply a nitrogen-balance method allowing the comprehensive assessment of mitigation. This would – in some cases – require the estimation of other nitrogenous losses as NO_x and N_2.

(19) The CRF table should allow reporting separately volatilisation fractions for NH_3 and NO_x and optionally N_2, and differentiating for animal housing and manure storage systems. This could be achieved, for example, with additional columns/rows in the table "Implied Emission Factors" in background Table4.B(b).

(20) The default volatilization fractions for NH_3 and NO_x or fertilizer application should be replaced by a more detailed method, such as the methodology described in the CORINAIR guidebook.

(21) Volatilization fractions for NH_3 and NO_x from soils should be differentiated for manure applied on agricultural soils and manure dropped on Pasture, Range, and Paddock. This could be achieved, for example,by an additional row in the table "Additional information" in Table4.D

(22) The name of category 4D31 "Atmospheric Deposition" easily leads to confusion with atmospheric nitrogen deposited on the agricultural land. The workshop recommends another short name, such as Indirect N_2O emissions from "*Volatilization of NH_3 and NO_x*".

(23) The calculation of "Direct N_2O emissions from Animal Production" should be done under category 4D rather then under category 4B.

(24) The definition of manure as "animal wastes" does not seem appropriate.

Advanced methodologies

Recommendations for the revision of the Guidelines

(25) Biogeochemical models are potentially a powerful tool for deriving emission factors on a regional basis and for the policy-making process (projections, scenario analysis). They could play a useful role for inventory generation in some year's time, provided that they are thoroughly validated. Guidance should be given on the use of biogeochemical models, in particular

(26) how sub-sources, that are integrated in one calculated emission rate should be separated. In biogeochemical models, sub-sources are interacting, non-linear, and non-additive.

(27) if changes in weather conditions and other ephemeral changes should be fully reflected in the emission estimates or if – during a commitment period – climate data should be used rather than weather

(28) how transparency could be ensured (assumption behind models, parameterization, underlying data sets etc.)

Other issues

Recommendations for the revision of the Guidelines

Intercrops

(29) The occurrence of intercrops is common in certain European regions and has an impact on the use and efficiency of nitrogen fertilizer. The use of intercrops should be reflected in the *Guidelines*.

Reporting of emissions from land use and land-use change

(30) Permanent crops are important in Mediterranean countries. Allocation of permanent crops within the land use categories proposed in the *Good Practice Guidance* for LULUCF is not straightforward. Better guidance should be given in the *Guidelines*.

(31) The transformation of volatilized nitrogen from agriculture into N_2O can happen after one or more cycles of deposition/volatilization processes. Indirect N_2O emissions should be reported from all land uses where N_2O emissions are being estimated rather than from cropland only.

Indirect emissions from energy-related activities

(32) Energy-related emissions of NO_x are leading to N_2O emissions further down in the "nitrogen cascade" can significantly contribute to total anthropogenic N_2O emissions. Considering these emissions in the guidelines would ensure methodological consistency across the sectors.

6.5 Sector-specific recalculations

6.5.1 Enteric Fermentation (CRF source category 4.A)

Information on recalculations of emission estimates in category 4A contained in the NIR of some countries are summarized below:

Table 6.104: Member State's background information for recalculations of emissions in category 4.A

Member State	Recalculations
Austria	The gross energy intake data (GE) and the methane conversion rate (Ym) for enteric fermentation of poultry were revised. The new values were obtained from the National Inventory Report of Switzerland 2008. The revision results in 50% higher methane emissions for 1990-2007.
Belgium	In Wallonia, the milk production has been slightly revised, as a mistake in the data source since 2003 was found. The EF for enteric fermentation is consequently revised from 2003. In Flanders, from 2004 on data on milk production (real milk supplies from Flemish producers to Flemish or Walloon consumers) are obtained for a calendar year in stead of a milk quota year (with exception of direct supplies on the farm for which only data on milk quota year (e.g. 1st April 2007 till 31st march 2008) are available). In the submission of 2008 all data were still based on a milk quota year. This results in a reduction of the methane emissions of less than 0.5%. In Wallonia, the emission factor for enteric fermentation for goats, horses and sheehas been revised in order to harmonize the methodology between the regions. The new EF are IPCC default values, the same factors as in Flanders. Wallonia and Flanders revised the estimates for CH_4-emissions from manure management for cattle (dairy and non-dairy) using the Tier 2 methodology and harmonized between the two regions. Flanders also revised the estimates for CH_4-emissions from manure management for swine, using the same Tier 2 methodology as described above for cattle. Flanders revised the MCF used to calculate the CH_4-emissions from manure management for the non key source categories. These MCFs are harmonized with the MCFs used for cattle and swine.
Denmark	A more detailed division in subcategories for goats and horses have resulted in changes in the feed intake and thereby in the IEF from 2006 to 2007. The IEF for sheep and goats includes lambs and kids. New stable types for mainly cattle and swine have been added also for matching latest listed categories for the Danish norm data system. Emission factors for fur farming have been raised from 25 to 36 % in agreement with Poulsen, H. D (pers. comm. 2008) and recalculation is done for the years 1990-2006.
Finland	A small correction to the milk production and CH_4 emissions of dairy cows was made for year 2006. As the time series of methane production of fur animals is now included has the annual total amount of methane produced changed accordingly.
Germany	The implementation of IPCC (2006) MCF (0,065 MJ MJ-1 instead 0,060 MJ MJ-1), as well as the MCF for the Dairy Cattle had implication to the emissions. The changes in the food of dairy cattle (more energetic food) and for bulls. The new information are known for the lactation energy and milk protein content.
Greece	Emissions from sheep were recalculated due to confirmed data regarding milking ewes, population of other female sheep > 1 year old, males > 1 year old, female lambs, male lambs, grazing flat pasture, grazing hilly pasture, housed fattening lambs, domestic / in flock sheep milked, nomadic sheep milked, wool production and births. Finally emissions from dairy cattle for the whole period (1990-2006) were recalculated by applying emission factors based on the confirmed milk production data.
Italy	Some parameter used for calculating the cow buffalo EF, the average weight of the category of less than 1 year for slaughter, and the Bo parameter for the buffalo category were recalculated. For the year 2001, ISTAT has provided information of main livestock categories considering data collected on 1 December (ISTAT, 2007[d]); therefore, this information has been updated.
Luxembourg	Update of activity data for livestock. revised activity data for dairy cattle (use of milk yield and fat content of milk for Luxembourg instead of German averages), reallocation of cattle types among option B categories: dairy-cattle, mature non-dairy cattle and young cattle, revised calculation of Gross Energy Intake for young cattle and revision of the Digestible Energy parameter for all animal categories.
Portugal	Update of livestock time series (in some cases as far as 2003); Update of activity data for 2006: agriculture area, agriculture production, livestock production, and production of fertilizers (INE data/National Statistics).
Netherlands	Feed intake is the basis for the calculation of the methane emission factor from enteric fermentation by cattle. The new method was only applied to the years starting from 2003 and no recalculations were carried out for the period 1990-2002. Furthermore, in 2003 energy requirement by dairy cattle was raised by 10%.

6.5.2 Manure Management (CRF source category 4.B)

Information on recalculations of emission estimates in category 4B(b) contained in the NIR of some countries are summarized below:

Table 6.105: Member State's background information for recalculations of emissions in category 4.B-CH_4

Member State	Recalculations
Germany	Poultry emissions are calculated for the first time using the Tier 2 approach (HAENEL & DÄMMGEN, 2007a, b; DÄMMGEN et al., 2008). N-excretion of ducks is updated. MCF given in IPCC2006 differ partly considerably from IPCC1997 and IPCC2000. Die Ausscheidungen für Enten wurden dem nationalen Stand des Wissens angepasst.
Greece	The CH_4 and N_2O emissions from manure management have been recalculated because of the availability of updated activity data as far as the population of the animals for 1999 to 2006 is concerned.
Ireland	There were major changes in the inventories for Agriculture in the 2006 submission with the adoption of Tier 2 methods for CH_4 emissions from enteric fermentation in cattle and robust improvement in estimates of emissions from manure management based on the results of major research and an extensive farm facilities survey conducted in recent years. During 2008, revised milk yield data provided by the C.S.O resulted in the adjustment of milk production patterns in the Tier 2 emission model for the calculation of CH_4 emissions from enteric fermentation in dairy cows.
Italy	Since the 2006 submission, parameters related to the estimation of CH_4 and N_2O emissions have been updated: average weight, production of slurry and solid manure and the nitrogen excretion rates. The source for updating has been the Inter-regional project on nitrogen balance and other national research studies.
Luxembourg	Revised estimates for the breakdown of manure by AWMS.
Netherlands	The total amount of nitrogen excreted from animals is no longer adjusted for nitrogen from ammonia volatilization during manure management, which makes the estimate consistent with the IPCC GPG.
Sweden	The stable period for cattle is revised for the whole time series. The method for calculating it has been refined in the underlying survey.
United Kingdom	Emissions in 2006 have been recalculated to reflect revised animal numbers for non-dairy cattle and sheep.The emission factor for methane emissions from pig wastes has been revised, in line with the value in the 2000 GPG.The emission factor for N_2O from poultry wastes has also been revised in line with the 2000 GPG.

Table 1.6.106: Member State's background information for recalculations of emissions in category 4.B-N_2O

Member State	Recalculations
Austria	
Belgium	In Flanders a few corrections have been made to the model used to calculate the NH_3-emissions from 1996 on. This has minor implications on the N_2O-emissions (from 1996 to 2004: minor increase, from 2005 on minor decrease).
Denmark	Emission factors for fur farming have been raised from 25 to 36 % in agreement with Poulsen, H. D (pers. comm. 2008) and recalculation is done for the years 1990-2006. Data for dairy cattle and heifer's time on pasture have been lowered with 10 % in 2007. In order to remove time-series inconsistency the data are interpolated for the years 2003-2006.
Finland	The nitrogen excretion rates of poultry were corrected for the time series since 1991 and for fur animals since 1990. These changes had no impact on emissions. For poultry corrections were made for nitrogen excretion per AMWS since 1994 because of a calculation error that appeared (broiler hens) and a small correction was also made for year 2006 (other poultry). For fur animals there was a small error in the share of solid storage since 1994 which was corrected. These corrections resulted in small changes in the reported emissions of nitrous oxide, fur animal error also affecting slightly atmospheric deposition and leaching and runoff. For dairy cows errors in the nitrogen excretion on pasture for years 2004, 2005 and 2006 were corrected. For non-dairy cattle a small correction was made to nitrogen excretion per AMWS (calves) and that slightly affected total nitrogen excretion for year 2006. All MCF's and 'Allocation by climate region to different AMWS' tables were corrected. In NIR sheep N_2O emissions were corrected to Table 6.3_2.
Germany	The distribution of AMWS was recalculated for the years 2003 to 2005. New IPCC emission factors (2006) integrated. For dairy cows, bulls, calves, suckling cows, pigs, horses and buffalos the nitrogen excretion

Member State	Recalculations
	was recalculated, for bulls and chicken the calculation was carried out in a more detailed manner..
Greece	N_2O emissions from manure management have been recalculated because of the availability of updated activity data as far as the population of the animals for 1999 to 2006 is concerned.
Ireland	Revised poultry population statistics for 4.B.9 Poultry for 2006 resulted in a 0.28 percent decrease in N_2O emissions from 4.B. Manure Management.
Italy	
Netherlands	N_2O emission for manure management of horses and ponies have been recalculated. Since 2006, excretion volumes and N excretion per animal are calculated for horses and ponies separately and in line with the calculation of the other animal categories (Van Bruggen, 2009). The 2006 data are used for the years 1990-2005. This has resulted in slightly lower emissions. The recalculation of feed intake leads to a recalculation on manure N excretion by cattle (Van Bruggen, 2009). Due to this recalculation the N_2O emission from manure management has increased. The effect of the recalculation is minor and is included in the figures given in 6.2.6. Implementing these data together with new data on N-excretion by horses and ponies has resulted to a very small increase of the N_2O emission in 1990 and a very small decrease in 2006.
Sweden	The stable period for cattle is revised for the whole time series. The method for calculating it has been refined in the underlying survey. Some other minor updates of data has been performed.
United Kingdom	Emissions in 2006 have been recalculated to reflect revised animal numbers for non-dairy cattle and sheep.The emission factor for N_2O from poultry wastes has also been revised in line with the 2000 GPG.

6.5.3 Rice Cultivation – CH_4 (Source category 4.C)

6.5.4 Agricultural Soils - N_2O (Source category 4.D)

Information on recalculations of emission estimates in category 4D contained in the NIR of some countries are summarized below:

Table 6.107: Member State's background information for recalculations of CH_4 emissions in category 4.D

Member State	Recalculations
Austria	4.D.1 and 4.D.3 – N_2O emissions from animal manure applied to soils. The revision of the share of dairy cattle held in loose (32%) and tied housing systems (68%) within the NH_3 inventory resulted in slightly lower direct N_2O emissions from animal manure applied to soils and slightly higher indirect N_2O emissions. The new data on housing system distribution is based on (AMON et al. 2007). 4 D 1 – Crop Residue. N contents of crops were revised, resulting in higher N_2O emissions from 1990 onwards.
Denmark	Updated data from The Danish Environmental Protection Agency for the use of sewage sludge as fertilizers for the years 2004-2006 have been received and therefore recalculations. This results in an increase in N_2O of 16 % for the period. NH_3 emission factors for crops are lowered from 5 to 2 % for crops and from 3 to 0.5 % for grass based on a literary survey (Gyldenkærne and Albrektsen, 2009).
Finland	The time series for N_2O emissions from crop residues was changed as the burned amount is now reduced from the total amount of residue. Nitrogen input in sewage sludge was updated for the year 2006. As corrections were made for manure nitrogen excretion there were changes in time series since 1994 for atmospheric deposition and leaching/run-off.
Germany	NH_3 volatilization from applied mineral fertilizer: for the years 1999 and 2003, a disaggregated calculation at district-level has been performed. Time series of applied sewage sludge corrected and completed. Improvement of N_2O, NO, and NH_3 emission calculations.
Greece	Updated activity data concerning the population of the animals for the period 1999-2006, synthetic fertilizers for the period 1990-2006 and the agricultural production per crop for 2006.
Ireland	Updated AD for sewage sludge application.
Netherlands	N_2Oemissionfromsoilshavebeenrecalculatedonbasisof recalculatedmanureNexcretiondata.
Portugal	Update of activity data for synthetic fertilizers. Changes in estimates of emission of ammonia reflect indirectly the changes in nitrogen excreted by livestock and the quantity of nitrogen in synthetic fertilizers and manure that is added to soil as fertilizer.
Sweden	The stable period for cattle is revised for the whole time series. The method for calculating it has been refined in the underlying survey. Some other minor updates of data has been performed.
United Kingdom	The N excretion factors have been revised according to values provided by Ken Smith and Bruce Cottrill (ADAS). These were corrected for all years 1990-2007. The new values are based on estimation of the total N consumption minus the N content of livestock products, for all the major categories of farm livestock

Member State	Recalculations
	and were developed and published in a Defra report (Defra, 2008).

6.5.5 Field Burning of Agricultural Residues (Source category 4.F)

Information on recalculations of emission estimates in category 4F contained in the NIR of some countries are summarized below:

Table 6.108: Member State's background information for recalculations of emissions in category 4.D

Member State	Recalculations
Finland	The emissions of straw burning are included in the inventory for the first time, therefore no recalculations were made.
Greece	Updated activity data.

List of references:

Austria (2009, p. 364-375)

Amon B, Fröhlich M, Amon T et al. (2007): Tierhaltung und Wirtschaftsdüngermanagement in Österreich. *Endbericht Projekt Nr. 1441.* Auftraggeber: Bundesministeriumfür Land- und Forstwirtschaft, Umweltund Wasserwirtschaft, Wien.

Amon B, Amon T & Hopfner-Sixt K (2002) Emission Inventory for the Agricultural Sector in Manure Management. Agricultural, Environmental and Energy Engineering (BOKU - University of Agriculture, Vienna). July 2002.

Bundesanstalt für Agrarwirtschaft (2005) Federal Institute of Agricultural Economics. Download from data pool. http://www.awi.bmlfuw.gv.at/framesets/datapoolframeset.html.

BMLFUW (2006a): 47. Grüner Bericht gemäß § 9 des Landwirtschaftsgesetzes BGBl. Nr. 375/1992. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

BMLFUW (2008): 49. Grüner Bericht gemäß § 9 des Landwirtschaftsgesetzes BGBl. Nr. 375/1992. Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien.

BUNDESANSTALT FÜR AGRARWIRTSCHAFT (2007): Federal Institute of Agricultural Economics. Download from data pool http://www.awi.bmlfuw.gv.at/framesets/datapoolframeset.html.

Detzel A, Vogt R & Fehrenbach Hea (2003) Anpassung der deutschen MethodikFreibauer A & Kaltschmitt M (2001) Biogenic Emissions of Greenhouse Gases Caused by Arable and Animal Agriculture“ (FAIR3-CT96-1877) Report Task 3.

Heim P (2005) Fütterung von Kuh und Kalb. *Article in UFA-Revue 3/05 an agricultural jurnal of Switzerland.*

Götz B (1998) Stickstoffbilanz der österreichischen Landwirtschaft nach den Vorgaben der OECD. Aktualisierte und erweiterte Fassung. UBA BE-087a. July 1998. Wien: Umweltbundesamt.

Gruber L & Pötsch EM (2006) Calculation of nitrogen excretion of dairy cows in Austria. *Die Bodenkultur - Austrian Journal of Agricultural Research*Vol. 57, Heft 1-4, Vienna.

Gruber L & Steinwidder A (1996) Einfluß der Fütterung auf die Stickstoff- und Phosphorausscheidung landwirtschaftlicher Nutztiere - Modellkalkulationen auf Basis einer Literaturübersicht. *Die Bodenkultur - Austrian Journal of Agricultural Research* 47, 4.

Konrad S (1995) Die Rinder-, Schweine- und Legehennenhaltung in Österreich aus ethologischer Sicht. Wien: WUV Universitätsverlag.

Löhr L (1990) Faustzahlen für den Landwirt.

Minonzio G, Grub A & Fuhrer J (1998) Methan - Emissionen der schweizerischen Landwirtschaft. Schriftenreihe Umwelt, 298. Bern: Bundesamt für Umwelt, Wald und Landschaft (BUWAL).

Minonzio G, GRUB A & Fuhrer J (1998) Methan - Emissionen der schweizerischen.

Pötsch EM, Gruber L & Steinwidder A (2005) Answers and comments on the additional questions, following the meeting in Bruxelles. Internal statement, HBLFA Raumberg-Gumpenstein.

Scharf S, Schneider M & Zethner G (1997) Zur Situation der Verwertung und Entsorgung des kommunalen Klärschlamms in Österreich. UBA Monographien Band 95. Wien: Umweltbundesamt.

Schechtner (1991) Wirtschaftsdünger - Richtige Gewinnung und Anwendung. Sonderausgabe des Förderungsdienst 1991. Wien: BMLF.

Statistik Austria (2007): Allgemeine Viehzählung am 1. Dezember 2007. National livestock counting December 2006, published in (BMLFUW 2008).

Steinwidder A & Guggenberger T (2003) Erhebungen zur Futteraufnahme und Nährstoffversorgung von Milchkühen sowie Nährstoffbilanzierung auf Grünlandbetrieben in Österreich. *Die Bodenkultur - Austrian Journal of Agricultural Research* 54, 1, 49-66.

Steinwidder A & all (2006) Einfluss des Absetztermins auf die Milchleistung und Körpermasse von Mutterkühen sowie die uwachsleistung von Mutterkuh -Jungrindern. Versuchsbericht. Extensively managed beef cows – Effects on animal health, reproductive success, performance of calves and economics. Experiment 2004 to 2008. *Interim report. Agricultural Research and Education Centre, HBLFA Raumberg-Gumpenstein.*

SBV (2007): Statistische Erhebungen und Schätzungen über Landwirtschaft und Ernährung 2006. Swiss Farmers Union, Brugg.

Austria;Germany - EMEP/CORINAIR (2003) Joint EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition October 2002, updated 2003. http://tfeip-secretariat.org/unece.htm.

Winiwarter, W. , and Rypdal, K.: Assessing the uncertainty associated with national greenhouse gas emission inventories: a case study for Austria, Atmos. Environ., 35, 5425-5440, 2001.

Belgium (2009, p. 134-135)

INS-agriculture (2001), "Recensement agricole et horticole au 15 mai 1999", (2002) "Recensement agricole et horticole au 15 mai 2000", (2002)"Recensement agricole et horticole provisoire au 15 mai 2001", Ministère des affaires économiques, Institut national de statistiques.

Pauwelyn J & Depuydt S (1997) Studie der kwantificering van de nutriëntenverliezen per stroombekken naar het oppervlaktewater door landbouwactiviteiten in Vlaanderen: een praktijkgericht onderzoek ter ondersteuning van het milieu- en landbouwbeleid. Instituut voor Scheikundig Onderzoek.

SITEREM (2001) Estimation des émissions dans l'air de CH_4, NH_3 et N_2O par le secteur agricole en région wallonne. Rapport final demandé par le Ministère de la Région Wallonne. Direction Générale des Ressources Naturelles et de l'Environnement.

VITO VLAAMSE INSTELLING VOOR TECHNOLOGISCH ONDERZOEK = Flemish Institute for Technological Research B, B-2400 MOL (www.emis.vito.be).

Smink W. & all (2004). Methaanproductie als gevolg van pensfermentatie bij rundvee berekend middles de IPCC-GPG Tier 2 methode. Feed Innovation Services. Studie uitgevoerd in opdracht van SenterNovem, Utrecht. Rapport FIS: FS 04 12, 45 p.

Denmark (2009, p. 285-288)

Børgesen CD & Grant R (2003) Vandmiljøplan II - modelberegning af kvælstofudvaskning på landsplan, 1984 til 2002. Baggrundsnotat til Vandmiljøplan II - slutevaulering (In Danish). Danmarks Jordbrugsforskning og Danmarks Miljøundersøgelser.

Bussink DW (1994) Relationship between ammonia volatilisation and nitrogen fertilizer application rate, intake and excretion of herbage nitrogen by cattle on grazed swards. *Fertil. Res.* 38, 111-121.

Danfær, A. 2005. Methane emission from dairy cows. Chapter 1. in Evaluering af mulige tiltag til reduktion af landbrugets metanemissioner. Arbejdsrapport fra Miljøstyrelsen Nr. 11 /2005.

Djurhuus J & Hansen EM (2003) Notat vedr. tørstof og kvælstof i efterladte planterester for landbrugsjord - af 21. maj 2003 (In Danish). Forskningscenter Foulum, Tjele.

DEA, 2008, Danish Energy Authority: S. Tafdrup. *Pers. Comm.*

Gyldenkærne, Steen. Researcher at NERI, Departement of Policy Analysis. *Pers. Comm.,* 2005.

Høgh-Jensen H, Loges R, Jensen ES, Jørgensen FV & Vinther FP (1998) Empirisk model til kvantificering af symbiotisk kvælstoffiksering i bælgplanter. In *E. S. KRISTENSEN and J. E. OLESEN (eds.) Kvælstofudvaskning og-balancer i konventionelle og økologiske produktionssystemer* Forskningscenter for Økologisk Jordbrug. p. 69-86.

Illerup JB, Nielsen M, Winther M, Mikkelsen MH, Lyck E, Hoffmann L & Fauser P (2004) Annual Danish Emissions Inventory Report to UNECE. Inventories 1990-2002. National Environmental Research Institute. - Research Notes from NERI 202: 490 pp. (electronic).

http://www2.dmu.dk/1_viden/2_Publikationer/3_arbrapporter/rapporter/AR202.pdf.

Jarvis SC, Hatch DJ & Roberts DH (1989) The effects of grassland management on nitrogen losses from grazed swards through ammonia volatilization; the relationship to extral N returns from cattle. *J. Agric. Camp.* 112, 205-216.

Kristensen IS (2003) Indirekte beregning af N-fiksering - draft, not published. Danmarks JordbrugsForskning. (In Danish).

Kyllingsbæk (2000) Kvælstofbalancer og kvælstofoverskud i dansk landbrug 1979-1999. DJF rapport nr. 36/markbrug. Dansk Jordbrugsforskning.

Mikkelsen MH, Gyldenkærne S, Poulsen HD, Olesen JE & Sommer SG (2005) Opgørelse og beregningsmetode for landbrugets emissioner af ammoniak og drivhusgasser 1985-2002 (In Danish). DMU arbejdsrapport nr. 204/2005. Danmarks Miljøundersøgelser og DanmarksJordbrugsForskning.

Poulsen, Hanne Damgaard. The Faculty of Agricultural Science, Pers. Comm.

Poulsen HD, Børsting CF, Rom HB & Sommer SG (2001) Kvaelstof, fosfor og kalium i husdyrgødning - normtal 2000. DJF rapport No. 36 (in Danish).

Sommer SG & Christensen BT (1992) Ammonia volatilization after in-jection of anhydrous ammonia into arable soils of different moisture levels. *Plant Soil* 142, 143-146.

Sommer SG & Ersbøll AK (1996) Effect of air flow rate, lime amend-ments and chemical soil properties on the volatilization of ammonia from fertilizers applied to sandy soils. *Biol. Fertil. Soils* 21, 53-60.

Sommer SG & Jensen C (1994) Ammonia volatilization from urea and ammoniacal fertilizers surface applied to winter wheat and grassland. *Fertil. Res.* 37, 85-92.

Sommer SG, Hutchings NJ, Andersen JM & Asman WAH (2001) A detail ammonia emission inventory for Denmark. *Atmos. Environ.* 35, 1959-1968.

Denmark;no - Jarvis SC, Hatch DJ & Lockyer DR (1989) Ammonia fluxes from grazed grassland annual losses form cattle production systems and their relation to nitrogen inputs. *Journal of Agricultural Science* 113, 99-108.

Finland (2009, p. 353-355)

ECETOC (1994) Ammonia emissions to air in Western Europe. Technical Report No. 62. Brussels: European Center for Ecotoxicology and Toxicology of Chemicals (ECETOC).

Grönroos J, Nikander A, Syri S, Rekolainen S & Ekqvist M (1998) Agricultural ammonia emissions in Finland (In Finnish). Finnish Environment 206. Finnish Environment Institute.

Hüther, L. (1999) Entwicklung analytischer Methoden und untersuchung von Einflussfactoren auf Ammoniak-, Methan- und Distickskstoffmonoxidemissionen aus Flüssing- und Festmist Landbauforschung Völkenrode, Sonderheft 200.

Kähäri J, Mäntylahti V & Rannikko M (1987) Suomen peltojen viljavuus 1981-1985. Summary: Soil fertility of Finnish cultivated soils in 1981-1985. Viljavuuspalvelu Oy. (In Finnish).

Kyntäjä JP (2005). *Personal Communication*.

Lehtonen A, Mäkipää R, Heikkinen J, SIEVÄNEN R & LISKI J (2004) Biomass expansion factors (BEFs) for Scots pine, Norway spruce and birch according to stand age for boreal forests. *Forest Ecology and Management* 188, 211-224.

McDonald P, Edwards RA & Greenhalg JFD (1988) Animal Nutrition. 4th ed. New York, USA: Longman.

MKL (1993) Environmental care programs 1990 B 1992 (In Finnish). Maaseutukeskusten liitto (Rural Advisory Centres).

Monni, S., Syri, S. , and Savolainen, I.: Uncertainties in the Finnish greenhouse gas inventory, Environmental Science & Policy, 7, 87-98, 2004.

Monni S, Perälä P & Regina K2007. Uncertainty in agricultural CH_4 and N_2O emissions from Finland - possibilities to increase accuracy in emission estimates. Mitigation and Adaptation Strategies for Global Change 12: 545-571.

Mylls M & Sinkkonen M (2004) Viljeltyjen turve- ja multamaiden pinta-ala ja alueellinen jakauma Suomessa. The area and distribution of cultivated organic soils in Finland (In Finnish, abstract and tables in English). *Suo* 55, 3-4, 53-60.

Niskanen R, Keränen S & Pipatti R (1990) Ammonia emissions in the 1980s. In *Kauppi et al. (ed.) Acidification in Finland*. Berlin: Springer-Verlag.

Rekolainen S, Posch M & Turtola E (1993) Mitigation of agricultural water pollution in Finland: an evaluation of management practices. *Water Sci. Tech.* 28, 3-5, 529-538.

Savolainen I, Tähtinen M, Wistbacka M, Pipatti R & Lehtilä A (1996) Economic reduction of acidifying deposition by decreasing emissions in Finland, Estonia and Russia (In Finnish). VTT Research Notes 1744.

Seppänen H & Matinlassi T (1998) Environmental care programs at Finnish farms 1995 B 1997. Maaseutukeskusten liitto (Rural Advisory Centres) (In Finnish).

Seppänen H & Matinlassi T (1998) Environmental care programs at Finnish farms 1995 B 1997 (In Finnish). 43 Maaseutukeskusten liitto (Rural Advisory Centres).

Yearbook of Farm Statistics 1990-2007 Information Centre of the Ministry of Agriculture and Forestry.

France (2007, p. 91-97; OMINEA 2006 B.2.3.2.2)

Germany (2009, p. 423-436)

Boeckx P & Van Cleemput O (2001) Estimates of N_2O and CH_4 fluxes from agricultural lands in various regions in Europe. Nutr. Cycl. Agroecosyst. 60, 1-3, 35-47.

Dämmgen U, Lüttich M, Döhler H, Eurich-Menden & B. O (2002) GAS-EM - A Procedure to Calculate Gaseous Emissions from Agriculture. *Landbauforschung Völkenrode* 52, 19-42.

Dämmgen U & Lüttich M (2006) The Derivation of Nitrogen Excretions for Dairy Cows from Available Statistical Data. *Landbauforsch. Volk.* special issue 291, 231-243.

Dämmgen U, Lüttich M, Haenel H.-D, Döhler H, Eurich-Menden B, Osterburg B Calculations of Emissions from German Agriculture - National Emission Inventory Report (NIR) 2007 for 2005. Part 3: Methods and Data (GAS-EM). Landbauforschung Völkenrode, special issue 304.

Dämmgen U, Haenel H.-D, Rösemann C, Conrad J, Lüttich M, Döhler H, Eurich-Menden B, Laubach P, Müller-Lindenlauf M, Osterburg B, Strogies M Calculations of Emissions from German Agriculture - National Emission Inventory Report (NIR) 2009 for 2007. In Veröffentlichung.

Dämmgen U (2006) Statistical Data for Animal Numbers in German Emission Inventories. *Landbauforschung Völkenrode* Special Issue 291, 223-229.

Dämmgen U, (ed.) 2004. Nationaler Inventarbericht 2004 - Berichterstattung unter Klimarahmenkonvention der Vereinten Nationen - Teilbericht für die Quellgruppe Landwirtschaft, Vol. Special Issue 260: Landbauforschung Völkenrode.

Dämmgen U, Lüttich M, Haenel H-D, Döhler H, Eurich-Menden B & Osterburg B (2006) Calculations of Emissions from German Agriculture -National Emission Inventory Report (NIR) 2007 for 2005. Part 3: Methods and Data (GAS-EM). *Landbauforschung Völkenrode* Special Issue 304.

Haenel H.-D, Dämmgen U (2007a) Consistent time series of data to model volatile solids and nitrogen excretions of poultry. 1. General considerations and pullets. Landbauforschung Völkenrode 57, 349-362.

Haenel H.-D, Dämmgen U (2007b) Consistent time series of data to model volatile solids and nitrogen excretions of poultry. 2.

Laying hens. Landbauforschung Völkenrode 57, 363-390.

Lüttich M, Dämmgen U, Eurich-Menden B, Döhler H, Osterburg B: Calculations of Emissions from German Agriculture – National Inventory Report (NIR) 2006 for the Year 2004. Part 2: Tables. Landbauforsch Völkenrode special issue 291A, 1-295.

Lüttich M, Dämmgen U, Haenel H-D, Eurich-Menden B, Döhler H, Osterburg B: Calculations of Emissions from German Agriculture – National Inventory Report (NIR) 2007 for the Year 2005. Part 2: Tables. Landbauforsch Völkenrode special issue 304A, 1-347.

Reidy, B.; Dämmgen, U.; Döhler, H.; Eurich-Menden, B.; Hutchings, N.J.; Luesink, H.H.; Menzi, H.; Misselbrook, T.H.; Monteny, G.-J.; Webb, J. (2008) Comparison of models used for the calculation of national NH_3 emission inventories from agriculture: liquid manure systems. Atmospheric Environment, in print.

Sauvant D, Giger-Reverdin S. (2007) Empirical modelling by meta-analysis of digestive interactions and CH_4 productions in ruminants. In: Ortigues-Maty I (ed.) Energy and Protein Metabolism and Nutrition. Wageningen: Wageningen Academic Publishers. Pp 561-562.

Greece (2009, p. 257-260)

Soil Science Institute of Athens (SSIA) (2001) Tenagi Filippon Soil Study. Athens.

Ministry of Agriculture, 1981, 'Tables for the economical analysis of agricultural data', Athens.

National Statistical Service of Greece (NSSG), "Agricultural Statistics of Greece", 1963 – 2001, Athens.

Ireland (2009, p. 136-140)

CSO (Central Statistics Office) (2003) Livestock Survey. Central Statistics Office, Ireland. http://www.cso.ie/.

European Commission (1991) Council Directive of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC). http://europa.eu.int/comm/environment/water/water-nitrates/directiv.html.

Hyde, B., Carton, O.T. and Murphy, W.E. (2008). Farm Facilities Survey – Ireland 2003. Report prepared for the Department of Agriculture by Teagasc, Johnstown Castle, Co. Wexford. 150 pages.

Hynds P (1994) A nutrient balance model for typical Irish farming systems. M.Sc Thesis. National Council for Education Awards.

Mulligan F & O'Mara F (2002) The Excretion of Nitrogen by Dairy Cows and Beef Cattle. A Review Presented to the Environmental Protection Agency. July 2002.

NEUT (Working Group on Nutrients and Eutrophication under the OSPAR Convention) (1999) Screening Procedure for Irish Coastal Waters with Regard to Eutrophication Status.

O'Mara F (2006) Development of Emission Factors for Enteric Fermentation from the Irish Cattle Herd. LS 5.1.1 Final Report. ohnstown Castle, Wexford, Ireland: Environmental Protection Agency.

DAF (Department of Agriculture and Food), 2008. CMMS Statistics Report 2007. Department of Agriculture and Food, Dublin. www.agriculture.gov.ie.

Italy (2008, p. 193-201)

CRPA: Biogas e cogenerazione nell'allevamento suino. Manuale pratico, Milano, Italy: ENEL, Direzione studi e ricerche, Centro ricerche ambiente e materiali, 1996.

Cóndor, G. R., Valli, L., De Rosa, G., Di Francia, A. , and De Lauretis, R.: Estimation of the Italian Mediterranean buffalo methane emission factor, submitted, 2006.

Cóndor R.D., Valli L., De Rosa G., Di Francia A., De Lauretis R., 2008. Estimation of the methane emission factor for the Italian Mediterranean buffalo. Accepted *International Journal of Animal Bioscience.*

CRPA, 2008. Le scelte politiche energetico-ambientali lanciano il biogas. L'Informatore Agrario 3/2008, p.28-32.

CRPA/AIEL, 2008. Energia dal biogas prodotto da effluenti zootecnici, biomasse dedicate e di scarto. Ed. Associazione Italiana Energie Ambientali (AIEL).

CRPA: Progetto MeditAIRaneo: settore Agricoltura. Relazione finale. Technical report on the framework of the MeditAIRaneo project for the Agriculture sector, Reggio Emilia, Italia: CRPA, 2006.

Giardini, L. (1983) Agronomia Generale. Bologna, Italy: Patron.

Husted, S.: An open chamber technique for determination of methane emission from stored livestock manure, Atmos. Environ., 11, 27, 1993.

Husted, S.: Seasonal variation in methane emissions from stored slurry and solid manures, J. Environ. Qual., 23, 585-592, 1994.

Leip, A., Russo, S., Smith, K. A., Conen, F. , and Bidoglio, G.: Rice cultivation by direct drilling and delayed flooding reduces methane emissions, Poster contribution: Third International Symposium on Non-CO_2 Greenhouse Gases (NCGG-3). Scientific understanding, control options and policy aspects. Maastricht, 21-23 January 2002., 2002.

Tani A (2000) Methane emissions from rice paddies: review, assessment and perspectives for Italian lands. Technical Report carried out for APAT.

TERNA, 2007. National production data from biogas. Available: http://www.terna.it/default/Home/SISTEMA_ELETTRICO/statistiche/dati_statistici/tabid/418/Default.aspx.

Portugal - Schütz H, Seiler W & Conrad R (1989) Processes involved in formation and emission of methane in rice paddies. *Biogeochem.* 7, 1, 33-53.

Yan, X., Yagi, K., Akiyama, H. , and Akimoto, H.: Statistical analysis of the major variables controlling methane emission from rice fields, Global Change Biol, 11, 1131-1141, 2005.

Luxembourg (2008, p. 193)

STATEC, Statistical Yearbook, Table C.2111: http://www.statistiques.public.lu/stat/TableViewer/tableView.aspx?ReportId=1224 data extracted on 11 March 2008 (subject to changes since that date).

CITEPA (1990): Estimation of emissions from biogenic sources. Paris.

STATEC 1990 – 2006. Annuaires statistiques. Luxembourg.

TÜV Rheinland (1990): Emissionskataster für das Großherzogtum Luxemburg. Köln.

Pulles, T., Marecková, K.; Svetlik, J. & Skákala, J. (1999): TrainerER – Compiling a National Emission Inventory using the CollectER and ReportER software system. Technical Report No 33. European Environment Agency (EEA). Copenhagen.

Netherlands (2009, p. 191 - 194)

Bannink A, Dijkstra J, Mills JAN, Kebreab E & France J (2005) Nutritional strategies to reduce enteric methane formation in dairy cows. In T. Kuczynski, et al. (eds.) Emissions from European Agriculture. Wageningen, the Netherlands.

Bannink, A. 2008. Methane emission from Dutch dairy cows in 2006; estimate of the national average and its uncertainty. ASG r apport, Lelystad.

Wageningen Academic Publishers. Bannink A, Kogut J, Dijkstra J, Kebreab E, France J, Van Vuuren AM & Tamminga S (2005) Estimation of the stoichiometry of volatile fatty acid production in the rumen of lactating cows. *Journal of Theoretical Biology*.

Bruggen, C. van, 2006: Dierlijke mest en mineralen 2004. CBS, Voorburg.

De Vries W, Kros J, Oenema O & de Klein J (2003) Uncertainties in the fate of nitrogen II: A quantitative assessment of the uncertainties in major nitrogen fluxes in the Netherlands. *Nutr. Cycl. Agroecosyst.* 66, 1, 71-102.

Dijkstra J, Neal HDSC, Beever DE & France J (1992) Simulation of nutrient digestion, absorption and outflow in the rumen: model description. *Journal of Nutrition* 122, 2239-2256.

Hoek, K.W. van der and M.W. van Schijndel, 2006. Methane and nitrous oxide emissions from animal manure management, 1990-2003. Background document on the calculation method for the Dutch NIR. RIVM Report No. 680125002, MNP report 500080002, Bilthoven, the Netherlands.

Hoek, K.W. van der, M.W. van Schijndel, P.J. Kuikman, 2007. Direct and indirect nitrous oxide emissions from agricultural soils, 1990-2003. Background document on the calculation method for the Dutch NIR. RIVM Report No. 680125003, MNP report 500080003, Bilthoven, the Netherlands.

Kroeze C (1994) Nitrous oxide. Emission inventory and options for control in the Netherlands. RIVM report 773001-004. Bilthoven, the Netherlands:

Kuikman PJ, De Groot WJM, Hendriks RFA, Verhagen J & De Vries F (2003) Stocks of C in soils and emissions of CO_2 from agricultural soils in the Netherlands. Alterra report 561. Wageningen, the Netherlands: Alterra, Wageningen UR

Kuikman PJ, Van den Akker JJH & De Vries F (2005) Emissions of N_2O and CO_2 from organic agricultural soils. Alterra rapport 1035-2. Wageningen, the Netherlands: Alterra, Wageningen UR.

Mineralen Boekhouding (1993) Kiezen uit gehalten. Forfaitaire gehalten voor de Mineralenboekhouding 1994. (Mineral Accounting).

Ramírez Ramírez, A., de Keizer, C., van der Sluijs, J. P., 2006: , r., July , and 2006.: Monte Carlo Analysis of Uncertainties in the Netherlands Greenhouse Gas Emission Inventory for 1990 – 2004, Utrecht, The Netherlands: NWS-E-2006-58, Department of Science, Technology and Society, Copernicus Institute for Sustainable Development and Innovation, Utrecht University.

Smink W, Van der Hoek KW, Bannink A & Dijkstra J (2005) Calculation of methane production from enteric fermentation in dairy cows. Utrecht: SenterNovem.

Valk H, van Vuuren AM & Beynen AC (2002) Effect of grassland fertilizer on urinary and fecal concentrations of nitrogen and phosphorus in grass-fed dairy cows*) Nitrogen and phosphorus supply of dairy cows*, Vol. Dissertatie RU. Utrecht.

Van Schijndel, M.W. and Van der Sluis, S.M., 2008 Methane and nitrous oxide emissions from agriculture, 1990 – 2006, Background document for the Dutch National Inventory Report 2008.

Van der Hoek KW (1994) Berekeningsmethodiek ammoniakemissie in Nederland voor de jaren 1990, 1991 en 1992. RIVM report 773004003. Bilthoven, the Netherlands: RIVM.

Van der Hoek KW, van Schijndel MW & Kuikman PJ (2006) Direct and indirect nitrous oxide emissions from agricultural soils, including an overview of emissions 1990 - 2003. Background document for the Dutch National Inventory Report. in preparation. RIVM Report No. 680.125.003. Bilthoven, the Netherlands.

Velthof GL & Kuikman PJ (2000) Beperking van lachgasemissie uit gewasresten. Een systeemanalyse. Alterra report 114.3. Wageningen, the Netherlands: Alterra.

Portugal (2009, p. 500-510)

Seixas J, Gois V, Ferreira F, Diniz R, Moura F, Torres P, Furtado C, Martinho S, Matos P, Fava S, Remédio M & Gonçalves J (2000) Emissão e Controlo de Gases com Efeito de Estufa em Portugal. Ministério do Ambiente e Ordenamento do Território, GASA-DCEA-FCT.

Schütz H, Seiler W & Conrad R (1989) Processes involved in formation and emission of methane in rice paddies. Biogeochem. 7, 1, 33-53.

McDonald, P., Edwards, R.A., Greenhalgh, J.F.D. Et C.A. Morgan, 2002. Animal Nutrition. Prentice Hall, Harlow.

FAO, 2001. Lecture Notes on the Major Soils of the World. FAO Agriculture Department. Rome http://www.fao.org/docrep.

Spain (2007, section 6)

Seiler W, Conrad R, Holzapfel-Pschorn A & Scharffe D (1984) Methane emission from rice paddies. *J. Atm. Chem.* 1, 241-268.

Sweden (2009, p. 242-247)

Berglund Ö & Berglund K (2005) Kartering av odlade organogena jordar i Sverige med hjälp av digi-tali-serade databaser. Swedish University of Agricultural Sciences. Dept of Soil Sciences. Division of hydrotechnics.

Bertilsson, J. 2007. Methane emissions from suckler cows. SLU, Swedish University of Agricultural Sciences. Department of Animal Nutrition and Management. Unpublished report to the Swedish Environmental Protection Agency.

Bertilsson J (2002) Methane emissions from enteric fermentation - effects of dietomposition. Plant Production no. 81 October 2002. Danish Institute of Agricultural Sciences.

Dustan A (2002) Review of methane and nitrous oxide emission factors for manure management in cold climates. Report 299. Uppsala: JTI - Swedish Institute of Agricultual and Environmental Engineering.

Frankow-Lindberg (2005) Bestämning av klöverandel I slåttervall. Uppsala: Swedish University of Agricultural Sciences.

Gustafsson, T.: Comparative study of Swedish emission factors for aviation with the IPCC default factors, SMED report 2005, 2005.

Høgh-Jensen H (2004) An empirical model for quantification of symbiotic nitrogen fixation in grass-clover mixtures. *Agric. Syst.* 82.

Johnsson H (1990) Nitrogen and Water Dynamics in Arable Soil. Reports and Dissertations 6 Swedish University for Agricultural Sciences. Department of Soil Sciences.

Kasimir-Klemedtsson A (2001) Methodology for estimating the emissions of nitrous oxide from agriculture. Report 5170. Swedish Environmental protection Agency.

Klemedtsson L, Kasimir-Klemedtsson Å, Esala M & Kulmala AE (1999) Inventory of N_2O emission from farmed European peatlands. In *A. Freibauer and M. Kaltschmitt (eds.) Approaches to Greenhouse Gas Inventories of Biogenic Sources in Agriculture*. Stuttgart: IER.

Laegreid M & Aastveit AH (2002) Nitrous oxide emissions from field-applied fertilizers. *Danish Institute of Agricultural Sciences Report. Plant Production* 81, 107-121.

Linder, J. (2001) STANK- the official model for input/output accounting on farm level in Sweden*) Element balances as a sustainable tool. Workshop in Uppsala, March 16-17, 2001*, Vol. Report 281 JTI-Swedish Institute of Agricultural and Environmental Engineering.

Mattson L (2005) Halmskörden, hur stor är den? Swedish University of Agricultural Sciences Dept of Soil Sciences, Soil Fertility and Plant Nutrition.

Nieminen M, Maijala V & Soveri T (1998) Reindeer feeding. (Poron ruokinta). Finnish Game and Fisheries Research Institute. (In Finnish).

Statistics Sweden, 2008. Gödselmedel i jordbruket 2006/07 (Use of fertilisers and animal manure in agriculture 2006/07). Statistical report MI 30 SM 0803. www.scb.se.

Statistics Sweden, 2008c. Försäljning av mineralgödsel för jord- och trädgårdsbruk under 2006/07 (Sales of fertilisers for agricultural and horticultural purposes in 2006/07). Statistical report MI 30 SM 0801.

Statistics Sweden, 2008b. Yearbook of agricultural statistics 2008.

Svensk Fågel, Swedish Poultry Meat Association. 2008 www.svenskfagel.se.

Svensk Mjölk, Swedish Dairy Association. 2008. www.svenskmjolk.se.

Swedish Board of Agriculture. 2008. Sales statistics on fertilisers, unpublished.

Swedish EPA (2002) Kväveläckage från svensk åkermark. Beräkning av normalutlakning för 1995 och 1999. Report 5248. Swedish EPA.

Swedish EPA (2002) TRK Tranport - Retention - Källfördelning. Belastning på havet. Report 5247. Swedish EPA.

Swedish EPA/SMED (2005) A review of Swedish crop residue statistics used in the greenhouse gas inventory. SMED report 2005. Swedish EPA/SMED.

United Kingdom (2009, 221-223)

ADAS (1995a), Personal communication to A Croxford (MAFF).Distribution of animal waste management systems for cattle.

ADAS (1995b), Personal communication to A Croxford (MAFF).Linseed burning data.

Brewers Licensed Retail Association (1998), Personal communication to R Gerry (MAFF).Estimate of dry matter content of hops.

BSFP (2005).British Survey of Fertiliser Practice: Fertiliser Use on Farm Crops for Crop Year 2004, The BSFP Authority, Peterborough. Data for preceding years comes from earlier versions of the same publication.

Burton (1982), Post-Harvest Physiology of Crops, Longman, London, ISBN 0-582-46038-7.

Cottrill, B (ADAS) *Personal Communication*.

Defra (2002), Personal communications from M Rose, Land Management Improvement Division.

Defra (2005a), Agriculture in the UK 2004, The Stationery Office, London.

Defra (2004b), Basic Horticultural Statistics for the United Kingdom: Calendar and Crop Years 1991/92 – 2001/02, The Stationery Office, London.

Defra (2008a), Agriculture in the UK 2007, The Stationery Office, London.

Defra (2008b), Basic Horticultural Statistics for the United Kingdom, The Stationery Office, London.

IPCC (1997), IPCC Revised 1996 Guidelines for National Greenhouse Gas Inventories, Volume 3, Greenhouse Gas Inventory Reference Manual, IPCC WGI Technical Support Unit, Hadley Centre, Meteorological Office, Bracknell, UK.

IPCC (2000), Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

Lord, E (1997), Personal communication to S Gleave (MAFF).Factor for biological nitrogen fixation by improved grass.

MAFF (1995), Straw Disposal Survey.Data for earlier years taken from previous editions of the survey.Contact: Government Buildings, Epsom Rd., Guildford, Surrey, GU1 2LD for copies.

MAFF (1997), Farm Incomes in the UK 1995/96, The Stationery Office, London, ISBN 0-11-2543026-0.

Nix, J (1997), Farm Management Pocket Book 1998, 28th ed., Wye College Press, Ashford, UK.

PGRE (1998), Personal communication to R Gerry (MAFF).Estimate of dry matter content of field beans.

Smith, K & Frost, J (2000), Nitrogen excretion by farm livestock with respect to land spreading requirements and controlling nitrogen losses to ground and surface waters.Part 1 Cattle and sheep. Bioresource Technology 71, 173-181.

Smith, K, Charles, D & Moorhouse, D (2000), Nitrogen excretion by farm livestock with respect to land spreading requirements and controlling nitrogen losses to ground and surface waters.Part 2 Pigs and poultry. Bioresource Technology 71, 183-194.

Smith, K (2002), Personal communication from K Smith, ADAS.

Sneath, RW, Chadwick DR, Phillips VR & Pain BF (1997), A UK Inventory of Methane/Nitrous Oxide Emissions from Farmed Livestock.Contract reports (2) to MAFF, projects WA0604/5, SRI, IGER & ADAS.

Tucker, S & Canning, P (1997), Personal communication to D Wilkins (MAFF).

USEPA (1997), Compilation of Air Pollutant Emission Factors, volume 1, 5th ed., AP-42, United States Environmental Protection Agency, North Carolina.

Other

Leip A (2005) The quality of European (EU-15) Greenhouse Gas inventories from agriculture. In *A. v. Amstel (ed.) Non-CO_2 greenhouse gases (NCGG-4)*. Rotterdam: Millpress. p. 231-238.

Leip A, (ed.) 2005. N_2O emissions from agriculture. Report on the expert meeting on "improving the quality for greenhouse gas emission inventories for category 4D", Joint Research Centre, 21-22 October 2004, Ispra., Vol. EUR 21675 p. Luxembourg: Office for Official Publication of the European Communities. Available at: http://carbodat.ei.jrc.it/ccu/Pubblications/N2O.EMISSIONSfromAGRICULTURE.pdf

Leip A, Dämmgen U, Kuikman P & van Amstel AR (2005) The quality of European (EU-15) greenhouse gas inventories from agriculture. *Environmental Sciences* 2, 2-3, 177 – 192.

Bulgaria (2009, p. 197)

Guidelines for balance method estimation of the pollutants emissions released in atmosphere, Sofia, 2000.

Fourth National Communication of Bulgaria under UNFCCC, 2002.

Second National Action Plan on Climate Change, Sofia, 2004.

Cyprus (2007, p. 62-63)

Ministry of Finance/ Statistical Service. Agricultural Statistics 1990 – 2005.

Ministry of Agriculture, Natural Resources and Environment, Forest Department. 1994. Pine trees inventory 1991-1992. (*Απογραφή παραγωγικών δασών τραχείας πεύκης 1991-92*).

Czech Republic (2009, p. 151-156)

Dolejš: Emissions of greenhouse gases in agriculture in the Czech Republic, Report for PROINCOM Pardubice, Research Institute of Animal Production, Uhříněves, Prague 1994 (in Czech).

EMEP / CORINAIR Atmospheric Emission Inventory Guidebook, UN ECE - EMEP 1999.

FAOSTAT, Food Balance Sheets, Food and agriculture organization, URL: http://faostat.fao.org/faostat/, 2005.

Hons P., Mudřík Z.: Czech country-specific data for estimation of methane emissions from enteric fermentation of cattle. AGROBIO report for CHMI, Prague 2003 (in Czech).

Jelínek A, Plíva P., Vostoupal B.: Determining VOC emissions from agricultural activities in the Czech Republic, Report for CHMI, Research Institute of Agricultural Technology, Prague, 1996 (in Czech).

Kolář F, Havlíková M., Fott P.: Recalculation of emission series of methane from enteric fermentation of cattle. Report of CHMI, Prague 2004 (in Czech).

Marek V.: Development of Land Resources in the Czech Republic. Proceedings of the Czech National Soil Conference, Prague 2002 (In Czech).

Mudřík Z., Havránek F. Czech country-specific data for estimation of methane emissions from enteric fermentation of cattle-updated data (communication of October, 2006) (in Czech).

Šefrna, L., Janderková, J. Organic carbon content in soil associations of the map 1:500000, Agricultural soils. VaV 640/18/03 Czech Carbo – Study of carbon in terrestrial ecosystems of the Czech Republic – interim project report. Czech Carbo VaV/640/18/03. Prague 2007 (in Czech).

Estonia (2009, p. 324-328)

Agriculture 2006. The Statistic Office of Estonia.

Dietary energy, protein and fat consumption, FAO

www.fao.org/faostat/foodsecurity/Files/FoodConsumptionNutrients_en.xls.

Gibbs M. J., Conneely D., Johnson D., Lasse K. R., Ulyatt M. J. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. CH_4 emission from enteric fermentation. Background Paper.

Homepage of Estonian Animal Recording Center (in Estonian Jõudluskontrolli Keskus) //http://www.jkkeskus.ee/.

Jun P., Gibbs M., Gaffney K., 2003. CH_4 and N_2O emissions from livestock manure.

Kaasik A., Leming R., Remmel T., Nurmekivi H. 2002. Orgaaniliste väetistega väetamine Põllukultuuride väetamine. ed Hennu Nurmekivi. 39 pp. // http://www.janeda.ee/jonk/files/pollukultvaetamine1.pdf.

Nova Scotia Agricultural college, Section 3: Applying Nutrient Management http://www.nsac.ns.ca/cde/courses/Agriprof/nmp4.pdf.

Turnpenny J. R., Parsons D. J., Armstrong A. C., Clark J. A., Cooper K., Matthews A. M. 2001. Integrated models of livestock systems for climate change studies. 2. Intensive systems. Global Change Biology 7, pp 163-170

Dustan A., 2002. Review of methane and nitrous oxide emission factors for manure management in cold climates. JTI-report // www.jti.se/publikat/rapporter/l&i/r299ad.pdf.

Reintam L., Rooma I., Kull A. 2001. Map of Soil Vulnerability and Degradation in Estonia. In: D.E. Stott, R.H. Mohtar and G.C. Steinhardt (eds). 2001. Sustaining the Global Farm. Selected papers from the 10th International Soil Conservation Organization Meeting held May 24-29, 1999 at Purdue University and the USDA-ARS National Soil Erosion Research Laboratory. pp. 1068-1074.

Hungary (2009, p. 105-107)

Borka, Gy.: Az állati termék elıállítás hatása az atmoszférára: a nitrogén- és üvegházgázemissziók jelentısége és csökkentési lehetıségei. (The effects of animal production on the atmosphere: nitrogen and greenhouse gas emissions and reduction possibilities). Állattenyésztés és Takarmányozás. 2007. 56:469-487.

Central Agricultural Office, Forestry Directorate web page: www.aesz.hu.

FAO (2008). FAOSTAT Livestock, http://faostat.fao.org/

Fébel, H.Ms., Department of Physiology of Nutrition, Research Institute for Animal Breeding and Nutrition (2007). Expert consultation, verbal communication.

Fébel, H.Ms. – Gundel, J.: A takarmányozás és a környezetvédelem kapcsolata. (Connection between nutriton and environment protection). Állattenyésztés és Takarmányozás. 2007. 56:427-456.

Lithuania (2009, p. 94-95)

Agriculture in Lithuania, 1990-2005, Statistics Lithuania, Vilnius, 1991-2008.

Armolaitis, K., Aleinikoviene, J., Baniuniene, A., Žekaite, V.. Chemical and biological properties of arenosols in abandoned and afforested arable land (in Lith.). Agriculture. Scientific Articles. Lithuanian Institute of Agriculture, 2005, 4, 92, 3-19.

Statistical Yearbook: Agriculture in Lithuania. Statistics Lithuania, Vilnius, 1990-2006. Statistics Lithuania. Statistics database. Agriculture. Crop production. http://db.stat.gov.lt/sips/Database/sipsen/s4en/p401en/g413en/g413en.asp.

Land Fund of the Republic of Lithuania. National Land Service under the Ministry of Agriculture,2002-2006. http://www.nzt.lt/index.cfm?fuseaction=displayHTML&attributes.file=File_483.cfm&langparam=LT.

Latvia (2009, p. 145-146)

Agriculture of Latvia in 2007. Central Statistical Bureau of Latvia, 2008.

Agriculture and rural Area of Latvia. Ministry of Agriculture. 2007.

Melece L. Petijums par organisko augšnu (histosols) daudzumu Latvija 1990-2004.

Research - Assessment, actualization and prediction of emission factors and coefficients of GHG and NH_3 from agriculture for projecting of GHG, based on “Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories - Module 4 Agriculture”.

Project “Projecting the impact of agriculture on Greenhouse Gas Fluxes in Eastern Europe”. Latvian State Institute of Agrarian Economics. 2005.

Malta (2009, p. 76-77)

FAOSTAT - Food and Agriculture Organization of the United Nations (as on 18th February 2009) http://faostat.fao.org/site/422/DesktopDefault.aspx?PageID=422.

Jackson, P. (2001) Animal waste in Maltese Agriculture, Unpublished report submitted to the Ministry of Agriculture & Fisheries, Malta..

NSO (2008d) Farm Structure Survey 2007, National Statistics Office, Malta..

NSO (2009a) Agriculture and Fisheries 2007, National Statistics Office, Malta.

Poland (2009, p. 158-162)

GUS R (2008). 2008 Statistical yearbook of agriculture and rural areas. GUS, Warszawa. 2008.

GUS R3 (2008). Production of agricultural and horticultural crops in 2007 r. Source materials. GUS, Warsaw, 2008.

Loboda T., Pietkiewitcz, S. Estimation of amount of CH_4, CO, N_2O and NOx released to atmosphere from agricultural residues burning in 1992, Warsaw Agricultural University, 1994 (in Polish).

Mercik S., Moskal, S. Study on GHG emission and sinks from arable land soils (in Polish), 2001.

Myczko A., Karlowski J., Szuly R. Study on GHG emissions from enteric fermentation and animal manure in 1999 (in Polish), 2001.

Romania (2009, p. 288)

Assessment of the carbon stock in the forest soils in the monitoring network level I and II, progress scientific report, ICAS, 2004.

Dendrometry, Iosif Leahu.

EMEP/CORINAIR Emission Inventory Guidebook - 3rd edition September 2004.

FAO Statistical Yearbook 2005-2006.

Slovakia (2009, p. 159)

Asman, V.A.H. – Van Jaarsved, H.A.: A variable resolution transport model applied for NH_3 in Europe. Atmos. Environ. 26 A, 1992: 59-66.;

Bielek, P. Nitrogen in agricultural soils of the SR, Bratislava 1998.;

Bielek, P.: Dusík v poľnohospodárskych pôdach Slovenska, Bratislava 1998, 256s.; Brestenský, V., Mihina, Š., Szabová, G., Botto, Ľ.: Produkcia a skladovanie hnoja a hnojovice. Slovenský chov 9, 1998, 33-34.;

Brestenský et al., national study, 1998; Nitra.

CORINAIR Emission Inventory Guidebook, revised 2003.;

Green Report about land use of the SR 20076, MoA www.mpsr.sk Bratislava 2008.7;

Green Report of the SR, MoA, 1998-20076; The Statistical Yearbook of the SR, SSO, 1990-2007..6;

Jurcova, O.; Toma, S. Methodology for quantification of nutriment potential of residual crops, Bratislava 1998.;

Jurčová, O., Torma, S.: Metodika kvantifikácie živinového potenciálu rastlinných zvyškov, VÚPÚ, Bratislava, 1998, 25s.;

Slovak Ministry of Agriculture (updated every year) http://www.mpsr.sk.

Šiška B, Špánik F, Agroclimatic Regionalization of the Slovak Territory in Conditions of Changing Climate, *Meteorologický časopis* 11, 2008, 63-66.

The Census of sowing areas of field crops in the SR; Annual Census of domestic livestock in the SR.;

Slovenia (2009, p. 198-201)

INRA Ruminant nutrition, Recomended allowance & feed tables, Paris, INRA, 1989, 389 pages.

Kahnt G., Gruen dungung, DLG Verlag, Frankfurt, 1998, 146 pages.

Kirchgessner M., Tierernaehrung, Frankfurt, DLG Verlag, 1985, 488 pages.

MIKKELSEN, J., COOLS, N., LANGOHR, R., KOBAL, Milan, URBANČIČ, Mihej, KRALJ, Tomaž, SIMONČIČ, Primož. Navodila za opis talnega profila za projekt BIOSOIL. Ljubljana: Gozdarski inštitut Slovenije, 2006.

Verbič J., Cunder T.. Podgoršek P.: Ocena potencialnih zmanjšanj izpustov toplogrednih plinov v sektorju kmetijstvo ob upoštevanju kvot, ki smo jih dosegli v predpristopnih pogajanjih z Evropsko unijo, Kmetijski inštitut Slovenije, Ljubljana 2003.

Verbič J., Cunder T., Podgoršek P.: Dodatek k poročilu: Ocena potencialnih zmanjšanj izpustov toplogrednih plinov v sektorju kmetijstvo ob upoštevanju kvot, ki smo jih dosegli v predpristopnih pogajanjih z Evropsko unijo, Kmetijski inštitut Slovenije, Ljubljana 2003.

Verbič J., Sušin J.: Poenostavljena metodika za oceno izpustov toplogrednih plinov iz kmetijstva, Kmetijski inštitut Slovenije, Ljubljana 2003.

Verbič J.: Izpusti amonijaka v kmetijstvu – ocene za leto 2002 in napovedi do leta 2020, Ljubljana 2004.

6.6 Agriculture for EU-27

6.6.1 Overview of sector (EU-27)

Figure 6.49 Sector 4-Agriculture: EU-27 GHG emissions for 1990–2007 in CO_2 equivalents (Tg)

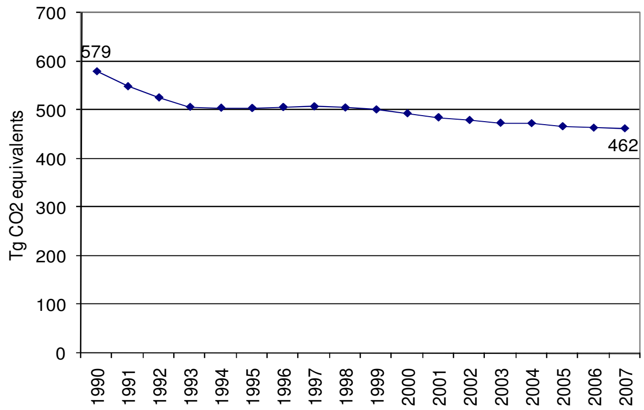
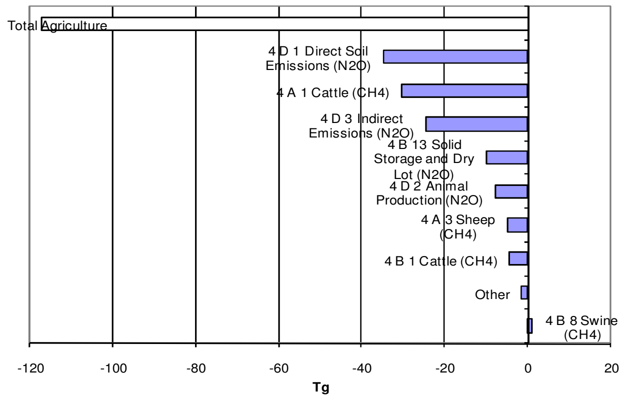
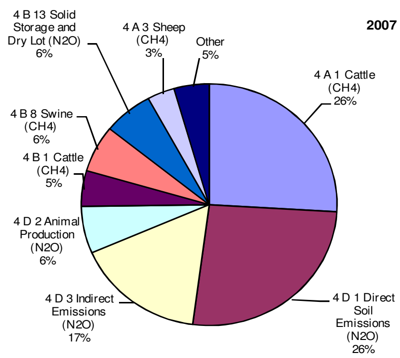


Figure 6.50 Sector 4-Agriculture: Absolute change of GHG emissions by large key source categories 1990–2007 in CO_2 equivalents (Tg) and share of largest key source categories in 2007





6.6.2 Source categories (EU-27)

6.6.2.1 Enteric fermentation (CRF Source Category 4A) (EU-27)

Table 6.109 4A1 Cattle: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	110.522	98.264	98.824	82,4%	560	1%	-11.697	-11%			
Bulgaria	2.098	918	904	0,8%	-15	-2%	-1.195	-57%	T1	NS	D
Cyprus	86	89	88	0,1%	-2	-2%	1	1%	T1	NS	D
Czech Republic	4.632	2.224	2.243	1,9%	19	1%	-2.388	-52%	T2	NS	CS
Estonia	1.049	423	414	0,3%	-10	-2%	-636	-61%	T2	CS	D, CS
Hungary	2.464	1.167	1.170	1,0%	3	0%	-1.293	-52%	T2	NS	CS
Latvia	1.973	539	564	0,5%	25	5%	-1.409	-71%	T1	NS	D
Lithuania	3.017	1.233	1.181	1,0%	-52	-4%	-1.836	-61%	T2	NS	CS
Malta	27	28	28	0,0%	0	1%	1	3%	C	NS	C
Poland	13.910	8.392	8.539	7,1%	147	2%	-5.372	-39%	T2	NS	CS
Romania	8.016	4.662	4.460	3,7%	-202	-4%	-3.556	-44%	T1	NS	D
Slovakia	1.802	831	834	0,7%	4	0%	-968	-54%	T2	RS	CS
Slovenia	700	604	634	0,5%	30	5%	-67	-10%	T2	NS, AS,Q	CS
EU-27	**150.297**	**119.375**	**119.882**	**100,0%**	**508**	**0%**	**-30.415**	**-20%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.110 4A3 Sheep: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	16.375	14.478	14.226	89,7%	-251	-2%	-2.149	-13%			
Bulgaria	1.350	272	266	1,7%	-6	-2%	-1.084	-80%	T1	NS	D
Cyprus	49	46	44	0,3%	-2	-5%	-5	-11%	T2	NS	CS
Czech Republic	72	25	28	0,2%	4	14%	-44	-61%	T1	NS	D
Estonia	23	11	12	0,1%	2	15%	-11	-48%	T1	CS	D
Hungary	329	228	218	1,4%	-10	-4%	-111	-34%	T1	NS	D
Latvia	28	7	9	0,1%	2	32%	-19	-67%	T1	NS	D
Lithuania	9	6	8	0,1%	2	38%	-1	-11%	T2	NS	CS
Malta	1	2	2	0,0%	0	1%	1	166%	C	NS	C
Poland	700	52	56	0,4%	4	8%	-643	-92%	T2	NS	CS
Romania	1.621	806	889	5,6%	83	10%	-731	-45%	T1	NS	D
Slovakia	101	72	75	0,5%	3	5%	-25	-25%	T1	RS	D
Slovenia	3	22	22	0,1%	0	0%	19	547%	T1	NS	D
EU-27	**20.661**	**16.027**	**15.857**	**100,0%**	**-169**	**-1%**	**-4.804**	**-23%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.6.2.2 Manure management (CRF Source Category 4B) (EU-27)

Table 6.111 4B1 Cattle: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	21.638	19.065	19.095	86,8%	30	0%	-2.543	-12%			
Bulgaria	466	205	202	0,9%	-3	-2%	-264	-57%	T2	NS	CS
Cyprus	34	35	35	0,2%	-1	-2%	1	2%	T1	NS	D
Czech Republic	653	268	270	1,2%	2	1%	-382	-59%	T1	NS	D
Estonia	78	32	31	0,1%	-1	-2%	-47	-60%	T1	CS	D
Hungary	121	57	57	0,3%	0	0%	-64	-53%	T1	NS	D
Latvia	143	39	41	0,2%	2	4%	-102	-71%	T1	NS	D
Lithuania	150	63	77	0,4%	14	23%	-73	-49%	T2	NS	CS
Malta	12	12	12	0,1%	0	1%	0	0%	C	NS	C
Poland	755	904	903	4,1%	-1	0%	148	20%	T2	NS/AS	CS
Romania	1.940	996	959	4,4%	-37	-4%	-981	-51%	T1	NS	D
Slovakia	127	41	41	0,2%	0	-1%	-86	-68%	T1	RS	D
Slovenia	250	261	274	1,2%	13	5%	25	10%	T2	NS, AS, Q	CS
EU-27	**26.366**	**21.979**	**21.997**	**100,0%**	**18**	**0%**	**-4.369**	**-17%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.112 4B8 Swine: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	19.971	23.544	23.613	81,5%	69	0%	3.642	18%			
Bulgaria	890	204	199	0,7%	-6	-3%	-691	-78%	T2	NS	CS
Cyprus	111	181	180	0,6%	-1	-1%	69	62%	T1	NS	D
Czech Republic	302	179	178	0,6%	-1	0%	-123	-41%	T1	NS	D
Estonia	56	23	26	0,1%	3	13%	-30	-54%	T1	CS	D, CS
Hungary	1.997	900	921	3,2%	21	2%	-1.076	-54%	T1	NS	D
Latvia	118	35	35	0,1%	0	-1%	-83	-70%	T1	NS	D
Lithuania	231	107	87	0,3%	-19	-18%	-143	-62%	T2	NS	CS
Malta	13	15	16	0,1%	1	4%	3	25%	C	NS	C
Poland	2.208	2.592	2.489	8,6%	-103	-4%	280	13%	T2	NS/AS	CS
Romania	1.716	1.002	965	3,3%	-37	-4%	-751	-44%	T1	NS	D
Slovakia	212	93	80	0,3%	-13	-14%	-132	-62%	T1	RS	D
Slovenia	248	184	176	0,6%	-8	-5%	-71	-29%	T2	NS, AS, Q	CS
EU-27	**28.071**	**29.058**	**28.964**	**100,0%**	**-94**	**0%**	**893**	**3%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.113 4B13 Solid Storage and Dry Lot: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	21.230	18.755	18.959	65,0%	205	1%	-2.271	-11%			
Bulgaria	939	328	320	1,1%	-8	-2%	-619	-66%	D	NS	D
Cyprus	77	96	95	0,3%	-1	-1%	18	23%	D	NS	D
Czech Republic	502	256	256	0,9%	0	0%	-247	-49%	T1	NS	D
Estonia	211	88	86	0,3%	-2	-3%	-125	-59%	T1	CS	D
Hungary	2.170	1.096	1.085	3,7%	-11	-1%	-1.085	-50%	T1	NS	D
Latvia	540	154	160	0,5%	6	4%	-380	-70%	T1	NS	D,CS
Lithuania	832	312	252	0,9%	-60	-19%	-580	-70%	0,0	0,0	0,0
Malta	0	0	0	0,0%	0	1%	0	-41%	C	NS	C
Poland	9.085	6.016	6.003	20,6%	-13	0%	-3.083	-34%	T2	NS/AS	CS/D
Romania	2.112	1.464	1.407	4,8%	-57	-4%	-704	-33%	T1	NS	D
Slovakia	1.076	404	395	1,4%	-8	-2%	-680	-63%	T2	NS	D
Slovenia	244	154	165	0,6%	11	7%	-79	-32%	T1	NS, AS, Q	D, CS
EU-27	**39.019**	**29.122**	**29.184**	**100,0%**	**62**	**0%**	**-9.835**	**-25%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.114 4B14 Other: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	777	986	955	70,5%	-31	-3%	178	23%
Bulgaria	59	28	27	2,0%	-1	-3%	-32	-54%
Cyprus	0	0	0	-	-	-	-	-
Czech Republic	80	46	45	3,3%	-1	-2%	-35	-43%
Estonia	81	28	31	2,3%	3	9%	-50	-62%
Hungary	0	0	0	0,0%	0	-	0	-
Latvia	6	2	2	0,1%	0	3%	-4	-71%
Lithuania	37	19	13	1,0%	-6	-32%	-24	-65%
Malta	NA	NA	NA	-	-	-	-	-
Poland	NA	NA	NA	-	-	-	-	-
Romania	581	278	280	20,7%	2	1%	-301	-52%
Slovakia	NO	NO	NO	-	-	-	-	-
Slovenia	1	1	1	0,1%	0	15%	0	-34%
EU-27	**1.623**	**1.388**	**1.354**	**100,0%**	**-34**	**-2%**	**-269**	**-17%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

6.6.2.3 Agricultural soils (CRF Source Category 4D) (EU-27)

Table 6.115 4D1 Direct soil emissions: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	110.547	95.148	93.386	77,3%	-1.762	-2%	-17.161	-16%			
Bulgaria	3.280	1.292	1.346	1,1%	54	4%	-1.933	-59%	D	NS	D
Cyprus	112	87	77	0,1%	-10	-11%	-34	-31%	T1a, T1b	NS, IS	D
Czech Republic	4.573	2.452	2.550	2,1%	98	4%	-2.023	-44%	T1	NS	D
Estonia	902	426	474	0,4%	48	11%	-428	-47%	T1	CS	D
Hungary	4.626	3.311	3.251	2,7%	-60	-2%	-1.375	-30%	T1b	NS	D
Latvia	1.650	774	775	0,6%	1	0%	-874	-53%	T1,T1a	NS	CS,D
Lithuania	2.724	1.462	1.536	1,3%	74	5%	-1.188	-44%	0,0	0,0	0,0
Malta	2	2	2	0,0%	0	24%	0	-4%	D	IS, NS	D
Poland	14.373	10.800	11.015	9,1%	215	-	-3.358	-	T1/CS	NS	CS
Romania	9.971	5.522	4.629	3,8%	-893	-16%	-5.342	-54%	T1	NS, IS	D
Slovakia	2.414	1.202	1.299	1,1%	97	8%	-1.116	-46%	T2	NS	CS
Slovenia	411	399	397	0,3%	-2	0%	-14	-3%	D, T1, T1b	NS, Q	D, CS
EU-27	**155.584**	**122.876**	**120.739**	**100,0%**	**-2.138**	**-1,7%**	**-34.846**	**-22%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.116 4D2 Pasture, Range and Paddock Manure: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	28.787	25.684	25.478	87,6%	-206	-1%	-3.308	-11%			
Bulgaria	1.539	520	492	1,7%	-28	-5%	-1.047	-68%	D	NS	D
Cyprus	114	138	162	0,6%	25	18%	49	43%	D	NS	D
Czech Republic	706	263	271	0,9%	8	3%	-435	-62%	T1	NS	D
Estonia	74	34	36	0,1%	2	7%	-38	-51%	T1	CS	D
Hungary	326	193	187	0,6%	-6	-3%	-139	-43%	T1	NS	D
Latvia	358	101	106	0,4%	5	5%	-253	-71%	T1	NS	D
Lithuania	400	173	166	0,6%	-7	-4%	-234	-58%	0,0	0,0	0,0
Malta	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Poland	1.500	368	393	1,4%	25	7%	-1.106	-74%	T1	NS	CS/D
Romania	2.871	1.538	1.660	5,7%	121	8%	-1.211	-42%	T1	NS, IS	D
Slovakia	222	92	93	0,3%	0	0%	-129	-58%	T2	NS	CS
Slovenia	22	53	54	0,2%	2	3%	32	147%	D	NS, AS, Q	D, CS
EU-27	**36.918**	**29.157**	**29.099**	**100,0%**	**-58**	**0%**	**-7.819**	**-21%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 6.117 4D3 Indirect Emissions: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	73.275	61.064	60.797	80,1%	-267	0%	-12.478	-17%			
Bulgaria	2.335	819	915	1,2%	97	12%	-1.420	-61%	D	NS	D
Cyprus	NE	NE	NE	-	-	-	-	-	T1a, T1b	NS, IS	D
Czech Republic	3.620	1.764	1.803	2,4%	40	2%	-1.816	-50%	T1	NS	D
Estonia	514	192	203	0,3%	11	6%	-311	-60%	T1	CS	D
Hungary	3.344	2.124	2.249	3,0%	126	6%	-1.094	-33%	T1	NS	D
Latvia	1.034	318	338	0,4%	20	6%	-696	-67%	T1	NS	D
Lithuania	1.915	866	849	1,1%	-17	-2%	-1.066	-56%	0,0	0,0	0,0
Malta	NE	NE	NE	-	-	-	-	-	NE	NE	NE
Poland	5.988	4.299	4.559	6,0%	260	6%	-1.428	-24%	T1	NS	D
Romania	7.091	3.490	3.561	4,7%	71	2%	-3.530	-50%	T1	NS, IS	D
Slovakia	946	368	358	0,5%	-10	-3%	-589	-62%	T1	NS	D
Slovenia	312	308	313	0,4%	5	2%	0	0%	D, T1a	NS, Q	D
EU-27	**100.373**	**75.610**	**75.946**	**100,0%**	**336**	**0%**	**-24.427**	**-24%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

7 LULUCF (CRF Sector 5)

Complying with relevant provisions, Sector 5 LULUCF (Land Use, Land Use Change and Forestry) of the European Comunity GHG Inventory is a compilation of the reports submitted by the European Union's Member States. Member States NIRs 2009 are used as the primary source of data and information, unless othewise specified and referenced.

With almost all lands under more or less intensive management, Europe is a fine-grained mosaic of different land uses, resulting in a highly fragmented landscape. According to Eurostat (2008), in EU-27 forests and other woodland represent around 177 Million ha, or 42% of total land. Utilised arable area accounts for 27 % of total land, permanent grassslands 15% and built-in area around 8%. Although no major differences exist between EU-15 and the new 12 Member States, the relative share of different land uses vary widely across individual Member States, according to the prevailing ecological and socio-economic conditions.

Among the main drivers of land use and land use change in Europe, the Common Agricultual Policy and rural development programs by the European Community had an important structural effect over the last two decades. In particular, these policies have stimulated less intense agricultural practices and a general decrease of utilized arable land, compensated by a significant increase in forest and urban areas.

Furthermore, since 1990 there has been a significant increase of forest and woodlands area under conservation regime with the purpose of preserving biodiversity and landscapes, stimulated by the environmental policy of the European Union (e.g. Natura 2000 network). Currently, around 25 % of total forest and woodland areas are excluded from harvesting. At EU-27 level, felling accounts for only 60% of the net annual wood increment (Eurostat 2008), what support a significant build-up of carbon in the forests.

While this chapter provides the general trends of emissions and removals from LULUCF at the EC level, compares the methods used by different countries and describes the efforts carried out to harmonize and improve the reporting, more detailed information can be found in the reports of each individual Member State.

For the EU-15, this chapter includes: an overview on LULUCF sector including overall trends, the contribution of land use changes, the completeness of reporting, the key categories and some very general methodological information (Ch. 7.1); the trends of net emissions, activity data and emissions factors for each category (Ch. 7.2); some specific methodological information for the relevant categories (Ch. 7.3); an overview of cross-cutting issues including uncertainties, QA/QC, time series consistency and recalculations (Ch. 7.4).

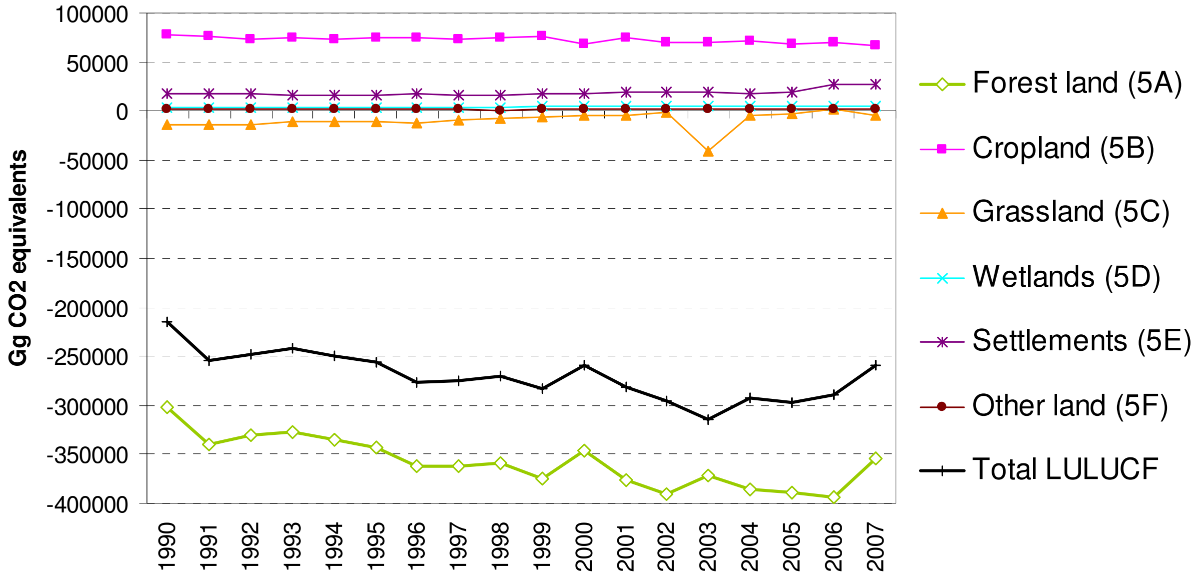
For new 12 Member States, Ch. 7.5 (LULUCF for EU-27) provides only some basic information.

7.1 Overview of sector (EU-15)

7.1.1 Trends by land use categories

The CRF Sector 5 LULUCF of the EU-15 is a net carbon sink, resulting from higher removals by sinks than emissions from sources. Overall, forests are a big net carbon sink, croplands are a source and grasslands are a small sink (Fig. 7.1).

Figure 7.1 **Sector 5 LULUCF: EU-15 GHG emissions (+) and removals (-) for 1990–2007, in CO_2 eq. (Gg), for all land use categories.**

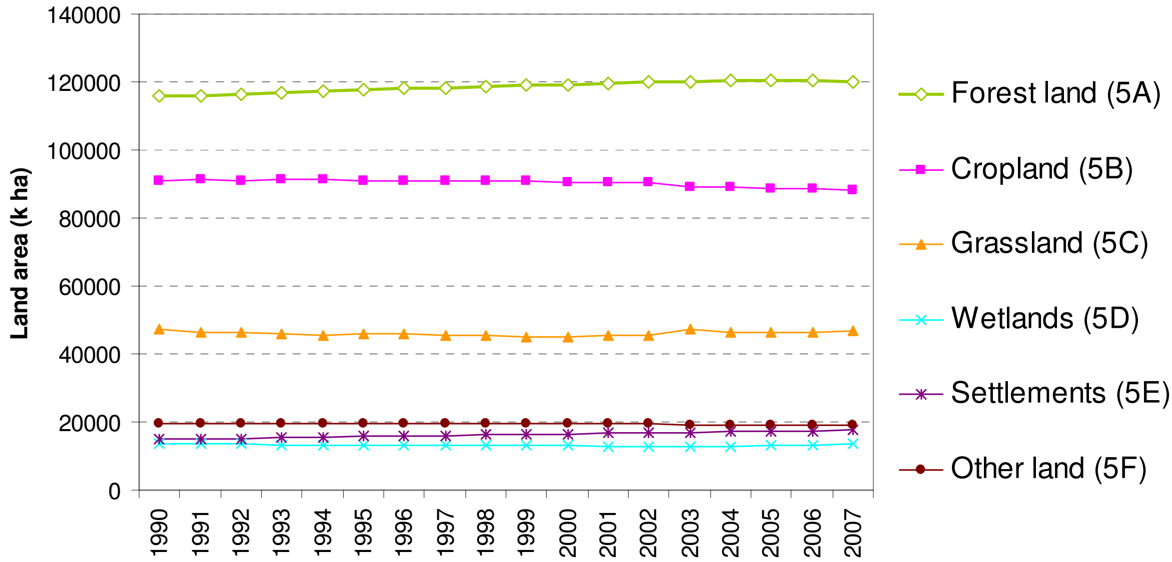


In 2007, the GHG sink in the EU-15 was -259416 Gg CO_2-eq (-265233 Gg if only CO_2 is considered), which represents an increase of about 20% from 1990 (Fig. 7.1).This increase is mainly due to the increase in CO_2 removals from forests between 1990 and 2007 (+17%) and, in part, to the decrease in net emissions from cropland (-14%) in the same period.

The year-to-year variations in the sink of the LULUCF sector are mainly related to major wind storms (2000 in central-western Europe) and forest fires (2003 and 2007 in Mediterranean countries). The spike in grassland in 2003 is due to reporting methodology applied by Italy (see section 7.2.3.2 for more details).

The reported land area of the different categories (Fig. 7.2) confirms the trends known from other statistics (e.g. Eurostat), although the absolute numbers may slightly differ due to different definitions under different reporting requirements. For EU-15, main changes in area from 1990 and 2007 regarded Forest land (+3.6%), Cropland (-2.8%) and Settlements (+18%). The total reported land area increased from 302292 kha in 1990 to 305727 kha in 2007 (+1.1%). This small inconsistency is due to the fact that reporting complete and consistent information on activity data still represents a challenging task for many Member States (see Ch. 7.2 for more details, and 7.4.2 for QA/QC and planned improvements).

Figure 7.2 **EU-15 total land area in the various LULUCF categories (kha), as reported in the Member States' CRFs.**



All Member States showed a net sink in LULUCF for 2007, except the Netherlands (Table 7.1). France, Italy, Spain, Finland and Sweden account for the largest absolute removals. Denmark, Ireland, Luxembourg, Portugal and UK turned from net source in 1990 to net sink in 2007.

Overall, for the EU-15, Sector 5 in 2007 offsets 6.4% of the total emissions (without LULUCF), with values ranging from +1.2 % (The Netherlands) to -32.2% (Finland) (Table 7.2, coluM a).

The most important LULUCF category, Forest Land, in 2007 was net sink for all Member States. The contribution of this category to each country's GHG emissions (without LULUCF) ranged from -1.3 % (The Netherlands) to -41.9% (Finland), and was -8.7% at the EU-15 level (Table 7.2, coluM b).

The management of management of organic soils and the conversion of land to croplands are the main sources of emissions from LULUCF in Europe.

Table 7.1 Sector 5 LULUCF: Member States' contributions to net CO_2 emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	-13.430	-17.434	-17.398	6,6%	36	0%	-3.968	30%
Belgium	-1.422	-1.061	-1.473	0,6%	-413	39%	-51	4%
Denmark	552	-875	-1.127	0,4%	-252	29%	-1.679	-304%
Finland	-17.960	-32.438	-25.489	9,6%	6.949	-21%	-7.529	42%
France	-44.941	-75.019	-76.350	28,8%	-1.332	2%	-31.409	70%
Germany	-28.306	-16.234	-16.790	6,3%	-556	3%	11.517	-41%
Greece	-3.248	-5.093	-3.808	1,4%	1.285	-25%	-560	17%
Ireland	235	-529	-1.019	0,4%	-490	93%	-1.254	-533%
Italy	-67.651	-90.136	-71.127	26,8%	19.010	-21%	-3.476	5%
Luxembourg	208	-389	-391	0,1%	-2	1%	-599	-288%
Netherlands	2.597	2.400	2.537	-1,0%	137	6%	-60	-2%
Portugal	1.366	-2.093	-2.370	0,9%	-277	13%	-3.736	-274%
Spain	-21.479	-27.908	-28.035	10,6%	-127	0%	-6.556	31%
Sweden	-32.134	-25.713	-20.578	7,8%	5.136	-20%	11.557	-36%
United Kingdom	2.929	-1.816	-1.815	0,7%	1	0%	-4.744	-162%
EU-15	**-222.685**	**-294.338**	**-265.233**	**100,0%**	**29.105**	**-10%**	**-42.548**	**19%**

Table 7.2 Sector 5 LULUCF: Contribution of Sector 5 (a) and Category 5A (b) to total emissions (without LULUCF) and Member States contribution to EU-15 Category 5A(c)

Member State	Sector 5 over total emission excluding LULUCF	Category 5.A over total emissions	Member States contribution to EU-15 total for Category 5A
	(a) (%)	(b) (%)	(c) (%)
Austria	-19,5%	-22,2%	5,5%
Belgium	-1,1%	-2,4%	0,9%
Denmark	-1,7%	-4,5%	0,8%
Finland	-32,2%	-41,9%	9,3%
France	-13,6%	-15,9%	23,9%
Germany	-1,7%	-8,3%	22,4%
Greece	-2,8%	-2,1%	0,8%
Ireland	-1,4%	-2,2%	0,4%
Italy	-12,8%	-10,0%	15,6%
Luxembourg	-3,0%	-3,1%	0,1%
Netherlands	1,2%	-1,3%	0,8%
Portugal	-2,8%	-4,6%	1,1%
Spain	-6,3%	-6,3%	7,9%
Sweden	-31,3%	-34,9%	6,4%
United Kingdom	-0,3%	-2,2%	4,0%
EU-15	**-6,4%**	**-8,7%**	**100,0%**

Source: 1: Member States' submissions 2009, CRF Table 5, 5A and Summary 2.

7.1.2 Contribution of land use changes

Despite all land use changes only represent 11% of the total reported land area (Tab 7.3, coluM b), they play a major role in terms of emissions, representing in absolute terms the 41% of the net emissions from LULUCF (table 7.3, coluM d).

Table 7.3 Contribution ofland use changes in 2007 for EU-15, in terms of area (coluMs a-b) and GHG emissions (coluMs c-d) .

	a) land area (kha)	b) % of area of the corresponding category[1]	c) emissions (+) and removals (-) (Gg CO_2 equivalents)	d) % of net emissions of the correspondingcategory[1,2]
5A2. Land converted to Forest Land	5995	5	-47246	13
5B2. Land converted to Cropland	10455	12	42190	64
5C2. Land converted to Grassland	11268	24	-28304	55
5D2. Land converted to Wetlands	520	4	2768	55
5E2. Land converted to Settlements	3804	22	25554	94
5F2. Land converted to Other Land	1305	7	1369	100
Total land use changes	*33347*	*11*	*-3669*	*41*

[1] the corresponding category is 5A (Forest land) for 5A2, 5B (Cropland) for 5B2 and so on.
[2] The contribution of emissions from land use changes to the total of each category was obtained by considering separately the absolute values of each subcategory, i.e. (abs 5A2)/(abs 5A1+ abs 5A2) x 100.

Table 7.4 EU-15 land use change matrix for the years 1990 and 2007*, in terms of area and net emissions (in italics).

Year 1990								
Conversions From: To:		Forest	Cropland	Grassland	Wetlands	Settlements	Otherland	**Total "to"**
Area(k ha)	Forest		765	2436	205	220	664	**4290**
	Cropland	326		11453	33	342	416	**12571**
	Grassland	1039	10790		70	436	1055	**13392**
	Wetlands	31	50	206		33	103	**423**
	Settlements	390	1323	1541	31		383	**3668**
	Otherland	484	9	1134	27	5		**1659**
	Total area "from"	**2271**	**12938**	**16770**	**366**	**1036**	**2621**	**36002**
Net emissions (Gg CO_2)	*Forest*		*-1986*	*-16872*	*-343*	*-1965*	*-2806*	*-23972*
	Cropland	*4594*		*41192*	*10*	*-184*	*43*	*45656*
	Grassland	*3315*	*-35252*		*-4*	*-810*	*-11*	*-32761*
	Wetlands	*666*	*74*	*61*		*7*	*937*	*1746*
	Settlements	*5672*	*4845*	*5848*	*4*		*69*	*16438*
	Otherland	*1259*	*-36*	*39*	*-1*	*-4*		*1257*
	Total emissions "from"	***15507***	***-32355***	***30269***	***-334***	***-2955***	***-1767***	*8.364*

Year 2007								
Conversions From: To:		Forest	Cropland	Grassland	Wetlands	Settlements	Otherland	**Total "to"**
Area(k ha)	Forest		1317	2750	336	307	1285	**5995**
	Cropland	263		9564	21	286	322	**10455**
	Grassland	721	9301		46	452	747	**11268**
	Wetlands	24	41	215		44	195	**520**
	Settlements	442	1231	1749	44		338	**3804**
	Otherland	265	10	827	178	26		**1305**
	Total area "from"	**1716**	**11901**	**15105**	**625**	**1114**	**2886**	**33347**
Net emissions (Gg CO_2)	*Forest*		*-11713*	*-22765*	*-1084*	*-2292*	*-9577*	***-47431***
	Cropland	*5158*		*33403*	*23*	*455*	*60*	***39098***
	Grassland	*6597*	*-34343*		*93*	*-659*	*-121*	***-28434***
	Wetlands	*1461*	*52*	*-135*		*-114*	*1289*	***2553***
	Settlements	*17059*	*3970*	*4536*	*-37*		*27*	***25554***
	Otherland	*1259*	*-16*	*61*	*1*	*64*		***1369***
	Total emissions "from"	***31534***	***-42050***	***15099***	***-1005***	***-2547***	***-8323***	*-7.291*

* Table 7.4 only consider CO_2, while tab. 7.3 considers all GHG. This explains small differences in emissions for 2007 between the two tables.

In terms area, no major differences appear by comparing land use changes reported for 1990 and 2007 (table 7.4). By contrast, in terms of total net emissions, land use changes turned from a small CO_2 source in 1990 (8.364 Gg CO_2 eq) to a small CO_2 sink in 2007 (-7.291Gg CO_2 eq).

The most important land use changes in EU-15 in terms of emissions and removals are the conversions from grassland to cropland (and vice versa), the conversions from grassland to forestland, and the conversion of forestland to settlements. On average, since 1990, 35% out of the lands “under conversion”are conversions to grasslands, 34% are conversions to cropland and 14% are conversions to forest land. When interpreting the data of Table 7.4 it is important to note that some differences may occur among Member States in terms of both land use definitions and the reported time series (e.g. some countries start only in 1990, and not all countries use the 20-yrs default transition period). More detailed information is provided in Ch. 7.2 and 7.3.

7.1.3 Completeness

Table 7.5 illustrates the current coverage of reporting for the various subcategories in the year 2007. While nearly all the countries reported for 5A1 (“forest remaining forest”) and most of them for 5A2 (“land converted to forest land”) and 5B1 (“cropland remaining cropland”), the other land use categories are reported less frequently because of lack of activity data or the irrelevance of net emission/removals. In general, the land use “remaining” the same is reported more frequently than the “conversions” to other land uses. Although the coverage of reporting is still far from being complete, it is worth noticing that in 2009 some country (Germany, The Netherlands) reported new subcategories previously not reported (Tab. 7.5, letters in bold).

It should be also considered that some country is not yet able to separate sub-categories between them (e.g. Finland included the category 5A2 in 5A1). Furthermore, UK did not report emissions and removals from category 5A1 (forests in existence since before 1921) because it was conservatively assumed no significant long term changes in biomass stock (see also footnote 1, later).

Table 7.5 Sector 5 LULUCF: Coverage of CO_2 emissions and removals in the various subcategories for the year 2007.

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5A1 F-F	5A2 L-F	5B1 C-C	5B2 L-C	5C1 G-G	5C2 L-G	5D1 W-W	5D2 L-W	5E1 S-S	5E2 L-S	5F1 O-O	5F2 L-O
Austria	R	R	E	E	E	R	NE,NO	E	NE,NO	E		E
Belgium	R		E		E							
Denmark	R	R	E	NA	E	NA,NO	E	R	NE	NE		NE
Finland	R	IE	E	IE,NE	E	NE,NO	IE,NE,NO	E	NE	IE,NE		NA,NE
France	R	R	E	E	NO	R	NO	E	NO	E		E
Germany	R	R	E	E	E	E	**E**	**E**	**E**	**E**		E
Greece	R	R	R	NO	NO	NO	NE,NO	NE,NO	NE,NO	NE,NO		NE,NO
Ireland	R	R	R	E	E	R	E	NE,NO	NE,NO	E		NO
Italy	R	R	R	NO	NO	R	NO	NO	NE	E		NO
Luxemb.	R	R	E	E	NO	R	NE,NO	NO	NE	NE,NO		NE,NO
Netherl.	R	R	NA,NE	E	E	E	NE	**E**	NE	E		E
Portugal	R	R	R	E	NE,NO	R	NO	E	E	E		E
Spain	R	R	IE,NE,NO	NE,NO	NE,NO	R	NE,NO	NE,NO	NE	NE,NO		NO
Sweden	R	R	E	R	R	R	E	IE,NE,NO	R	R		NE
United Kingdom	IE,NO	R	E	E	E	R	IE,NE,NO	IE,NE,NO	NO	E		NO

Legend: R: net Removal; E: net Emission; IE: included elsewhere; NE: not estimated; NO: not occurring; NA: not applicable Bold letters cells indicate a subcategory reported this year for the first time.

Table 7.6 shows the completeness of reporting of carbon stock changes by pool for the most important subcategories in 2006. As compared to the previous submissions, several Member States have increased the number of pools reported (letters in bold)

Table 7.6 Sector 5 LULUCF: Reporting ofcarbon pools for the most important categories for the year 2007 (from Tables 5A, 5B and 5C of MS's CRF).

Member State	Reporting category																							
	Forest land								Cropland								Grassland							
	5.A.1. F-F				5.A.2. L-L				5.B.1. C-C				5.B.2. L-C				5.C.1. G-G				5.C.2. L-G			
	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG
Austria	I	D			I		D		D		I		I		D				D		D		I	
Belgium	I		D								D								D					
Denmark	I				I	**D**			I		D	D								D				
Finland	I	D	D	I					**I**		I	D							D	D				
France	I	I	D		I	D	D						D	D	D						D	D	I	
Germany	I				I							**D**	D		D	**D**				**D**	D		I	**D**
Greece	I	D			I				I		I	D												
Ireland	I	D			I	D	I	I			I				D					D	I		I	D
Italy	I	D	D		I	D	D		I			D									**D**		**I**	
Luxemb.	**I**				**I**		**I**		**D**				**D**		**D**						**D**		**I**	
Netherl.	I	D			I								**D**	**D**					D		D	**D**		
Portugal	I	I	D		I	I	D		I	D	D		D	D	D						D	D	I	
Spain	I				I																		I	
Sweden	I	D	D	I	I				I	I	D	D	I				I	D	I		I			
United Kingdom					I	D	D	D	I			D	D		D					D	I		I	

Legend: I = net Increase of the C pool (i.e. the pool is a net sink); D = net Decrease of the C pool (i.e. the pool is a net source); Empty cells = the pool was not reported or reported as zero. Bold letters indicate a pool reported this year for the first time.

7.1.4 Key categories

The following subcategories of the LULUCF sector of the EC GHG inventory resulted key categories for the trend and the level:

5A1 Forest Land remaining Forest Land: CO_2

5A2 Land converted to Forest Land: CO_2

5B1 Cropland remaining Cropland: CO_2

5B2 Land converted to Cropland: CO_2

5C1 Grassland remaining Grassland: CO_2

5C2 Land converted to Grassland: CO_2

5E2 Land converted to Settlements: CO_2

7.1.5 General methodological information

This chapter provides some very general information on methods, activity data and emissions factors for the most relevant categories (5A: Forest Land, 5B: Cropland and 5C: Grassland). More detailed information can be found in Ch. 7.3 (Methodological issues).

7.1.5.1 Methods used

The methods used by the Parties to calculate emissions and removals from the LULUCF sector vary among countries and land use categories. Table 7.7 is a summary of the type of methodology used by Member States in the GHG inventory 2009 for the LULUCF sector and the different GHGs.The most developed methods and factors are generally used to assess emission and removals of CO_2. Only few countries explicitly report the use of Tier 3 methods, and usually only for the most significant categories (e.g., Austria, Finland, Ireland, Sweden and United Kingdom).

Table 7.7 Type of methods and emission factor (EF) used by countries to calculate emission and removals of different GHGs in the LULUCF sector. T1, T2, T3: Tier 1, 2, 3; D: default; CS: country specific; NA: not applicable; OTH: other.

Member State	CO_2		CH_4		N_2O	
	Method	EF	Method	EF	Method	EF
Austria	T1,T3	CS,D	T1	CS,D	T1	CS,D
Belgium			NA	NA	NA	NA
Denmark	CS,T1	CS,D	D	D	CS	CS
Finland	D,T2,T3	CS,D	D,T2	CS,D	D,T1,T2	CS,D
France	CR,CS,T2	CS	CS,T2	CS	CR,T2	CS
Germany	CS,D,T2	CS,D	NA	NA		
Greece	CS,D,T1,T2	CS,D	T1	D	T1	D
Ireland	D,T1,T2,T3	CS,D	D,T1	D	D,T1	D
Italy	T1,T2	CS,D	T1	D	T1	D
Luxembourg	CS	CS	NA	NA	NA	NA
Netherlands	CS,D,T2	CS,D	NA	NA	NA	NA
Portugal	CS,D,T2	CS,D	D	D	D,T2	CS,D
Spain			CS	D	CS	D
Sweden	T1,T3	CS,D	T1	CS,D	CS,T1	CS,D
United Kingdom	CS,D,T3	CS	D	CS	D,T1,T2	CR,CS

7.1.5.2 Activity data

Given the heterogeneity in terms of ecological and socio-economic conditions, there are no unique definitions of different land uses across MS.Data on the area of land use categories, land affected by disturbances and amount of harvest used to estimate GHGs emissions and removals come mainly from national statistics, forest inventories and forest management plans (Tab. 7.8). Thematic maps are sometimes used to integrate the information (national maps, Corine Land Cover).

Table 7.8 Data sources for activity data in NIR 2008. NFI: national forest inventory; NS: national statistics (agricultural and forest statistics, management plans, cadastral data); NM: national maps; CLC: Corine Land Cover.

Member State	Reporting categories								
	5A				5B		5C		Other LU categories
	5.A.1	5.A.2	Harvest	Disturbance	5.B.1	5.B.2	5.C.1	5.C.2	
Austria	NFI	NFI	NFI, NS	NFI	NS	NS	NS	NS	NS
Belgium	NFI		NS		CLC, NS		CLC, NS		NS
Denmark	NS, NFI	NS,NFI	NS,NFI		NS, NM		NS,NM		NS
Finland	NFI		NS		NS		NFI, NS		NFI, NS
France	NFI, NM	NFI, NM	NS	NS	NS, NM	NS, NM	NS, NM	NS, NM	NS, NM
Germany	NFI	NFI		NS	NS, NM, CLC	NS, NM, CLC	NS, NM, CLC	NS, NM, CLC	NS, NM, CLC
Greece	NFI, NS	NS	NS	NS	NS		NS		
Ireland	NFI, NS	NS, NM, CLC	NS	NS	NS	NM	NS	NM, CLC	NS, CLC
Italy	NFI, NS	NS	NS	NS	NS	NS	NS	NS	NS, CLC
Luxembourg									
Netherlands	NFI, NM	NFI, NM	NS		NM	NM	NM	NM	NM
Portugal	NFI, CLC	CLC, NS	NS	NS	CLC	CLC	CLC	CLC	CLC
Spain	NFI, CLC	NS		NS	CLC, NS	CLC	CLC	CLC	CLC
Sweden	NFI	NFI	NFI	NFI	NFI	NFI	NFI	NFI	NFI
United Kingdom		NS	NS	NS	NS	NS	NS	NS	NS

7.1.5.3 Emission factors

Tab. 7.9 shows some general information on the emission factors used by MS to assess emissions and removals in the categories 5A, 5B and 5C in the biomass, soil and dead organic matter pools. For the living biomass pool, the information refers to the biomass expansion factors.

Table 7.9 Emission factors applied in the GHG inventory 2009. CS: country specific; D: default; OTH: other factors (e.g. selection of factors from similar countries); 0: no changes in the pools reported; empty cells: no information reported.

Member State	Reporting category											
	5A1			5A2			5B			5C		
	B	Soil	DOM	B	Soil	DOM	B	soil	DOM	B	soil	DOM
Austria	CS	0	CS, 0	CS	CS		CS, D	CS		CS	CS	
Belgium	OTH, CS	CS	CS, D				0	CS				
Denmark	OTH, CS			OTH	CS		CS	CS, D		CS	CS	
Finland	CS	CS	CS					D, CS			D	
France	CS	0	0	CS	CS, D	CS, D	0, CS	0, CS	0, CS	0, CS	0, CS	0, CS
Germany												
Greece	D	0	D	D		0	CS, D	D	0	0	0	0
Ireland	CS	0	0, D	CS	0	0, D	0, D	0, D		0, D	0, D	
Italy	CS	CS	D, OTH	CS, D	CS	D, OTH	0, D	0, D, CS		0, D	0, D, CS	
Luxembourg												
Netherlands	OTH	CS	CS	OTH	CS	CS	0	0, CS			CS	
Spain	CS, D	0	0	CS, D	0	0						
Sweden	CS	CS	CS	CS	CS	CS		CS			CS	
United Kingdom	CS	CS		CS	CS		CS	CS		CS	CS	

7.2 Source and sink categories (EU-15)

This section presents a short description for each of the LULUCF categories at EC level. Then, the trends of activity data (area, in kha) and the trends of emissions and removals are illustrated and briefly discussed (at the level of subcategories when relevant). Additional methodological issues for the main categories are described more extensively in Chapter 7.3.

7.2.1 Forest land (5A)

Forests land is the dominant category in the LULUCF sector. According to the data contained in the MS' submissions, forest area in EU-15 covers 120192 kha in 2007 (it was 115978 kha in 1990). The largest forest areas are in Sweden (31 M hectares or 75% of its total national land area), Spain (28 Mha or 57%), Finland (23 Mha or 77%), France (17 Mha or 31%), Germany (11 Mha or 32%) and Italy (11 Mha or 37%), while the lowest shares were found in Malta (1%), Ireland (10%), the Netherlands (11%) and the United Kingdom (12%). According to EEA (2008), among the six EU's Member States with the largest area covered by forests and other wooded land, the proportion of forest available for wood supply varied from 37% in Spain and 69% in Sweden to 86% in Finland.

European Union's forests present a large variety of ecological and socio-economic conditions. While forests are recognised as one of Europe's most important renewable resources providing multiple benefits to the society and the economy, they represent the main depository of biological diversity, ranging from the Mediterranean to the Arctic Circle, from sea shores to alpine zones. Largely because of this ecological and socio-economic diversity, the definition of "forest" differs among Member States (see chapter 7.3 for definitions).

Based on MS' NIRs, the total area of the forest land category increased from 38.3% to 39.3% (of total reported area) from 1990 to 2007. This trend, reflected in all official statistics, is due to the promotion of national afforestation programs (including grant-aid), decreasing grazing pressure and decrease of land under agricultural use.

Deforestation is not a major issue in Europe. According MS' NIRs 2009, about 1,7 M ha is reported as being under conversions from forest land. By considering a 20-years transition period (applied by most MS), the annual deforestation rate appears lower than100000 ha. Furthermore, this deforestation rate is more than compensated by the rate of new planting and forest expansion.

Currently, European forests show a considerable sink, documented by both forestry administrative institutions and the scientific community. For many centuries, European forests have been intensively exploited and consequently depleted of carbon. Since the middle of the 20^{th} century, in most EU countries growth rates started to increase, as globalized trading and technological development diminished direct anthropogenic pressure on forests. This reversal was first noted during the extensive surveys carried out in the '80s, when there was concern that Europe's forests were dying due to acid rains. Although it was found evidence of patches of damaged forests, it appeared progressively evident that most of European forests were growing much faster than previously thought from yield table estimates (Karjalainen 1999). Overall, in the last 50 years, forests of Europe have increased by 75% their standing stock (Ciais et al. 2008). Among the likely causes of this increased forest growth the scientific community has suggested: 1) harvesting less than the increment, especially in central and Southern Europe, 2) young age structure, i.e. most forests are still recovering from past overexploitation and are still an exponential growth phase, 3) increased fertility of forest soils due to improved silvicultural practices, and 4) fertilizing effects of increased nitrogen deposition (e.g., Magnani et al. 2007) and possibly effects of the climate change (enhanced atmospheric CO_2 concentration and increased length of growing season, although considerable uncertainties still exist).

In addition to the above general causes, differences among countries in the absolute level and trend of the carbon sink may be also due to other factors, including:

- Different biological and ecological potential under the range of climatic zones;
- Past and current intensity of forest management: in Nordic countries like Finland and

Sweden, where the forest sector is very important for economy, almost all the growth is harvested and little biomass accumulates. By contrast, in countries like France and Italy, the current wood harvest is considerably less than the increment.

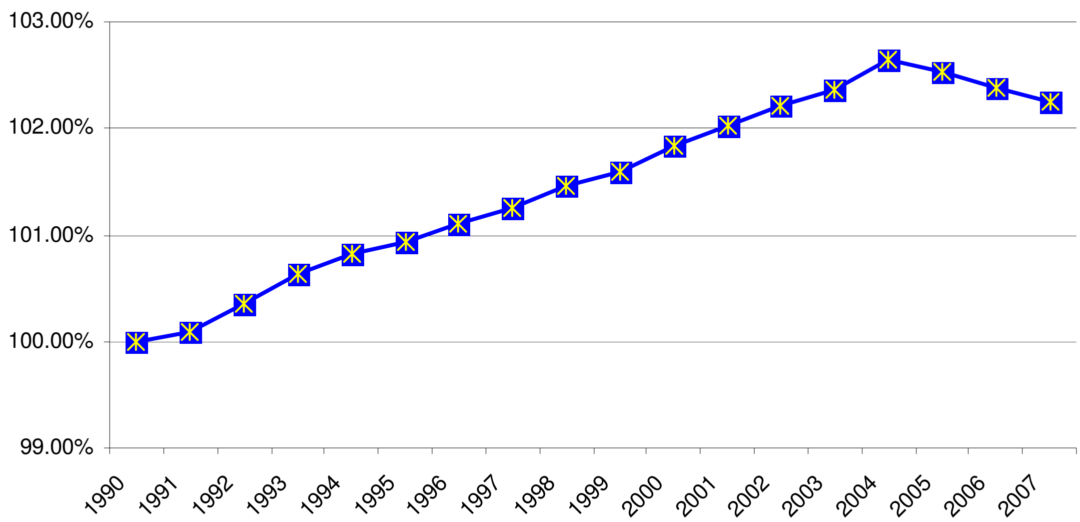
- The intensity and frequency of natural events, which is somewhat regionalized (e.g. forest fires are typically more frequent in the Mediterranean countries, windbreaks damages occur especially in coniferous plantations)

Forests and forestry are under competence of the Member States. At European Union level there is only a general framework mainly aimed at co-ordinating the national forest policies and supporting the sustainable management of forests (i.e. Forest Strategy, Forest Action Plan).

7.2.1.1 Forest land remaining forest land (5A1)

The area of "Forest remaining forest" slightly increased at EU-15 level since 1990 (+2.3%, Figure 7.3), with large differences among Member States (e.g., +41% in Ireland, +21% in Denmark. +17% in Italy, -10% in the Netherlands).

Figure7.3. Relative trend of area of 5A1 - forest remaining forest in EU-15, 1990-2007



In absolute terms, area of 5A1 increased of 2.5 M ha in EU-15 from 1990 to 2007 (Table 7.10), with the largest increase in Italy (1.7 M ha), France (0.7 M ha) and Finland (0.3 M ha). The most significant decrease of 5A1 is shown by Sweden (0.4 million ha), whose decline in the last years affected also the EU-15 trend.

Table 7.10 5A1 – Forest land remaining Forest land: trend of activity data (kha)in the EU-15 Member States.

Member State	1990	1995	2000	2005	2007	Difference 2007 to 1990
Austria	3,170.7	3,193.2	3,296.5	3,355.7	3,373.1	6.38%
Belgium	641.1	632.1	624.2	621.0	621.0	-3.14%
Denmark	411.4	411.4	440.8	440.8	499.0	21.28%
Finland	21,770.2	22,061.2	22,374.2	22,238.7	22,039.2	1.24%
France	13,736.3	13,898.7	13,936.3	14,270.0	14,392.6	4.78%
Germany	10,478.6	10,456.2	10,433.7	10,411.3	10,402.6	-0.73%
Greece	6,513.1	6,513.1	6,513.1	6,513.1	6,513.1	0.00%

Ireland	194.7	172.8	203.1	248.2	276.2	41.82%
Italy	9,153.8	9,632.4	10,111.1	10,589.8	10,782.3	17.79%
Luxembourg	NE	NE	NE	NE	NE	-
Netherlands	380.6	369.1	357.6	346.2	341.6	-10.26%
Portugal	3,214.6	3,273.7	3,309.2	3,338.6	3,338.6	3.86%
Spain	13,522.7	13,522.7	13,522.7	13,522.7	13,522.7	0.00%
Sweden	27,671.8	27,772.7	27,785.2	27,811.4	27,284.2	-1.40%
United Kingdom	828.6	824.7	820.3	813.0	810.8	-2.15%
EU15	111,688.2	112,734.0	113,728.0	114,520.4	114,196.8	2.25%

At EU 15 level, 5A1 is a sink of CO_2 in 2007 as being 10 % above 1990, despite a small drop since previous year (2006) (Table 7.11).

Table 7.11 5A1 – Forest Land remaining Forest Land:emissions and removals (Gg CO_2) in the EU-15 Member States.

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	-11.511	-16.959	-16.967	5,5%	-8	0%	-5.456	47%	T3 (biomass, dead wood), T1 (soil)	NS	CS (biomass, dead wood), D (soil)
Belgium	-3.205	-2.777	-3.169	1,0%	-392	14%	36	-1%	CS/M	RS/NS	CS
Denmark	-2.831	-2.600	-2.769	0,9%	-169	6%	62	-2%	CS, D	CS	CS
Finland	-23.220	-40.712	-32.830	10,7%	7.883	-19%	-9.609	41%	T2,T3	NS	CS
France	-48.990	-69.953	-71.432	23,2%	-1.479	2%	-22.442	46%	CS/T2	NS	CS
Germany	-74.064	-74.064	-74.064	24,1%	0	0%	0	0%	D,T2	Q,NS	CS,D
Greece	-2.043	-3.725	-2.452	0,8%	1.273	-34%	-409	20%	CS,D,T1,T2	NS	CS,D
Ireland	-996	-839	-1.491	0,5%	-652	78%	-495	50%	T1	NS	D
Italy	-52.546	-81.835	-53.384	17,3%	28.451	-35%	-839	2%	T1, T2	NS	D, CS
Luxembourg	205	-394	-396	-	-	-	-	-	NA	NE	NA
Netherlands	-2.529	-2.359	-2.167	0,7%	192	-8%	362	-14%	CS,T2	NS	CS
Portugal	526	-2.933	-3.210	1,0%	-277	9%	-3.736	-710%	0,0	0,0	0,0
Spain	-21.474	-21.474	-21.474	7,0%	0	0%	0	0%	T1, CS, D	NS	D, CS
Sweden	-35.949	-26.287	-22.028	7,2%	4.260	-16%	13.921	-39%	T1, T3	NS	CS
United Kingdom	IE,NO	IE,NO	IE,NO	-	-	-	-	-	IE,NE	IE,NE	IE,NE
EU-15	**-278.625**	**-346.911**	**-307.833**	**100,0%**	**39.079**	**-11%**	**-29.207**	**10%**			

In 2007 the largest removals were reported by Germany, France, Italy, Finland, Sweden and Spain. No MS reported a source in this subcategory in 2007. For 5A1, UK assumed no significant long term changes in biomass stock[31]. The 11 % decrease of the removal as compared to 2006 is mainly due to Italy (forest fires), Finland and Sweden (increased wood harvests). In Portugal, the significant sink increase compared to 1990 is generated by the continuous decrease of the "losses" since 1990 (especially the reduction of emissions from wildfires). In general, CO_2 emissions from disturbances are usually considered under category 5A1 as, in the majority of cases, there is no subsequent change of the land use, while other GHG emissions are considered under 5(V). The main types of disturbances across are forest fires (mainly Southern European countries) and wind storms (mainly in central Europe), while other type of disturbances generally have a localized effect and low magnitude (e.g. insect outbreaks). Estimation of emissions from forest fires is made with Tier 1 method in case of

[31] According to UK's NIR, only forests in existence since before 1921 are considered in Category 5A1 (Forest remaining Forest Land, which represents some 1/3 from UK's forestland). For these forests, it was conservatively assumed no significant long term changes in biomass stock. All the changes in carbon stocks of the forests established since 1920 were entirely included in the Category 5A2 (Land converted to Forest Land)

small emissions (e.g. Austria) or with higher tiers where these emissions are significant (e.g. Portugal, Spain).

7.2.1.2 Land converted to forestland (5A2)

According to the CRFs submitted by Member States, the area of the subcategory 5A2 Land Converted to Forest Land in EU-15 increased by about 40 % from 1990 to 2007. With few exceptions, MS report conversions to forest land using a 20 years transition period. Significant increases over time of the area converted to forest are reported by France and UK, while in Sweden and Austria the area of this conversion decrease from 1990 to 2007 (Table 7.12).

Table 7.125A2 – Land converted to forest land: trend of activity data in EU-15's MS (kHa)

Member State	Year					Difference 2007 to 1990
	1990	1995	2000	2005	2007	
Austria	386.6	372.6	271.5	233.3	227.6	-41.14%
Belgium	NO	NO	NO	NO	NO	-
Denmark	0.7	7.1	19.3	31.0	35.8	4809.59%
Finland	IE*	IE	IE	IE	IE	-
France	1,522.6	1,841.2	1,947.8	1,914.1	1,922.3	26.25%
Germany	24.3	117.1	244.9	366.2	420.7	1632.62%
Greece	NE	5.6	22.8	45.6	47.7	-
Ireland	175.4	222.1	256.5	289.3	302.0	72.14%
Italy	95.7	95.7	95.7	95.7	96.8	1.11%
Luxembourg	NE	NE	NE	NE	NE	-
Netherlands	3.0	17.8	32.6	47.4	53.4	1700.00%
Portugal	137.2	137.2	137.2	137.2	137.2	0.00%
Spain	NO	136.4	522.3	646.1	685.2	-
Sweden	528.9	414.6	412.1	364.9	384.0	-27.40%
United Kingdom	1,415.6	1,511.2	1,595.6	1,663.9	1,682.2	18.84%
EU15	4,290.1	4,878.7	5,558.3	5,834.7	5,994.9	39.74%

* In this and the following tables the notation keys are used according to FCCC/SBSTA/2006/9

As some Member State did not separate between 5A1 - Forest Land Remaining Forest Land and 5A2 - Land Converted to Forest Land, the above figures are likely to be somehow underestimated.

Table 7.13 5A2 Land converted to Forest Land: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	-4,402	-2,607	-2,572	5.4%	35	-1%	1,830	-42%	T2	NS	CS
Belgium	0	0	0	-	-	-	-	-	NA	NA	NA
Denmark	NA,NE,NO	-184	-208	0.4%	-25	14%	-208	-	CS, D	CS	CS
Finland	IE	IE	IE	-	-	-	-	-	NA	NA	NA
France	-6,585	-13,860	-13,802	29.2%	57	0%	-7,217	110%	CS/T2	NS	CS
Germany	-336	-5,013	-5,351	11.3%	-338	7%	-5,015	1493%	D,T2	Q,NS	CS,D
Greece	IE,NE,NO	-500	-524	1.1%	-24	5%	-524	-	0.0	NS	0.0
Ireland	659	-119	-27	0.1%	92	-78%	-686	-104%	T1, T3	NS	CS, D
Italy	-1,003	-2,359	-2,204	4.7%	156	-7%	-1,201	120%	T1, T2	NS	D, CS
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NE	NA
Netherlands	-3	-514	-575	1.2%	-61	12%	-572	20282%	T2	NS	CS
Portugal	-577	-577	-577	1.2%	0	0%	0	0%	0.0	0.0	0.0
Spain	IE,NO	-6,343	-6,465	13.7%	-122	2%	-6,465	-	T1, CS, D	NS	D, CS
Sweden	477	-1,506	-811	1.7%	695	-46%	-1,288	-270%	T3	NS	CS
United Kingdom	-12,155	-15,091	-14,173	30.0%	917	-6%	-2,018	17%	CS,D,T3	RS	CS
EU-15	**-23,925**	**-48,672**	**-47,289**	**100.0%**	**1,382**	**-3%**	**-23,364**	**98%**			

The sink in 2007 for 5A2 almost doubled since 1990 at the EU-15 level, despite the decrease since 2006 (table 7.13). In 2007 the largest removals were reported by UK and France, while Spain and Germany report moderate increase. MS reported an increase in annual removals from 1990 to 2006 (except Sweden, Austria and Ireland). Given the relatively small area of land converted to forest (not easily estimated with sample-based forest inventories), it should be noted that several Member States underlined the significantly higher uncertainty are associated with the emissions/removals of this subcategory as compared to the subcategory 5A1. In general applied methods correspond to Tier 2 and 3 (for more detailed information, see chapter 7.3).

7.2.2 Cropland (5B)

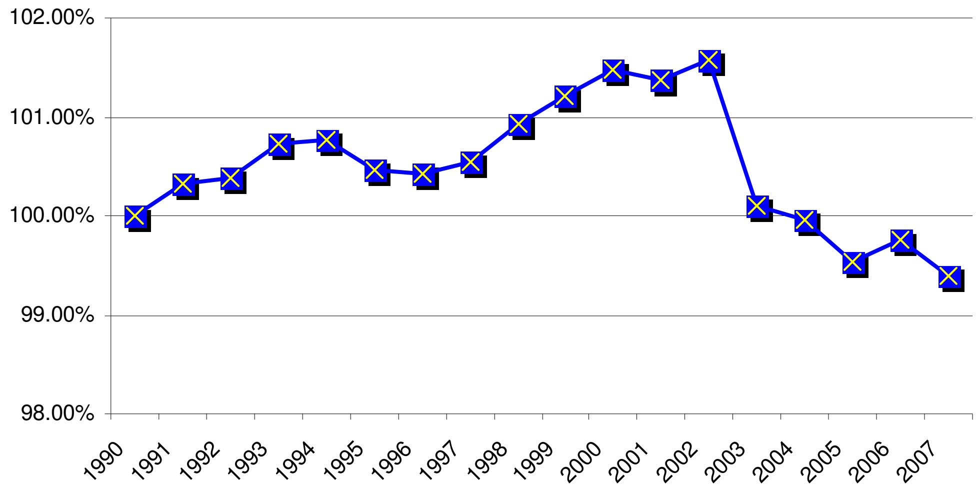
In Europe, cropland category includes arable lands for annual and permanent crops and set aside land. Based on the data contained in the MS' submissions, cropland area in EU-15 covers 88346 kha in 2007, equal to 28,9 % of total reported land area (it was 90931 kha in 1990).

According to EEA (2008), the share of arable land varies between Denmark (57,5 % of national land in 2007, or 2,5 million ha) and Hungary (48,3 %, or 4,5 million ha) to Sweden (6%, or 2,7 million ha), Finland (8,6%, or 2,3 million ha) and Slovenia (8,8 %, or 0.2 million ha). The highest arable land area is in France (around 21,1 million ha, or 37,6 % of national land), Spain (12,5 million ha, or 24,7 %), Poland (11,7 million ha, or 37,6 %) and Germany (11,9 million ha, or 33,3 %). Permanent crops are mainly orchards, vineyards and olive plantations, mainly located in Spain (5 million ha, or 10 % of national land), Italy (2,5 million ha, or 8,4 %) and Greece (8,7 million ha, or 1,2 %). In EU 15, the utilized agricultural area declined from 49,5 % in 1995 to 45,0 % in 2005, with the area of arable land felling from 30,6 % to 27,4 % in the same period, reflecting mainly set-aside policy and increase of the area of settlements. Set aside land was a practice to withdraw land from current cropping requested to decouple the production by payments within the EU, in order to reduce production of cereals since the early 1990's.

7.2.2.1 Cropland remaining cropland (5B1)

According to Member States' CRFs, the area of "cropland remaining cropland" varied little from 1990 to 2007, with a negative growth between 2004 and 2007 (Figure 7.4).

Figure 7.4 The relative trend of Cropland remaining Cropland over the period of 1990-2007 (% relative to 1990)



Among the MS the highest cropland area increase is retained by France and Belgium, while the larger decrease have been recorded by Ireland, Italy and Austria (Table 7.14), which resulted in 2007 in an overall decrease of 0.6 % area compared to 1990. Cropland emissions/removals are significantly influenced by agricultural policy (i.e state support, programmes), that may substantially contribute on short term to the change of the pattern of GHG emissions/removals associated with this category.

Table 7.14 Trend of activity data in subcategory 5B1 - Cropland remaining cropland in EU-15's MS (kHa)

Member State	1990	1995	2000	2005	2007	Difference 2007 to 1990
Austria	1,021.4	999.7	963.1	942.1	926.1	-9.33%
Belgium	772.9	866.3	880.0	859.4	855.9	10.74%
Denmark	2,575.4	2,525.0	2,489.5	2,524.8	2,477.1	-3.82%
Finland	2,271.0	2,141.3	2,186.8	2,234.4	2,255.3	-0.69%
France	10,622.3	11,530.4	13,002.1	13,727.5	14,031.7	32.10%
Germany	14,205.4	14,096.0	13,959.3	13,445.8	13,307.9	-6.32%
Greece	3,930.0	3,906.1	3,848.2	3,801.7	3,720.7	-5.33%
Ireland	404.6	396.6	379.6	326.3	319.7	-20.98%
Italy	11,027.8	11,021.9	11,106.1	9,673.8	9,543.7	-13.46%
Luxembourg	NE	NE	NE	NE	NE	-
Netherlands	1,013.7	985.2	956.7	928.2	916.8	-9.55%
Portugal	129.1	129.1	129.1	129.1	129.1	0.00%
Spain	21,359.0	21,155.1	20,701.5	20,510.3	20,444.2	-4.28%
Sweden	3,056.1	2,996.2	2,935.7	2,919.3	2,991.5	-2.11%
United Kingdom	5,971.7	5,971.7	5,971.7	5,971.7	5,971.7	0.00%
EU15	78,360.2	78,720.5	79,509.4	77,994.5	77,891.5	-0.60%

In fact, area increase in the two MS compensated the decreases in all the other MS.

Table 7.15 5B1 Cropland remaining Cropland: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	-87	66	143	0,6%	78	118%	231	-264%	T1	NS	D, CS
Belgium	480	575	578	2,4%	2	0%	98	20%	CS/M	NS	CS
Denmark	3.287	1.841	1.779	7,5%	-62	-3%	-1.508	-46%	CS, T1	0,0	CS, T1
Finland	7.415	3.236	3.329	14,0%	94	3%	-4.086	-55%	D	NS	CS
France	1.051	983	936	3,9%	-48	-5%	-115	-11%	CS/T2	NS	CS
Germany	27.676	25.246	25.271	106,5%	25	0%	-2.405	-9%	CS,D,T2	Q,NS	CS
Greece	-1.205	-868	-833	-3,5%	35	-4%	373	-31%	T1,T2	NS	CS,D
Ireland	20	-54	-30	-0,1%	24	-45%	-50	-248%	T1	NS	D
Italy	-16.876	-10.534	-10.960	-46,2%	-425	4%	5.916	-35%	T1	NS	D, CS
Luxembourg	2	4	4	-	-	-	-	-	NA	NE	NA
Netherlands	IE,NA,NE	IE,NA,NE	IE,NA,NE	-	-	-	-	-	CS,T2	NS	CS
Portugal	-164	-164	-164	-0,7%	0	0%	0	0%	0,0	0,0	0,0
Spain	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	-	NE	NS	NE
Sweden	4.072	2.853	2.725	11,5%	-128	-4%	-1.347	-33%	T1, T3	NS	CS
United Kingdom	1.788	968	959	4,0%	-8	-1%	-829	-46%	CS,T3	RS	CS
EU-15	**27.458**	**24.151**	**23.739**	**100,0%**	**-412**	**-2%**	**-3.719**	**-14%**			

At EU 15 level, subcategory 5B1 is a source (Table 7.15). It only represents an active sink in those Member States where there are large areas of permanent crops under active management and improvement (Italy reports a high sink, although a decreasing one in 2007 compared to 1990). Germany reports significant emissions from soils, while other countries report soils as a relatively small source. Overall, the subcategory shows a reduction of total net emissions (14% since 1990 and only 2% over 2006-2007), mainly due to the trends in Ireland, Denmark, Finland, Sweden and United Kingdom. Few countries report a switch from sink/source in the base year to source/sink in 2007 (i.e. Austria, Ireland).

7.2.2.2 Land converted to cropland (5B2)

Subcategory 5B2 "Land converted to cropland" is an important source at the EU-15 level. France and UK reports the largest areas under transition (Table 7.16).

Table 7.16 Trend of activity data in subcategory 5B2 - conversions to cropland in EU-15 MS (kHa)

Member State	Year					Difference 2007 to 1990
	1990	1995	2000	2005	2007	
Austria	506.9	513.8	520.6	535.6	547.8	8.07%
Belgium	NO	NO	NO	NO	NO	-
Denmark	NO	NO	NO	NO	NO	-
Finland	NE	NE	NE	NE	NE	-
France	8,059.4	7,105.1	5,625.5	4,523.9	4,058.6	-49.64%
Germany	7.5	7.5	7.5	93.2	80.9	981.12%
Greece	NO	NO	NO	NO	NO	-
Ireland	NO	12.7	20.5	57.6	57.6	-
Italy	NO	34.2	NO	NO	NO	-
Luxembourg	NE	NE	NE	NE	NE	-
Netherlands	14.3	14.3	14.3	14.3	14.3	0.00%
Portugal	51.6	51.6	51.6	51.6	51.6	0.00%
Spain	NO	NO	NO	NO	NO	-
Sweden	31.4	49.8	64.0	96.1	97.4	210.65%
United Kingdom	3,899.5	4,383.9	4,868.4	5,352.8	5,546.6	42.24%
EU15	12,570.6	12,172.9	11,172.4	10,725.1	10,454.8	-16.83%

Table 7.17 5B2 Land converted to Crop Land: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	1.823	1.915	1.891	4,8%	-24	-1%	68	4%	T2	NS	CS
Belgium	NE	NE	NE	-	-	-	-	-	NA	NA	NA
Denmark	NA	NA	NA	-	-	-	-	-	0,0	Not	0,0
Finland	IE,NE	IE,NE	IE,NE	-	-	-	-	-	NA	NA	NA
France	28.937	15.778	15.008	38,4%	-770	-5%	-13.929	-48%	CS/T2	NS	CS
Germany	498	7.343	7.343	18,8%	0	0%	6.845	1375%	D,T2	Q,NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0,0	0,0	0,0
Ireland	NE,NO	127	127	0,3%	0	0%	127	-	T2	NS	D
Italy	NO	2.448	NO	-	-2.448	-	0	-	T1	NS	D, CS
Luxembourg	2	2	2	-	-	-	-	-	NA	NE	NA
Netherlands	35	47	48	0,1%	1	2%	13	38%	T2	NS	CS
Portugal	354	354	354	0,9%	0	0%	0	0%	0,0	0,0	0,0
Spain	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NO	NS	NO
Sweden	-24	-48	-1	0,0%	47	-97%	23	-95%	T3	NS	CS
United Kingdom	14.034	14.312	14.329	36,6%	17	0%	295	2%	CS,T3	RS	CS
EU-15	**45.659**	**42.278**	**39.100**	**100,0%**	**-3.178**	**-8%**	**-6.559**	**-14%**			

Even not all MS do not report yet under this subcategory (area is comparatively small also), annual emission is almost double to that of 5B1 (table 7.17). In 2007, the largest emissions are reported by France (decreasing emissions compared to 1990), Germany (increasing emissions) and UK (roughly unchanged), but mantained relatively stable compared to rpevious year. At EU-15 level, there is a general decrease of 14 %compared to 1990 level.

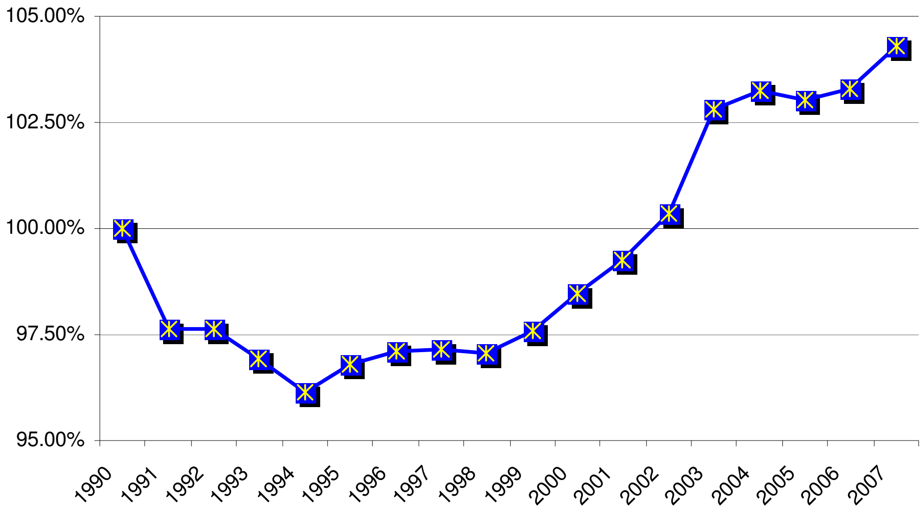
7.2.3 Grassland (5C)

According to MS' submissions, in 2007 the total grassland area was 15.3 % of total reported land area. The highest area of permanent grasslands is in France (9.9 million ha, or 18.1 % of national land), Spain (7.5 million ha, or 15%) and the lowest in Estonia (0.2 million ha, or 4.3%) and Finland (0.04 million ha, or 0.1 %).

7.2.3.1 Grassland remaining grassland (5C1)

After a decrease of 5C1 grassland area in early 1990, now there is reported a steady increase since 1999. Overall, grassland area increased by 4.3 % at the end of 2007 compared to 1990 (Figure 7.5)

Figure 7.5 The relative trend of grassland area over 1990-2007 in EU-15 (%, compared to 1990)



Grassland area shows a rather high variation range in time, since 1990. Majority of this increase is due to France and UK, where grassland area increased by 85 % and 12 % respectively, while it decreased for almost all other MS (42 % in Finland, 13 % in Sweden, 12 % in Belgium) (Table 7.18). Few countries show a very constant area in time (i.e., Spain, Greece).

Table 7.18 Trend of activity data in "grassland remaining grassland" subcategory 5C1 in EU-15's MS (kHa, 1990-2007)

Member State	1990	1995	2000	2005	2007	Difference 2007 to 1990
Austria	1,392.0	1,378.4	1,382.2	1,280.4	1,288.8	-7.41%
Belgium	578.5	495.2	506.9	519.0	507.2	-12.32%
Denmark	217.2	207.1	166.3	193.0	196.6	-9.49%
Finland	676.8	718.8	561.0	441.7	391.9	-42.09%
France	3,944.2	4,373.7	5,770.2	6,740.1	7,305.2	85.21%
Germany	7,049.6	6,353.4	6,390.3	6,359.1	6,378.3	-9.52%
Greece	1,636.2	1,636.2	1,636.2	1,636.2	1,636.2	0.00%
Ireland	4,122.9	3,949.6	3,921.7	3,861.5	3,842.5	-6.80%
Italy	7,659.5	7,145.3	6,541.2	7,453.5	7,374.6	-3.72%
Luxembourg	NE	NE	NE	NE	NE	-
Netherlands	1,500.7	1,465.1	1,429.5	1,394.0	1,379.7	-8.06%
Portugal	NO	NO	NO	NO	NO	-
Spain	4,663.0	4,663.0	4,663.0	4,663.0	4,663.0	0.00%
Sweden	470.0	441.3	416.0	402.3	407.1	-13.38%
United Kingdom	8.1	12.1	9.0	8.5	9.1	12.12%
EU15	33,918.5	32,839.2	33,393.4	34,952.1	35,380.1	4.31%

Category 5C1, grassland remaining grassland, is a source of CO_2, with an amount of emission in 2007 comparable with 5B1's. Germany is the largest contributor at EU-15 level (Table 7.19). Sweden reports a small sink over the whole time series. Relative to 1990, some countries report a steady increase of emissions from grasslands on mineral soils and a slow decrease on organic soils (i.e., Finland). Several Member States report the notation key NO (i.e. France reports net change in all pools as zero according a Tier 2 methodology, estimated after measurements, while several MS report no change with Tier 1).

Table 7.19 5C1Grass Land remaining Grass Land: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	39	46	45	0.2%	0	-1%	6	15%	T1	NS	D, CS
Belgium	1,304	1,141	1,118	4.8%	-23	-2%	-186	-14%	CS/M	NS	CS
Denmark	93	81	84	0.4%	3	4%	-9	-9%	CS, D	CS	CS, D
Finland	-2,131	4,239	4,057	17.4%	-182	-4%	6,188	-290%	D	NS	D
France	NO	NO	NO	-	-	-	-	-	CS/T2	NS	CS
Germany	13,304	12,848	12,800	54.8%	-48	0%	-504	-4%	CS,D,T2	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	T1	NS	D
Ireland	622	494	604	2.6%	110	22%	-17	-3%	T1	NS	D
Italy	NO	NO	NO	-	-	-	-	-	T1	NS	D, CS
Luxembourg	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NE	NA
Netherlands	4,246	4,246	4,246	18.2%	0	0%	0	0%	CS,T2	NS	CS
Portugal	NE,NO	NE,NO	NE,NO	-	-	-	-	-	0.0	0.0	0.0
Spain	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NE	NS	NE
Sweden	-497	-624	-319	-1.4%	305	-49%	178	-36%	T1	NS	CS
United Kingdom	1,041	735	701	3.0%	-34	-5%	-341	-33%	CS,T3	RS	CS
EU-15	**18,021**	**23,206**	**23,336**	**100.0%**	**130**	**1%**	**5,316**	**29%**			

7.2.3.2 Land converted to grassland (5C2)

Area of lands under conversion to grassland is around 28 % from 5C total area of EU-15 (table 7.20). Highest share of conversions to grassland is shown by France and UK, under their specific circumstances. Conversions to grassland occur usually from unmanaged grassland (often reported under Otherland, i.e.Ireland) and Wetlands or from set aside croplands.

Table 7.20 Trend of activity data in "conversions to grasslands" subcategory 5C2 in EU-15's MS (kHa, 1990-2007)

Member State	Year					Difference 2007 to 1990
	1990	1995	2000	2005	2007	
Austria	600.8	598.2	575.0	562.7	549.3	-8.57%
Belgium	0.0	0.0	0.0	0.0	0.0	-
Denmark	NO	NO	NO	NO	NO	-
Finland	NE	NE	NE	NE	NE	-
France	9,423.7	8,361.8	6,671.0	5,676.8	5,101.4	-45.87%
Germany	19.2	19.2	19.2	174.8	156.6	715.48%
Greece	21.3	39.6	80.3	104.0	180.5	747.25%
Ireland	26.3	163.9	160.9	129.7	151.3	475.25%
Italy	8.6	NO	8.7	108.7	173.9	1914.64%
Luxembourg	NE	NE	NE	NE	NE	-
Netherlands	15.5	15.5	15.5	15.5	15.5	0.00%
Portugal	8.0	8.0	8.0	8.0	8.0	0.00%
Spain	5.8	34.7	63.5	92.4	104.0	1700.00%
Sweden	29.1	43.8	68.6	90.5	96.3	231.35%
United Kingdom	3,233.2	3,673.7	4,114.9	4,555.4	4,731.4	46.34%
EU15	13,391.5	12,958.4	11,785.7	11,518.6	11,268.2	-15.86%

In contrast to 5C1 and 5B, category 5C2 is a sink at EU-15 level (increased by 13 % compared to 1990), despite a 30 % drop compared to previous year. The highest removals are reported by France, United Kingdom and Italy in 2007 (Table 7.21).

Table 7.21 5C2 Land converted to Grassland: Member States' contributions to CO_2 net emissions

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2)	(%)	(Gg CO_2)	(%)			
Austria	-1.061	-1.334	-1.311	4,6%	23	-2%	-250	24%	T2	NS	CS
Belgium	NE	NE	NE	-	-	-	-	-	NA	NA	NA
Denmark	NA,NO	NA,NO	NA,NO	-	-	-	-	-	CS, D	CS	CS, D
Finland	NE,NO	NE,NO	NE,NO	-	-	-	-	-	NA	NA	NA
France	-23.951	-12.821	-11.942	42,1%	879	-7%	12.009	-50%	CS/T2	NS	CS
Germany	-247	1.303	1.303	-4,6%	0	0%	1.550	-627%	D,T2	NS	CS
Greece	NO	NO	NO	-	-	-	-	-	0,0	0,0	0,0
Ireland	-128	-194	-270	1,0%	-76	39%	-141	110%	T1	NS	D
Italy	-385	NO	-7.760	27,4%	-7.760	-	-7.375	1915%	T1	NS	D, CS
Luxembourg	-1	-1	-1	-	-	-	-	-	NA	NE	NA
Netherlands	394	533	542	-1,9%	9	2%	148	37%	T2	NS	CS
Portugal	-25	-25	-25	0,1%	0	0%	0	0%	0,0	0,0	0,0
Spain	-5	-91	-96	0,3%	-5	6%	-91	1700%	T1	NS	D
Sweden	-148	-573	-109	0,4%	463	-81%	39	-26%	T3	NS	CS
United Kingdom	-7.172	-8.524	-8.668	30,6%	-143	2%	-1.496	21%	CS,D,T3	RS	CS
EU-15	**-32.729**	**-21.726**	**-28.336**	**100,0%**	**-6.610**	**30%**	**4.393**	**-13%**			

Germany turned form a small sink to a source, Netheland is the only MS where this category mantains as a source, while France's sink halved from 1990 to 2007.

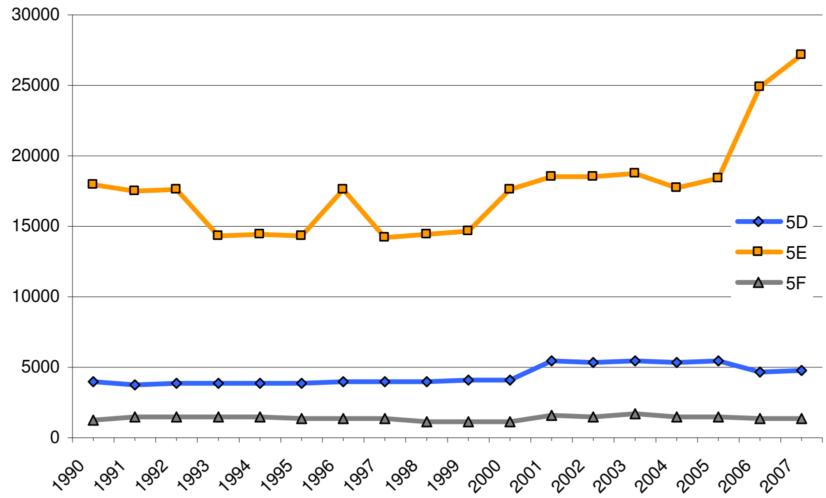
7.2.4 Wetlands, Settlements and Other land (5D, 5E, 5F)

In general, trends in these land categories are not always easy to detect, both in terms of activity data and emissions factors.

In the EU 15, the total reported Wetlands (5D) area in 2007 is 13.6 million ha, with 7.2 million ha in Sweden, 3.0 million ha in Finland, 0.8 million ha in France, 0,8 million ha in The Netherlands and 0.7 million ha in Germany. The annual conversion to wetlands varies over time by around 4% of the permanent Wetland area at EU 15 level (roughly 0.45 million ha/year). This category often attracts environmental concerns across the EU, thus for protection reasons (i.e. reducing runoff of nitrogen & phosphorus to lakes, rivers and coastal waters) the Member States actively promote conversions to natural water regime and wetlands, established especially in areas of organic soils and under grassland. This is also reflected in the increasing area under conversion since 1990 (with an overall EU 15 increase of 23%). In Ireland, peat areas are entirely classified under wetlands. Overall, the CO_2 emission from wetlands has increased by 20% since 1990 (Figure 7.6).

In the EU 15, the total reported Settlements (5E) area in 2007 is 17,6 million ha. The removals / emissions assciated with this category are still difficult to capture with a reasonably low uncertainty level. The area of conversion to settlements is significant, being nearly 30% ot total settlements area. Emissions form 5E, Settlements, have increased by 51% since 1990 (Figure 7.6).

Figure 7.6 Trend of CO_2 emissions from 5D, 5E, 5F over 1990-2007 in EU-15 (Gg)



The area of category Other land (5F) covers 19.2 million ha in 2007. The largest share of Other land is reported in Spain (10 million ha), Sweden (roughly 4.3 million ha), Finland (1.2 million ha), France (1.5 million ha) and Italy and Ireland (0.8 million ha each). The Other land category is sometimes used also to report unmanaged land areas (e.g. unmanaged grassland in Ireland and France). Emissions from 5F have been relatively steady since 1990 (Figure 7.6), although it should be noted that the uncertainties are likely to be high. Some Member States do not report any emission in this category, despite large areas (i.e. Spain, Sweden, Italy).

7.2.5 Other emissions from land uses: tables 5(I)-5(V)

7.2.5.1 Direct N_2O emissions from N fertilization – 5(I)

This source category covers direct nitrous oxide emissions from forest fertilization. In most MS fertilization of forests does not occur, or is negligible from quantitative point of view. Only Finland, Sweden and the UK report these emissions under this source category; other MS report fertilizer consumption within the total consumption under the agricultural sector (Chapter 4). On the whole, these emissions at the EU-15 level decreased by 39% compared to 1990 (Table 7.22).

Table 7.22 Direct N_2O emissions from N fertilization (Gg)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg)	(%)	(Gg)	(%)
Finland	0.09	0.06	0.05	30.5%	0	-8%	0	-38%
Sweden	0.19	0.09	0.12	67.3%	0	35%	0	-36%
United Kingdom	0.02	0.00	0.00	2.2%	0	-7%	0	-81%
EU-15	**0.29**	**0.15**	**0.18**	**100.0%**	**0**	**17%**	**0**	**-39%**

7.2.5.2 N_2O emissions from drainage of soils – 5(II)

This source category covers non–CO_2 emissions from drainage of soils, direct N_2O and CH_4 emissions (CO_2 emissions are reported under other land categories, usually under Wetlands). According to Appendixes 3a.2 and 3a.3 of the IPCC Good Practice Guidance for LULUCF, it is not mandatory for Parties to estimate these source categories; accordingly, most countries do not report them (some report "NO – not occurring", like Austria, Spain, Portugal, Grece and France, or "IE – included elsewhere", i.e. UK). Drainage occurs on Forest land and Wetlands (managed peatlands), both on organic and mineral soils. Currently, non-CO_2 emissions from drained areas are not entirely reported (i.e. Finland), as not enough information is available, which is also the case of other Member States (Table 7.23). Emissions of N_2O and CH_4 from drainage and peatland extraction occurs in Finland (areas concerned increased from some 65 thousand ha in 1990 to 84 thousand ha in 2007), in Ireland (slightly decreasing of area over time, currently some 58 thousand ha under various management regime), and in Denmark (around 1 thousand ha, decreasing).

Table 7.23 N_2O and CH_4 emissions from drainage of soils

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg)	(%)	(Gg)	(%)
N_2O emissions								
Denmark	0.0003	0.0002	0.0002	0.1%	0	0%	-0.0001	-6%
Finland	0.19	0.25	0.25	80.5%	-0.0050	-2%	0.0610	8%
Ireland	0.05	0.06	0.06	19.5%	0	0%	0	24%
EU-15	**0.24**	**0.31**	**0.31**	**100.0%**	**0**	**-2%**	**0**	**31%**
CH_4 emissions								
Denmark	-0.0284	-0.0235	-0.0235	-0.4%	0	0%	0.005	-128%
Finland	4.65	6.24	6.13	100.4%	-0.1080	-2%	1	148%

EU-15	**4.62**	**6.22**	**6.11**	**100.0%**	**0**	**-2%**	**1**	**32%**

7.2.5.3 N_2O emissions from disturbance associated with land-use conversion to cropland – 5(III)

This source category covers direct N_2O emissions from land area converted to cropland. At the EU-15 level, conversions to cropland steadily decreased over time (see table 7.16). Most of these conversions is due to France, which reports large areas from Grassland to Cropland. Across the EU-15, the majority of conversions occur on mineral soils (> 99 % of area under conversion). Some Member States reported NE (i.e. Finland, The Netherlands, UK), while other countries reported NO (Table 7.24). Overall, there is a decrease of emissions, with the highest contribution from France.

Table 7.24 N_2O emissions from disturbance associated with land-use conversion to cropland (Gg)

Member State	N_2O emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg)	(%)	(Gg)	(%)
Austria	0.81	0.86	0.89	8.9%	0.02	3%	0.07	9%
France	10.89	6.87	6.52	65.7%	-0.35	-5%	-4.37	-40%
Germany	0.18	2.14	2.14	21.5%	0.00	0%	1.95	1072%
Portugal	0.08	0.08	0.08	0.9%	0.00	0%	0.00	0%
Sweden	0.07	0.28	0.25	2.5%	-0.02	-8%	0.18	261%
EU-15	**12.04**	**11.23**	**9.92**	**100.0%**	**-1.31**	**-12%**	**-2.12**	**-18%**

Overall there is a decrease of emissions, with the highest contribution from France.

7.2.5.4 Carbon emissions from agricultural lime application - 5(IV)

Source category covers direct nitrous oxide emissions from liming. Liming occurs especially in croplands (85 % of applied amount, computed based on activity data in NIRs 2009) and on permanent grassland (14 %), while a very small amount is used in Forestland. At level of EU, consumption of lime decreased in time since 1990 with almost 30 %. Few MS report “NO”, and some did not estimate yet the emissions from liming (Table 7.25).

Table 7.25 (IV) CO_2 emissions from agricultural lime application

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2)	(%)	(Gg CO_2)	(%)
Austria	90.30	90.09	90.04	1.6%	0	0%	0	0%
Denmark	565.53	193.73	191.97	3.5%	-2	-1%	-374	-66%
Finland	617.87	298.26	248.65	4.5%	-50	-17%	-369	-60%
France	1,051.08	983.37	935.58	16.8%	-48	-5%	-115	-11%
Germany	3,772.51	2,666.79	2,780.19	50.1%	113	4%	-992	-26%
Ireland	355.04	254.86	376.77	6.8%	122	48%	22	6%
Netherlands	183.15	81.12	71.08	1.3%	-10	-12%	-112	-61%
Sweden	169.79	90.86	118.75	2.1%	28	31%	-51	-30%
United Kingdom	1,430.45	769.69	740.28	13.3%	-29	-4%	-690	-48%
EU-15	**8,235.72**	**5,428.76**	**5,553.31**	**100.0%**	**125**	**2%**	**-2,682**	**-33%**

Some MS reduced notably the emissions from lime applications (i.e. Germany, Finland, Denmark, UK), which contribute to an overall reduction of 33 % at EU-15 level. Ireland increased its lime emissions by 6 %.

7.2.5.5 CO_2, CH_4 and N_2O emissions from Biomass Burning – 5(V)

The source category covers CO_2, CH_4 and direct N_2O emissions from biomass burning, as well as emissions of other greenhouse gases (NO_x and CO). It includes emissions both from wildfires and controlled burning, on any type of land (Forestland, Cropland, Grassland, Wetland and Settlement). Controlled burning in managed forest is not a common practice in the EU, with few exceptions (UK, Spain). The majority of emissions is generated from wildfires in forests, or from wildfires in grasslands (in Southern Member States). In general, CO_2 emissions from forest fires are reported under 5A, Forest land, while for the other land categories, CO_2 and non-CO_2 gases emissions are reported under 5(V). Spain reports aggregate emissions from forest fire, both CO_2 and non-CO_2 in 5A1. Some Member States report emissions from burning biomass on an area basis (Greece, Italy, France, Finland, Germany), while others on a dry mass basis (Spain, Portugal). Further harmonization of reporting may be required in order to move to an area basis as to facilitate the assessment and comparison of such emissions with emissions from any other LULUCF categories or other processes (e.g. biomass growth, harvest).

Table 7.26 CO_2, CH_4 & N_2O emissions from Biomass Burning

Member State	Net CO_2 emissions (Gg)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg)	(%)	(Gg)	(%)
CO_2 emissions (Gg CO_2)								
Finland	3.26	13.44	4.91	1.0%	-9	-63%	2	51%
Ireland	19.68	20.58	10.27	2.1%	-10	-50%	-9	-48%
Portugal	737.75	383.03	105.92	21.9%	-277	-72%	-632	-86%
Sweden	18.80	133.30	26.06	5.4%	-107	-80%	7	39%
United Kingdom	182.56	329.62	336.16	69.6%	7	2%	154	84%
EU-15	**962.05**	**879.96**	**483.32**	**100.0%**	**-397**	**-45%**	**-479**	**-50%**
CH_4 emissions (Gg CH_4)								
Austria	0.01	0.00	0.00	0.0%	0.00	-50%	-0.01	-82%
Finland	0.19	0.11	0.05	0.1%	-0.06	-57%	-0.14	-76%
France	64.30	52.16	51.41	71.6%	-0.75	-1%	-12.89	-20%
Greece	2.37	0.80	6.80	9.5%	6.00	753%	4.42	186%
Ireland	0.09	0.09	0.04	0.1%	-0.04	-50%	-0.04	-48%
Italy	6.80	1.46	9.37	13.1%	7.91	543%	2.56	38%
Portugal	6.53	3.18	0.88	1.2%	-2.30	-72%	-5.65	-87%
Spain	8.14	24.34	1.65	2.3%	-22.69	-93%	-6.49	-80%
Sweden	0.08	0.58	0.11	0.2%	-0.47	-80%	0.03	39%
UnitedKingdom	0.80	1.44	1.47	2.0%	0.03	2%	0.67	84%
EU-15	**89.31**	**84.15**	**71.78**	**100.0%**	**-12.38**	**-15%**	**-17.54**	**-20%**
N_2O emissions (Gg N_2O)								
Austria	0.00020	0.00007	0.00004	0.0%	-0.0001	-50%	-0.0002	-82%
Finland	0.001	0.001	0.000	0.1%	-0.0004	-57%	-0.0010	-76%
France	0.55	0.37	0.37	72.3%	-0.0037	-1%	-0.1850	-34%
Greece	0.02	0.01	0.05	9.3%	0.0412	753%	0.0304	186%
Ireland	0.00	0.00	0.00	0.1%	-0.0003	-50%	-0.0002	-48%
Italy	0.05	0.01	0.06	12.8%	0.0543	543%	0.0176	38%
Portugal	0.04	0.02	0.01	1.2%	-0.0158	-72%	-0.0388	-87%
Spain	0.06	0.17	0.01	2.2%	-0.1560	-93%	-0.0450	-80%
Sweden	0.00	0.00	0.00	0.2%	-0.0032	-80%	0.0002	39%
United Kingdom	0.01	0.01	0.01	2.0%	0.0002	2%	0.0046	84%
EU-15	**0.72**	**0.59**	**0.50**	**100.0%**	**-0.0836**	**-14%**	**-0.2174**	**-30%**

In general, Member States report that CO_2 emissions from burning biomass do not occur or are included elsewhere, while CH_4 and N_2O emissions are not estimated yet by some Member States (see Table 7.26). Overall, these emissions have decreased by 50 % since 1990. The CH_4 emissions decreased by 20% and those of N_2O by 30%, but their trends are related to wildfire incidence, which has a large interannual variability.

7.2.6 Harvested Wood Products (HWP)

There are only two MS that report on HWP. In general, the HWP is a sink, but, in some years, it may turn from sink to a small source. It is a small carbon sink in Finland (i.e. a multiyear average of 922 Gg/year, 3% of the total sink in the LULUCF sector in 2007). In UK the HWP sink represents some 50% of LULUCF sink in 2007, but only 7% of 5A category, with an annual average of 850 Gg/year over 1990-2007.

7.2.7 Emissions from organic soils

At EU-15 level, organic soils are spread over some 14 million ha, especially in Northern Member States. Overall, emissions at the EU-15 level are decreasing (from - -69708 Gg CO_2 in 1990 to -61421 Gg CO_2 in 2007). The highest areas of organic soils are in Finland (~ 6,1 million ha), Sweden (~ 5 million ha), Germany (1,3 million ha), Ireland (0,4 million ha), The Netherlands (0,3 million ha), and the UK (0,4 million ha). Overall, in EU-15, most of this area is under Forestland (10,8 million ha), but most of the emissions come from Croplands. Furthermore, most of organic soils (98%) are in categories "remaining" the same. The rest of 2 % of land is under various conversions. Emissions from organic soils are included under relevant land use categories by the Member States. Here we only present data for different land use categories averaged over time.

Table 7.27 Total emissions and implied carbon stock change factors in EU's MS (average over 1990-2007, ± StDev)

Land use subcategory	Area (kHa)	IEF Mg (CO_2/an/ha)	Net annual C stock change (Gg)
5A1	10829	-0.40 ± 0.03	-4345 ± 269
5A2	283	0.02 ± 0.24	6 ± 68
5B1	1406	-6.89 ± 0.08	-9629 ± 392
5B2	5	-8.66 ± 1.40	-50 ± 46
5C1	1383	-2.78 ± 0.06	-3828 ± 65
5C2	18	-1.55 ± 0.70	-28 ± 22

Highest unitary emission is associated with stable cropland and conversions to cropland, under intensive management interventions, while forests show the lowest values (table 7.27).

7.3 Methodological issues (EU-15)

This section illustrates general methodological information and issues for the main land use categories, related to definitions and to methods used for estimating emissions by EU's Member States.

When comparing the absolute levels or trends of implied emission/carbon stock change factors across Member States much caution should be used. Indeed, in some cases, large differences may be only apparent, because resulting from the different estimating or reporting methodology and not truly reflecting different intensity of emissions and removals.For example, implied emission factors may be significantly affected by new areas entering a given category. Furthermore, the fact that not all countries use the 20-years default transition period for land use change categories means that the corresponding emission factors are not fully comparable across all Member States.

7.3.1 Forest land (5A)

7.3.1.1 Forestland remaining forestland (5A1)

Definitions of forest land are transparently reported by EU-15's Member States in their NIR 2009. In the current EC report, the consistency of the forest land representation is considered under two aspects: 1) within the country in terms of time and space and 2) across the Member States. The Member States' forest definitions are not uniform, but slightly different in terms of the key parameters, i.e., crown coverage, tree height and minimum area (Table 7.28). There are also other qualitative aspects (i.e. treatment of forest roads, nurseries, etc) that make differences.

Table 7.28 Information on forest definitions and related parameters. NIR = National Inventory Report under UNFCCC

Member State	NIR 2009			
	Crown cover (%)	Height (m)	Area (ha)	Width(m)
Austria	30	2	0.05	-
Belgium	20	5	0.5	-
Denmark: ▪ Forest Census	-	-	0.5	-
▪ New NFI[1]	10	5	0.5	20
Finland	10	5	0.5	20
France	10	5	0.5	20
Germany[2]	Qualitative definition (type of vegetation included)			
Greece[3]	10	-	0.5	30
Ireland	20	5	0.1	20
Italy				
Luxembourg				
Netherlands	20	5	0.5	30
Portugal				
Spain	10	-	-	-
Sweden	10	5	0.5	-
United Kingdom	20	2	0.1	20

[1] The data from the NFI apply to the period 2000-2006. starting 2007 data is reported according NFI
[2] Based on the definition of "forest" used by the Federal Forest Inventory (BWI).

The impact of these different forest definitions on carbon stock, annual sink and trend at EC level is difficult to assess, as it depends on numerous factors (i.e. land fragmentation, land use change frequency, transition period, etc.). Changing of forest definition over 1990-2007 is reported by a few Member States (i.e. Denmark and Finland). Finland has changed the forest definition to match that of the FAO TBFRA 2000 (to a uniform 0.5 ha from previously 0.5 ha in Norhern Finland and 0.25 ha in Sothern Finalnd). Methodological difficultes and the likely impact on sink estimates will be revealed in next year submission of Finland. In Denmark, the change of both forest definition and data sources has caused the increase of the forest area of 8% in 1999/2000 and 12% in 2006/2007, with an increase of the total annual removal of ~ 8% in 2006/2007.

Depending on the available data, various method have been developed by Member States in order to generate the time series for annual activity data (forest area) from 1990 to date: by interpolation (over NFI cycles, or from statistics and maps), extrapolation (for periods since last NFI cycles), and combining other sources of data (Table 7.29).

Table 7.29 Activity data methods for the subcatgory 5A1 forest remaining forest

Member State	***Description of method***
Austria	1990 to 2007 time series is compiled from several national databases (NFI, Statistic Austria, Integrated Administrative and Control System), with a technique which observes the consistency with national area, across & within sectors annual data and predefined hierarchical treatment of available data sources. Forestland remaining forestland area is derived from NFI data, with annual area interpolated between inventory years and assumed constant in time after last inventory (2001). Land use matrix is available with a rolling period of 20 years
Belgium	Forestland area is provided by similar regional forest inventories in the two main regions, based on permanent systematic sampling. Since 1994, each year 10 % of the approximately 14000 sampling plots are visited (highest coverage in Europe, 1 plot/50 ha of forest). In each plot, stand and trees biometrical and site characteristics are recorded. It assumed land use change is negligible
Denmark	Forestland area is provided from last Forest Census carried out in 1990 and 2000, for the time series 1990-2006. Definition of forest only minimally requires reporting the trees areas over 0.5 ha (no data on crown cover or tress height), while open woodland and open areas within the forest are not included.Since 2002, a new plot-based NFI, has replaced the Forestry Census. First cycle NFI data is used to report GHG emissions for the year 2007. NFI forest definition refers to 0.5 ha area, with specific thresholds for height, cover and width of the forest. It is also more inclusive as include temporarily non wooded areas, fire breaks and other small open areas that are considered an integral part of the forest. Land use matrix still remains to be developed (i.e. to involve remote sensing)
Finland	Estimation of the area of Forest land is based on the successive NFI cycles. Distinction between “forest land remaining forest land” and “areas converted to forest land” is not yet made and all emissions /removals are reported in 5.A1. NFI data is used to estimate time series of areas, increment of growing stock and tree biomass. Forestland category is sub-divided on organic and mineral soils
France	A combination between Approach 2 and 3 for land representation is achieved. The system relays on aerial photographs dataset combined with an annual “on-the-ground” survey of lands (in terms of land use and activities which occur on). Based on this a land use change matrix is achieved on IPCC land categories (including also explicit non-managed lands), an annual matrix (captures changes with higher cinetique) and a 20 years land use change matrix (captures slower changes). Differentiation between “stable” and “under conversion” lands is made only in the 5th year since land use change, in order to define if land use change is permanent or not. For French Guyana a photointerpretation system based on Landsat and Spot, combined with a permanents plots survey in small part of the area is used to estimate land use and changes, while biomass data are delivered by field studies

Germany	Forestland area is computed based on two successive NFI (1987, 2002) for former Western Germany, while for former Eastern Germany based on forest management plans and 2002 NFI, linearly interpolated to develop annual time series
Great Britain	Forest plantations established since 1920 are considered lands "under conversion", thus reported under 5A2. Forests in existence before 1920 are considered not to have significant long term changes in their carbon pool stocks (so neutral). Their area is provided according UK Countryside Survey and Northern Ireland Countryside Survey, on 1990-1998 and extrapolated for after 1999
Greece	Approach 1 / 2 is used for land representation, by combining several sources and databases: 1st National Forest Inventory (1994), annual Agricultural census, afforestation registry and statistics, general geographical data of National Statistical Service of Greece (decennial survey). Land use change matrix is available.
Ireland	Approach 2 is assumed for forestland. Forestland area for 1990-2006is obtained from sectoral Forest Inventory and Planning System data of 1995 and the total forest area by Forest Service, stratified on tree species and three age cohorts: < 6 years old, young stands (7 to 25y) and mature stands (> 25y). Starting from forestland area & tree species matrix for year 1995, the corresponding data was extrapolated foreword and backward to cover entire time span 1990-2007 (counting also the annual data on planting and clear felling rates). Also, the share between broadleaves and resinous was estimated in 1995 and used as a fix share all over time series, both for mature and young forests
Italy	Area of forests in 1990 was calculated through a linear interpolation between the 1985 and 2002 data (supplied by 1st and 2nd National Forest Inventories), extrapolated data for 2003-2006, as following previous span trend, building on Statistics' annual data on forest area (available only for 1990-2005). A number of rules are established to allow building of land use change matrix
Netherlands	Activity data is constructed based on observational maps in 1990 and 2000, then since 2001 on forest inventories carried out in 1988–1992 (HOSP data) and 2001–2002 & 2004-2005 (MFVdata), within a wall-to-wall approach (approach 3: geographically explicit land-use data and a Tier 3 for activity data).
Portugal	Area data is given by NFI (1982, 1995, 2006) combined with Corine Land Cover maps (1990, 2000) involving linear extrapolations and extrapolations to obtain full time series of land use remaining in the same category Species share is given according the management and afforestation plans
Spain	Forestland area is provided from a combination between CORINE LANDCOVER 1990-CLC90 and 2000-CLC00 (after the harmonization of their nomenclature) with Forest Maps of Spain (2004), in order to identify the lands with trees crown cover over 10 %. Further on, annual estimation of area is obtained by linear intrapolation between 1990 and 2000, and then extrapolated since 2000
Sweden	A national level systematic grid of permanent monitoring plots provides estimates of the areas of all land-use categories and gross & net land-use transfers from the base year onward, actually since 1983 (Approach 3 and Tier 3 for activity data).

Further on, the Member States breakdown forest area on *various subdivision* types and levels of detail, according to available datasets. Although the breakdown is consistent for the categories and subcategories within the country, they differ from one Member State to another. The breakdown may be by **groups of species** or **forest types** (i.e. Broadleaves/Coniferous; Evergreen/Deciduous; species based classification - beech, oak, pine, spruce, etc), **climate** (i.e. temperate, tropical), **soil** and **site type** (i.e. lowland, organic or mineral soils), **geographic criteria** (regions of the country), and **management type** (clear cut, hedgerows, horticulture area, arable land, fallow land, permanent cultures, peat extraction area, pastures, hayfield, perennial converted to annual crops, annual crops remaining annual/perennial).

For forestland, the *definitions of pools* are relatively transparently reported by the Member States. In general, the share of the sink in the biomass pool compared to the total is 85%, that of soil is 11% and that of the dead organic matter pool is 4%. Among national estimating systems, there are slight variations regarding the definition of the pools, whose impact on the estimation of carbon stock changes and other GHG emissions may be low, but also difficult to asses in quantitative terms (Table 7.30). The biomass pool is defined according to the threshold of minimal diameter of the trees measured (which varies across the Member States from 0 to 7,5 cm), against models which provide estimates for the entire biomass. Concerning the belowground biomass, the information on definition is rather poor. The litter and dead wood pools mostly differ in terms of type (standing, laying), threshold diameter and height, and duration since laying down (also avoiding double accounting with harvest). In soils, C stock changes are computed according to various soil depths. Carbon stock in understory's biomass is only accounted for the purpose of forest fires emissions.

Table 7.30 Forest carbon pool definitions in EU-15's Member States

Member State	Description of the pools
	Aboveground biomass
Austria	Stem wood over bark with a diameter at breast height > 5 cm
Belgium	Tree and shrub species with circumference exceeding 20/22 cm at 1.50 m height (i.e 7 cm in diameter), while in coppices the stems under 7 cm diameter are also recorded
Denmark	Biomass of living trees with a height of at least 1.3 m. Smaller trees, shrubs and other non woody are not counted. Aboveground biomass is defined as living biomass above stump height (1 % of tree height)
Finland	Living tree biomass of trees with a height of at least 1.3 m (DBH of 0 cm). For estimation of emission from forestfire, understorey is counted
France	Trees with diameter at breast height over 7.5 cm are accounted. Woody understory or annual/perennial non woody plants are not considered
Germany	Trees with DBH > 7 cm

Great Britain	Entire living woody biomass modeled by carbon accounting model (it does not include understory and annual/perennial non woody vegetation)
Ireland	Modeled approach covering living biomass (but not the understory and annual/perennial non woody vegetation)
Italy	All trees with DBH > 3 cm
Portugal	All living biomass above the soil, including: stems, stumps, branches, bark and foliage, and forest understory (only for estimation of emissions from forest fires)
Spain	Every single tree is counted, no matter of diameter (but trees DBH > 75 mm "at foot" is measured, while those under 75 mm are only counted)
Sweden	Biomass of living trees with a height of at least 1.3 m. Smaller trees, shrubs and other vegetation, (i.e. herbs) are not counted. Aboveground biomass is defined as living biomass above stump height (1 % of tree height)
Greece, Netherlands – na (na – description is not available in NIR 2009)	
Belowground biomass	
Belgium	Diameter of estimated roots > 5 mm
Great Britain	Fine roots biomass is integrated by the carbon accounting model used
Ireland	Modeled approach including fine roots of living biomass
Portugal	Living biomass of all roots
Sweden	Biomass of living trees below stump height (1 % of tree height) down to a root diameter of 2 mm
Austria, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Spain - na	
Dead Organic Matter - Litter	
Belgium	Logging residue is taken into account if it is up to 3 years old. Logs and branches inferior to 20 cm circumference are taken into account by the NFI and their volume is visually estimated
Denmark	Non-living biomass which is not included in other classes, under various states of decomposition on top of mineral or organic soil. It includes the litter, fumic and humic layers
Finland	Non-living biomass with a diameter less than 10 cm in various states of decomposition (allocated by model in compartments: fine woody litter, coarse woody litter, extractives, celluloses and lignin-like compound)
France	Non-living dead wood lying on soil with maximum 7.5 cm diameter, dead leaves, humic and fumic layers, fine roots (which are not taken into account in the biomass)
Great Britain	Dead wood is integrated by the carbon accounting model
Ireland	Modeled approach, it includes the litter fall
Portugal	Non living biomass on top of mineral soil, in various stages of decomposition (include fumic, humic)
Sweden	Non-living biomass not classified in other classes, under various states of decomposition, on top of mineral or organic soil. It includes the litter, fumic and humic layers. Litter includes, as well: a) live fine roots (<2 mm) from O horizon; b) coarse litter with a "stem diameter" between 10-100 mm; c) fine litter from the previous season or earlier
Austria, Germany, Greece, Italy, Netherlands, Spain - na	
Dead Organic Matter- Dead wood	
Austria	Only standing dead wood
Belgium	Standing dead trees (above 20 cm of circumference) and fallen logs (1 m long and 20 cm circumference) and branches. A dead tree is considered as fallen when it inclines under an angle equal or superior to 45°
Denmark	Fallen dead wood or snags, with a minimum "diameter" of 10 cm and a length of at least 1.3 m
Finland	Non-living biomass which is not contained in litter (described by model as coarse woody litter input, larger than 10 cm in diameter, from natural mortality of trees and harvesting residues)
France	Standing trees, dead for less than 5 years, plus 10 % from the wood which is annually harvested
Great Britain	Dead wood is included in carbon accounting model
Greece	Dead wood that remain on site after fire is assumed to fully decompose in 10 years
Portugal	Non living woody biomass on top of mineral soil, in various stages of decomposition
Sweden	Fallen dead wood or snags, with a minimum "diameter" of 10 cm and a length of at least 1.3 m
Germany, Italy, Ireland, Netherlands, Spain - na	
Soil Organic Matter	
Austria	Humus layer and mineral soil layers to 50 cm depth
Belgium	Modeled approach (depth is then not defined)
Denmark	Organic carbon in the mineral soil below the litter, fumic and humic layers and all organic carbon in soils classified as Histosols. 50 cm depth between top of the mineral soil or, alternatively, from the soil surface (if histosol)
Finland	Organic carbon in mineral soils (described with model as humus in two compartments), with undefined depth. Organic soils are considered under peatlands, with a site is classified as peatland if the organic layer is peat or if more than 75% of the ground vegetation consists of peatland vegetation
France	Organic carbon in the first 30 cm of both mineral and organic soils
Great Britain	Modeled approach, include soils with non-defined depth
Italy	Soil depth is 30 cm
Ireland	Modeled approach, include soils carbon change with non-defined depth
Portugal	Organic carbon in mineral soils to 30 cm depth
Sweden	Organic carbon in the mineral soil below the litter, fumic and humic layers and all organic carbon in soils classified as Histosols, to a depth of 50 cm
Germany, Greece, Netherlands, Spain - na	

It should be considered that, as what is not reported under a pool is usually reported under another (i.e. fine roots are accounted for as either litter or dead organic matter), as long as all the pools are reported the lack of fully matching definitions is not a major problem. Some pools are very difficult to address (i.e. fine roots) due to lack of data, so there is a general assumption that there is no annual change. This information gap is caused by existing datasets, while research and harmonization programs are continuously implemented by Member States and at EU level in order to increase completeness and accuracy of the estimation.

Removals or emissions are estimated by methods that quantitatively assess the change of the C stocks in forest carbon pools. The method used is either the "stock change"or the "gain-loss" method (as defined by IPCC GPG LULUCF), but it often is a mix of the two, according the availability of data to ensure accuracy and reduce uncertainty (Table 7.31). The gain-loss method is complemented by country-specific statistics on harvest, forest fires and wood harvest, and are often based (or at least complemented) by yield models (e.g. UK, Italy, Ireland).

Table 7.31 Methods for estimating of living biomass emission/removal in the subcatgory 5A1

Member State	*Description of C stock change method*
Austria	Tier 3 national method. Austrian NFI (first cycle was carried out in 1961–70) provides data on growing stock volume increment and drain (harvest, other losses). For living biomass C stock change estimate, NFI data is completed with country specific conversion factors and biomass functions to account tree branches, foliage and below ground biomass.
Belgium	Tier 2/3 for living biomass C stock change method. Solid wood volumes of each species (aboveground woody biomass: stem + branches) is obtained from forest inventories data, and country specific BEFs. Various C stock change estimation methods are applied in time: a) for 1990-2000 it is assumed a linear biomass increase by intrapolation of inventory data (the annual wood growth), while annual wood harvest is estimated as the difference between estimated annual increase of the carbon stock and effective annual carbon stock determined by the inventories; b) for 2001-2007, EFOBEL, a (peer reviewed) mechanistic model is used. Input data into the model link each grid cell of the forest inventories (NFI 2000) with stands data (area, trees' solid wood volume, species, age classes)
Denmark	Tier 1/2, with gain loss method is used for C stock change in living biomass. For 1990-2006 the last 2 Forest Census provide basic information on species, age classes and site productivity,which further allows computation of the standing volume and volume increments on species based on yield tables. For 2007, data from 1st NFI cycle is directly used. Harvested wood is obtained from Statistics Denmark, to which non-commercial wood from thinning operations in conifers (not accounted in statistics), is added annually a 20%. BEFs from neighboring countries are used
Finland	Tier 2 method for living biomass: carbon stock change is estimated with the IPCC Method I. C removal & loss is calculated from data on stem volume increment and drain from NFI plots and respectively annual statistics on commercial wood removals. Tree stem volume increment (linearly interpolated between inventory mid-years) and drain are converted to whole tree biomass and carbon content using the country specific conversion factors. Drain includes commercial felling, logging, fuelwood, harvesting losses, and unrecovered natural losses
France	Gain loss method is used to estimate the C stock change in living biomass. IFN delivers basic data on forest growth, which is then computed with yield tables on each species, while harvest (both commercial and non commercial) are obtained from statistics. BEFs, as well as C content in wood are country specific
Germany	"Stock-Change-Method" is used with data from forest inventories (for former Western Germany). By biomass functions, the individual tree stem volume is computed, further on expanded to carbon content based on country specific volume expansion factors, and IPCC default root to shoot ratio and carbon content. For former Eastern Germany data from forestry management plans is aggregated and the C-Balance method is used (BURSCHEL et al, 1993)
Great Britain	Forests in existence before 1920 are considered not to have significant long term changes in biomass stocks, thus net C stock change is reported only for forest established after 1920 in 5A2.
Greece	C stock change in living biomass is approached with "gain loss", forest increment from NFI data disaggregated by forest type, while IPCC default factors for root/shoot ratio, wood density and BEFs are used. Loss in living biomass was estimated as the sum of losses due to commercial round wood feelings, fuelwood gathering and wildfires
Ireland	C stock change in living biomass is estimated as Tier 2, under default method. Annual increment is computed with CARBWARE model which calculates total standing carbon content of forests year-on-year, based on Irish forest yield tables, on species, involving country specific BEFs, wood density and carbon content. Reduced actual standing volume (standing volumes less thinning) on *a net areas basis is* used to estimate standing volume in a year, then annual net change results as the difference between standing carbon stocks at the end of one year and previous year.
Italy	Tier 2 for stock change in living biomass. Annual unitary wood volume increment is computed with the derivative function based on yield tables for each grouping of forest types (4 groupings of forests according NFI, each including a number of forest types). Previous year growing stock volume increases by annually calculated increment of the current year and diminishes by the losses due to harvest, mortality and wildfire in the current year. Aboveground and belowground biomass were obtained by country specific BEFs. Commercial harvested wood has been obtained from statistics. Starting from these data, C stock changes have been modeled for each region of the country
Netherlands	For C stock change a country-specific Tier 2 methodology is applied (peer review published), based on IPCC Method I. C stock/fluxes annual changes are computed based on: forest inventories, database for tree biomass and allometric functions, soil C estimates, litter from Van den Burg database, harvesting statistics. For living biomass carbon balance is calculated at NFI plot level. Changes in the carbon stock are calculated for aboveground and belowground biomass.DOM (dead wood and litter) is computed under Tier 2 with country specific data. DOM dead wood is computed based on fix rate of trees mortality and dead wood decomposition rate. DOM litter is computed with a stock change method based on several datasets, combined with field sampling as to link average litter stock value with forest inventory plots. SOM carbon stocks are assumed that did not change during the period 1990–2007.
Portugal	C stock change in living biomass (above and belowground) is estimated by default method under Tier 2. Average values of annual aboveground increment are available from a research study at national level; belowground biomass is added based on IPCC default expansion factor. Biomass loss is counted from wood volume harvest (with country specific BEFs) and wildfire emissions.
Spain	A Tier 1 method is used to estimate C stock change in living biomass, DOM and SOM, relaying on both default or country specific EF. Stock change method is used with NFI data, as to compute the commercial wood volume for each province, on unit area. Then based on national specific biomass conversion and expansion factors for each species and with IPCC default shoot-to-root ratio the C stock is estimated for the inventoried years. The difference between two successive inventory years allows the estimation of C stock change, followed by linear intrapolation toward estimation of annual C stock change. For the regions which still miss the last recent inventory data, an average of all the other regions is computed and used as a proxy. In

	final annual area of 5A1 is multiplied with respective C stock change
Sweden	Tier 3 is used to estimate C in biomass. IPCC stock change method is developed based on National Inventory of Forests which integrates Swedish NFI and Swedish Forest Soil Inventory in the same sample design and plots. Aboveground & belowground biomass per trees in permanent sample plots is obtained by biomass functions, and then converted to carbon. Annual C stock change is derived by difference between two successive estimates.

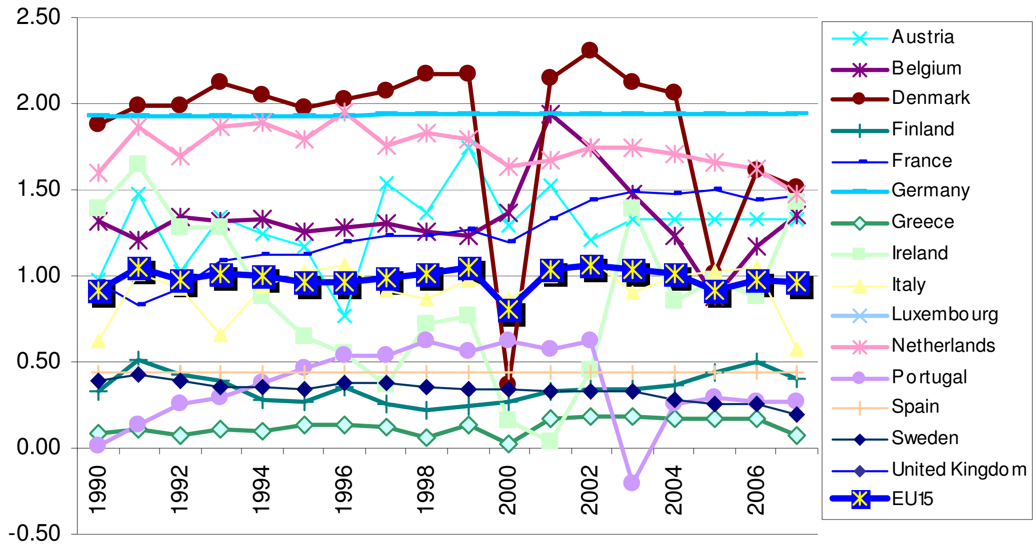
The "Stock change" method is used in conjunction with Regional or National Forest Inventory (NFI) data. Actually, NFIs represent key source of information for the GHG inventory in all EU 15's Member States. The use of remote sensing and aerial photographs or their derived products such as CORINE Land Cover maps, are also used in few cases especially to derive retroactive data (i.e. Spain). Forest inventories provides basic input both for forestland and conversions to/from forestland areas and data for the estimation of carbon stock changes in the various pools under the selected method. Methods for the collection of data in forest inventories slightly differ among Member States in terms of design, spatial density, frequency of field survey, and latest information available, while they typically are based on repeated measurements in permanent sample plots (Tabel 7.32). However, MS have made considerable efforts to adjust their forest inventories to the specific requirements of UNFCCC/KP reporting, as well as to obtain as recent and accurate information as possible. Also, efforts have been made to adjust the inventory cycles to the first commitment period.

Table 7.32 Relevant information on the National Forest Inventories (NFI) of Member States

Country	Type of survey	Frequency	Latest survey
Austria	NFI, 30 m2 sample plot – based, 4 x 4 km grid across all of country	5-10 years since 1961	2000-2002
Belgium	Regional forest inventories, with same approach for both Wallon and Flemish Region, 1.0 km x 0.5 km grid, plot area of 10 are	~ 10 years, since 1980	1999 -2000
Denmark	Questionnaire-based Forestry Census (till 2000) Sample based NFI with partial replacement of plots (since 2002). Annually, 1/5 of the total of more than 7000 plots are visited and measured every year.	Forest Census 10 years, since 1881 Continuous NFI	The two latest censuses carried out in 1990 and 2000. First NFI cycle (2002-2006)
Finland	NFI, sample-based (systematic cluster sampling) inventory, cover all land use classes with cycles of 8-10 years. Now with cycles of 5 years, different grids 6 x 6 km to 10 x 10km according the region, and cover all country in a year	10 years, since 1921	2004-2008 (10th NFI)
France	NFI, sample based, systematic clusters, 1 x 1 km, cover all the country in a year.	Continuous, since 1962	2004-2006
Germany	Carried out on a random basis with permanent sample points. The sample (cluster) distribution is based on a nationwide 4 km x 4 km quadrangle grid whose resolution may be increased, at Länd request, on a regional basis.	Two NFIs so far (1986-1989; 2001-2002)	2001-2002
Greece	Sample-based	Only one NFI so far.	1992
Ireland	Forest Inventory and Planning System and forest census, increment and harvest statistics.	Since 1958	1995
Italy	Sample-based. The new inventory uses a 3-phase sampling approach. The quantitative measurements are done in the 3rd phase on 7000 points. These points are representative of the forest composition within a region, detected in the previous phases. Data on forest area available per species category.	First in 1985, second on-going.	2003-2008
Luxembourg	Sample-based: simple systematic sampling; points on a 1000x500m grid	Planned every 5-10 years. Only 1 so far.	1998-2000
Netherlands	Sample-based NFI	~ 10 years, since 1940	2001-2002
Portugal	Sampling in geographically located points and not by polygon wall to wall mapping, it represents clearly the geographical distribution of forest species	~ 10 years, since 1965	1999
Spain	Sample-based NFI	Planned every 10 years, since 1964	1997-2007
Sweden	Sample-based since 1983, with an area measured each year.	5-10 years, since 1923	Ongoing
United Kingdom	National Inventory of Woodland and Trees carried out between 1995 and 1999, combined with Forestry censuses data (combined with model fed by yield table data)	Various, NFI since 1924	1999

Furthermore, considerable efforts have been made to improve and transform the information on forest inventory timber volume into carbon stock change. These efforts include, e.g., developing new country-specific biomass functions (e.g. Austria, Ireland and Spain), biomass expansion factors, as well as inter-calibration and harmonization exercises (i.e. with projects).

Figure 7.7 Implied net carbon stock change in living biomass in 5A1 (Mg C/ha/year)



The EU-15 annual net C stock change in biomass averages 0.98, with a range between -0.21 and 2.30 MgC/ha. In the most intensive forestry systems (i.e. Finland, Sweden), as well as in Southern MS (i.e. Greece, Portugal, Spain) the annual net C stock change is in general smaller than in Central European MS or less intensive ones. Heavy impact on emission is given by forest fire (i.e. Portugal in 2004; Greece, often; Spain in 1991, 1994).Windstorms regularly affect resinous forests in Europe (i.e. Denmark in 1999, 2005) which heavily affect emission and removal pattern in following years especially by lower rate forest growth in 5A1. As well, windstorm in France 1999 generated an increase of emissions in 5A1 in 2000.

DOM and SOM represents together like 15 % of annual forest sink. Methods used by MS to estimate the C stock change are adapted to existing data and information at their own level (Table 7.33), while efforts to acquire new, more appropriate data for reporting purposes, are underway.

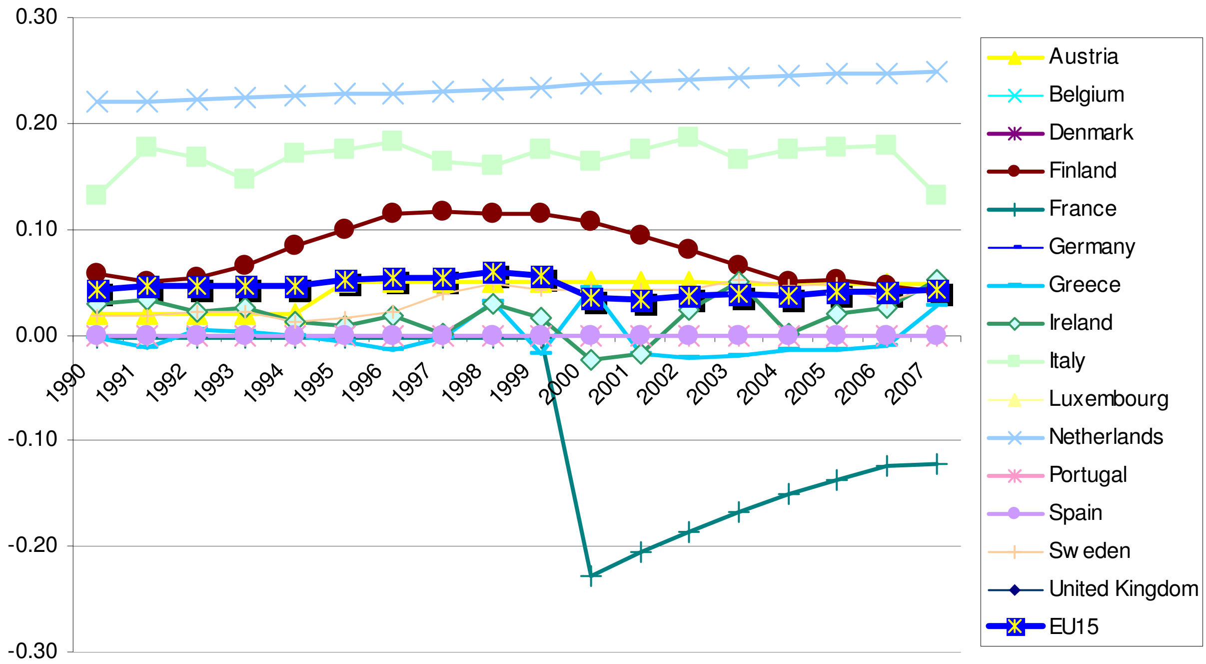
Table 7.33 Methods for estimating of DOM and SOM emission/removal in subcatgory 5A1

Member State	*Description of C stock change method*
Austria	Tier 3 for estimating the annual change in standing DOM, based on NFI measured data, assuming a ratio of dead wood between deciduous/coniferous as their stands proportion
Belgium	Tier 2 for DOM, with a constant C stock in time, while for SOM a Tier 3 based on 2 coupled models (EFOBEL and YASSO) is used.
Denmark	SOM and DOM C stock change are not reported yet.
Finland	Tier 3 method for SOM & DOM pools. Annual changes in the carbon stocks of litter, dead wood and soil organic matter in mineral soils are estimated using a model-based method (YASSO 2005, cf. Liski et al. 2006), driven by tree litter production. In organic soils, country specific measured emission factors were used in estimating decomposition of peat, combined with YASSO model to estimate above ground C stock changes.
France	DOM-dead wood are country specific, while for SOM is assumed as no change (Tier 1). DOM dead wood is delivered by NFI.
Germany	"Stock-Change-Method" is used with data from forest inventories (for former Western Germany). By biomass functions, the individual tree stem volume is computed, further on expanded to carbon content based on country specific volume expansion factors, and IPCC default root to shoot ratio and carbon content. For former Eastern Germany data from forestry management plans is aggregated and the C-Balance method is used (BURSCHEL et al, 1993).
Great Britain	Forests in existence before 1920 are considered not to have significant long term changes in biomass stocks, thus net C stock change is reported only for forest established after 1920 in 5A2.
Greece	Tier 1 is assumed for SOM and DOM. For wildfires affected areas there is a Tier 2 approach for DOM.
Ireland	Tier 1 is assumed for DOM, but annual litter C stock change is estimated with default emission factors. Tier 1 is assumed for SOM change.
Italy	Tier 1 for estimation of C stock change in DOM by applying a dead mass conversion factor, according IPCC GPG LULUCF, while C stock change in litter has been estimated from aboveground carbon stock with linear regression, for each type of grouping and forest type.
	Tier 1 for soil carbon. Soil C stock is estimated with linear regression from aboveground carbon stock, for each type of grouping and forest type.
Netherlands	DOM (dead wood and litter) is computed under Tier 2 with country specific data. DOM dead wood is computed based on fix rate of trees mortality and dead wood decomposition rate. DOM litter is computed with a stock change method based on several datasets, combined with field sampling as to link average litter stock value with forest inventory plots.
	SOM carbon stocks is assumed that did not change during the period 1990–2007.
Portugal	SOM and DOM changes are not accounted.
Spain	DOM and SOM C stock change is considered as NO.
Sweden	Tier 3 methodology is used to estimate the dead organic matter annual change based on NFI in case of dead wood (its volume

	is measured, then conversion to carbon content using factors per decay class). Carbon in the litter pool is separately estimated for three different compartments: coarse litter (not inventoried, but calculated as 15 % of the aboveground dead wood), annual litter fall (empirical functions based on tree stand properties or by biomass functions based on leaf biomass in deciduous, regarded as an annual pool) and fine litter (roots < 2 mm) is estimated by sampling the O or H horizon.
	Tier 3 method is used for C stock change in mineral soils. Annual estimates are based on repeated measurements in the NFI plots of several variables (i.e. fraction of fine earth, organic C in that soil layer) in combination with pedotransfer functions.
	Tier 2 method is used for C stock change in organic soils. Annual changes in the organic carbon pool are calculated based on the difference between annual below ground litter input (derived from the NFI) and the heterotrophic respiration (data from research).

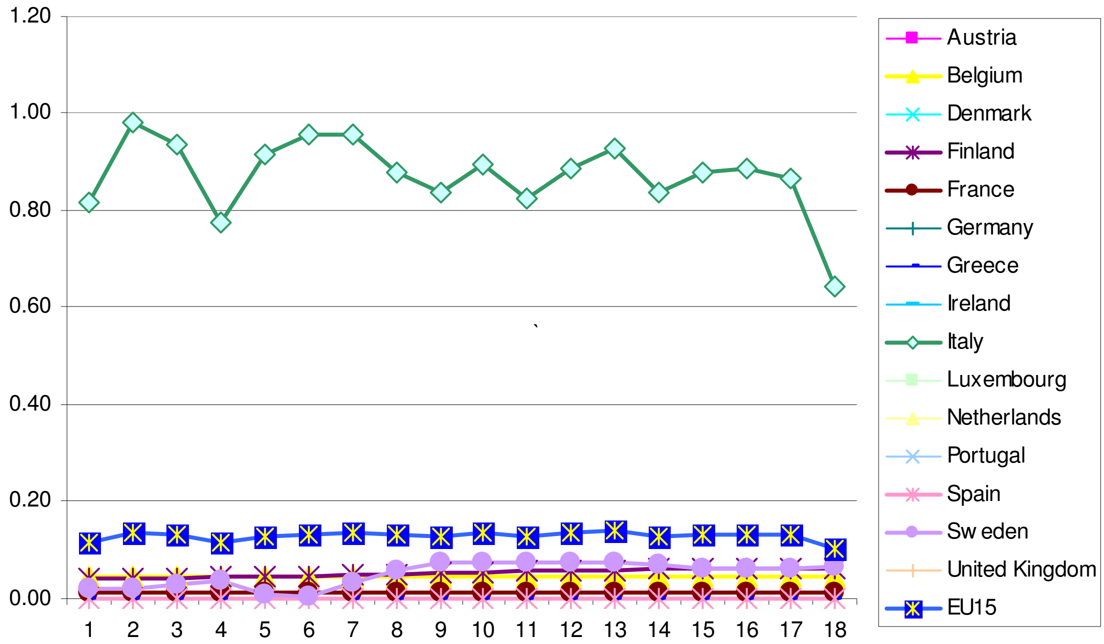
The majority of the Member States report annual low sinks in DOM, comprising of both dead wood and litter. Quantitatively, the mean net annual DOM sink amounts to 4 % of total forest sink, but it may reach up to 20 % (i.e. Finland).

Figure 7.8 Implied net carbon stock change in DOM in 5A1 (Mg C/ha/year)



The annual DOM implied net carbon stock change factor is 0.04 within a range between -0.23 to 0.25 MgC/ha*yr. A significant DOM sink is shown by very few Member States (i.e. The Netherlands, Italy), while few other Member States report high net annual emissions (i.e. France). France reports a sudden increase of emission for this pool starting with year 2000.

Figure 7.9 Implied net carbon stock change in SOM mineral soils in 5A1 (Mg C/ha/year)



The average annual C stock change in soil organic mater in mineral soils is 0.13 MgC/ha*yr, within a range between 0 and 0.98 MgC/ha*yr (note, however, that only 7 MS report this pool). On average, the sink in SOM represents some 11 % of the total annual forest sink. Italy reports a very significant sink in soil of about 0.8-1.0 MgC/ha*yr, while for other Member States, it is within the range 0-0.6 MgC/ha*yr (Figure 7.9). Under 5A1, France reports a sink of 0.01 MgC/ha*yr which includes both the C stock increase in SOM and an absorption of methane from atmosphere of 2.5 kg CH_4/ha*yr by not disturbed soils in the "forest land remaining forest land" category (CH_4 removals represent 35 % of the total annual sink).

Regarding the organic soils under forest land remaining forest land, there are two Member States (i.e., Finland and Sweden) that report average annual emission of -0.48 MgC/ha*yr, based on country specific data and measurements.

7.3.1.2 Conversions to forestland (5A2)

Overall, at the EC level, Member States report around 5% of their forest land area as being under conversion in different stages. The subcategory is important as the EU Member States and the EC, as well as other Annex I Parties to UNFCCC, has to report emissions and removals associated with these conversions under the specific accounting rules of the Kyoto Protocol. Methods used to identify the area under conversion, as well as to report emissions factors and emissions estimation, are sometimes different from those used for subcategory 5A1 (Table 7.34). The ability of the Member States' GHG estimating systems to detect the former land use is limited due to lack of historical data, but it has been improved by additional measures.

Table 7.34 MS's background information on C stock change estimation methods in 5A2

Member State	Description of method
Austria	Approach 3 for land use change, based on NFI which captures changes to/from forestland. Nevertheless, the ability of NFI to capture these changes is considered as low. If the land use change, the NFI records data on the type of land in the neighborhood of the inventory plot and data on conversion from last inventory is applied also to previous inventories. C stock change in living biomass is computed based on national level estimated annual increment (a constant over the 20 years transition) and loss, with country specific conversions factors, under default method. Reference C stock in mineral soil for all land uses has been estimated and assuming a transition period of 20 years, it is computed the annual change for a depth of 30 cm. Reference C stock under forest is 121 MgC/ha, based on Austrian soil inventories for forests (BFW 1992).
Belgium	No land use change occur
Denmark	Afforested area is derived from Danish Forest and Nature Agency statistics, summing up state afforested areas, municipal areas and also private subsidized afforestations, since 1990. Biomass C stock change is estimated under a Tier 3, with a simple carbon storage model using Danish forest yield table data for Norway spruce (representing conifers) and oak (representing broadleaves) and age dependent BEFs (by expert

	guess). The estimation is made under assumption of middle class growth, with no differentiation of soils and sites. For DOM a Tier 3 method for detection change based on field sampling and measurement of organic C is used (by regressions on afforestation chronosequences or assuming linear distribution in time by C stock in dead organic mater divided by stands/plantation age), as data availability. C stock change in SOM is not estimated as there is no consistent change detected in soil organic matter during the first 30 years following afforestation.
Great Britain	Annual statistics is published by UK Forestry Commission and the Northern Ireland Department of Agriculture divided in two time period: 1920 – 1990 and 1991 onwards. Area data is provided according UK Countryside Survey and Northern Ireland Countryside Survey, on 1990-1998 and extrapolated for after 1999. Tier 3 method. The C-Flow model requires as input data (a) areas of forest planted in each year (initiated with 1920) on broadleaves/resinous and on mineral/organic soils (b) the stemwood growth rate and harvesting pattern and two sets of country specific parameters (i) stemwood, foliage, branch and root biomas expanded from the stemwood volume and (ii) the decomposition rates of litter, soil carbon and wood products. Model accounts also non standard management practices (i.e. different production cycles). It provides separate annual gains and losses for carbon stock change in living biomass. Key assumption of the C-Flow is that the forests are harvested according to standard management tables (i.e. Forestry Commission Yield Table). The forestfire estimations relies on a Tier 2 method, using country-specific activity data and default emission factors.
Finland	Finland does not yet make distinction between "forest land remaining forest land" and "areas converted to forest land", all emissions and removals are reported under 5.A1
France	Land use changes area is determined by an approach combining aerial photographs datasets with an annual on-the-ground survey of lands (in terms of land use and activities which occur on). Based on this an annual land use change matrix is achieved on IPCC land categories (including also explicit non-managed lands). Differentiation between "stable" and "under conversion" lands is made only in the 5^{th} year since land use change, in order to clarify if land use change is permanent or not. An annual matrix is developed (to capture changes with high cinetique) and another one on 20 years (for slower changes). For French Guyana a photointerprestation system based on Landsat and Spot, combined with a permanents plots survey in small part of the area is used to estimate land use and changes, while biomass data are delivered by field studies. C stock change in living biomass is achieved from yield tables and NFI data, considered under no harvesting, using country specific BEFs, C content in wood and DOM data. For computation purposes a period of 20 years is taken, with a linear change in time.
Germany	Time series start in 1990 (1987). Based on NFIs (1987, 2002) in Western Germany and on management plans and NFI 2002 in Eastern Germany the area of conversion is deducted and assumed linearly distributed over the time span since base year (transition period of 20 years). Previous land use is reported only for former Western Germany. NFIs data and single tree biomass functions are used to generate the biomass/C stock in conversion to forest areas under 20 years old, then C stock was allocated proportionally according share of previous land use categories and linearly interpolated for annual net increase. SOM and DOM changes are considered negligible.
Greece	Afforestation area is provided from statistics since 1990, disaggregated on forest types. Carbon pools change is Tier1 as using data from LULUCF GPG for all type of conversions. Dead wood and litter carbon stocks change were assumed status quo under a Tier 1 assumption. C stock changes in soils were estimated according to Tier 1.
Ireland	"Conversion to forestland" annual area is a spatially explicit GIS database for after 1990, while for the period before yearly statistics on afforestation area are available, (as early as 1920). Afforested areas maps were superimposed on Soil map and CORINE 1990 Land Cover Map in order also to identify the soils distribution. Tier 2 for estimation of annual C stock increment is obtained from CARBWARE model based on yield tables (as in 5A1), applied to relevant age cohort's area, assuming no C accumulation in plantations younger then 7 years and no harvest in young plantations till 20 years old. Tier 1 is assumed for DOM - dead wood, while for DOM – litter, the C stock change is estimated based on IPCC default data. For afforestation on organic soils a country specific transition period of 4 years is used, based on research results, while reported under Tier 2. Tier 1 is assumed for reporting emissions from afforestation on mineral soils.
Italy	Land use change matrices for each year of the period 1990–2007 have been assembled based on time series of national land use statistics for forest lands, croplands, grasslands, wetlands and settlement areas. Growth in forest land area as detected by the National Forest Inventory is used as the basis. The contribution from stock changes is applied in the first year following the relevant land-use change, and it is applied only once, for the year in which it is determined.
Netherlands	Land use matrix is available with land-use changes calculated by comparing the digitized map (for the period 1988-1992 for 1990) with those from 1999-2002 for 2000). In 2005/2006 afforestation and deforestation were evaluated based on field studies. Changes in carbon stocks in living biomass, DOM and SOM are the same as in 5A1.
Portugal	Area data is given by National Forest Inventory (1982, 1995, 2006) combined with Corine Land Cover maps (1990, 2000) involving linear interpolations and extrapolations to obtain annual land use changes since 1990. Species share is given according the management and afforestation plans. Country specific data is used for living biomass. DOM (only litter) stocks for initial and final equilibrium status of the land are determined. C stock change in soils is computed based on default data. Transition period is 20 years for soils and 15 for other C pools.
Spain	Conversions to forestland area is provided from a superposition of CORINE LANDCOVER 1990-CLC90, 2000-CLC00 and Forest Maps of Spain (2004), in order to identify the lands with trees crown cover over 10 %. Annually converted area is computed based on differences between land uses in each year and constantly distributed in time. For all pools, the method for C stock change estimation is Tier 1, with some country specific factors. Annual average increment in aerial biomass on lands under conversions to forestland is estimated based on the Map of Potenatial Forest Productivity of Spain, then using country average value for BEFs and root to shoot ratio the total annual biomass and C stock, computed for each province. Transition period is 20 years.
Sweden	Since 1985 there is in place a national level systematic grid of permanent monitoring plots which provides estimates of the gross & net land-use transfers from the base year onward, actually since 1983 (Approach 3). Activity data is Tier 3. Transition period is 20 years. Estimation of C stock change in living biomass is based on NFI data and country specific biomass functions. Tier 3 is used for DOM and SOM, based on data from forest inventory and functions.

Heterogeneity in individual MS approaches imply more cautious interpretation of implied carbon stock change factors in 5A2, caused by: time series length, use of averaged or annual living biomass growth, emissions from previous land use. Transition period for areas under conversion adopted by MS is in general of 20 years, with exception of UK which adopted 100 years (showing an annual stock and sink comparable to what other MS report under 5A1).

For the rest of MS, the multiyear average C stock change in living biomass is 1.5 MgC/ha/yr, with a variation between 0.5 to 3.5 MgC/ha/yr. It has shown a slowly increasing trend over time series since 1990 caused by MS that report plantations only established after 1990 or latter (i.e. Denmark, Germany, Greece, Netherlands, Spain). The highest annual sink in living biomass is shown by Germany (3.5 MgC/ha/yr) and Greece (2.8 MgC/ha/yr).

Some countries show negative values of the living biomass and DOM carbon stock change in 5A2 (as well as emissions from 5A2), for some spans. This is a calculation artifact generated by a combined effect of transition period length, high annual variation of past/current planted area in time with the method selected (difference of standing carbon stocks in 2 successive years) which “create” false emissions when areas are transferred from 5A2 to 5A1 (i.e. Ireland, Sweden).

DOM is reported as a sink of about 0.16 MgC/ha/yr, with a small variation between MS.

SOM is a sink of about 0.90 MgC/ha/yr, with a range between -0.2 to 3.5 MgC/ha/yr. SOM shows an increasing trend which is mainly given to Italy which report increasing annual sink from 2.1 in 1990 to 4.5 MgC/ha/yr in 2007.

On organic soils it is reported a significant decrease of C stock in organic matter, ranging from -0.78 MgC/ha/year for afforestation occurring on croplands and -4.3 MgC/ha/year in case of grassland and wetlands conversions (i.e. Ireland).

7.3.2 Cropland (5B)

The definitions of croplands are not always transparent, but descriptions given in NIRs show a good match with IPCC categories (Table 7.35). The match could be direct or after aggregation or disaggregating of existing data at MS level. Often lands may be under different forms of conversions between grassland and cropland, and *vice versa* (especially under strong ecoconditionality of EC agricultural policies), but ability of the national GHG estimating systems to accurately capture their status vary from MS to another.

Table 7.35 Information on cropland definitions and/or description

Member State	Definition/description
Austria	Arable land, including annual and permanent crops
Finland	The area of cropland comprises of the area under cereals, grass (≤ 5 years), other arable crops, set-aside and permanent horticultural crops
Germany	Annual and perennial crops
Greece	Cropland includes all annual and perennial crops as well as temporary fallow land. Forest plantations – mainly consisted of poplar trees - are considered as Cropland
Ireland	Permanent crops and tillage areas (including set-aside)
Netherlands	All arable and tillage land, including rice-fields, and agro-forestry systems where the vegetation structure falls below the thresholds used for the Forest Land category
Spain	Cultivatedland, including cultivated areas in the Dehesa (with trees). Annual crops, perennial crops and mix of annual and permanent crops are included, except when they qualify as forest
Sweden	Regularly tilled agricultural land

Belgium, Denmark, France, Italy, Luxembourg, Portugal, United Kingdom – definition/description is not available in NIR 2009

Methods used by the MS to estimate the emissions related to cropland remaining cropland and conversions to croplands are described under following subchapters.

7.3.2.1 Cropland remaining cropland (5B1)

Net fluxes of GHG in this category are reported mainly for soils, which is the most significant pool in terms of carbon stock and stock changes, while for lliving biomass the C stock changes are reported only for multi-annual woody crops (i.e. orchards, vineyards, Christmas trees, fruits bushes plantations). Soil pool definition varies amongst MS, in terms of estimated soil depth (20 cm in Finland and Finland; 100 cm in Denmark or indefinite depth in case of modelled approach) and threshold content for organic matter in organic soils. Methods used for the estimation of emission/removal depend on data type and their time series availability (Table 7.36).

Table 7.36 Background information on C stock change estimation methods in subcategory 5B1

MS	Description of methods
Austria	Activity data is compiled from Statistic Austria and IACS data base
	Annual C stock change in biomass is considered according the type of permanent woody crops (Tier 1 for orchards, vineyards and Tier 2 for energy crops, Christmas tree) and estimated based on an annual removal rate of permanent crops and country specific total biomass carbon stock at harvest/removal.
	C stock in mineral soils is computed based on national reference C stock and average C stock change factors for (tillage, land use factor and input factor) whose values were adjusted according the technology and management change since 1985 to now. Then, based on a 20 years transition period the change of SOM was derived for the entire time series.
Belgium	Belgiumn territory is divided into landscape units (LSU) obtained from topological intersection of 2 geo-datasets: 1990 Corine Land Cover (LANDSAT-images, European Commission 1993) and digitized Soil Association map of Belgium (Tavernier et al., 1972), each intersection provides one soil type and one land use class. LSUs derived from CLC-1990 are expanded used for 1960 and 2000. System is not able to provide data on land use changes. Living biomass pool is not reported.
	Tier 2/3 for SOM stock change in mineral soils. C stock for each type of LSUs is computed for the years 1960, 1990 and 2000, based on several databases and modeling approaches, according the LSU features, by: “geomatching” or “class matching” when there are available measurements that match the LSU; “disaggregation and reagregation” of the average SOC-percentage data per municipality or other type of administrative unit, as available, and “use of a mechanistic model” (YASSO for forest soils, ROTH C for agricultural soils) for those LSUs without any other sources of data.
Denmark	Land data is provided from a thorough GIS analysis of country’s agricultural area in 1998, combined with databases used for Common Agricultural Policy implementation and detailed soil maps, both stratified in mineral & organic soils and cropland & grasslands (further on breakdown in: annual crops, set-a-side, grass in rotation and permanent grassland), whose constant ratios are expanded over 1990-2007 time series.
	C stock change in living biomass (horticultural) is computed based on country’s average stock biomass for each crop type, while for hedgerows a simple linear growth model has been used.
	Estimation of the SOM stock change in mineral soils is made under a Tier 3, using the C-TOOL, a 3-pooled dynamic soil model, run at county level, validated against long term field measurements. Emissions from grassland on mineral soils are also included in 5B. Annually reported C stock change in mineral soils is a five-year average.
	For organic soils emission factors are under Tier 1, as adapted from neighboring countries. National definition is that organic soils have >10% SOM, in contrast to the IPCC definition where organic soils have >20%.
Finland	Cropland area is derived annually based on The Yearbook of Farm Statistics. Based on soil analysis the area is stratified on mineral & organic soils, low/high activity soils and fallow/till/no-till lands.
	Tier 2 carbon stock changes method for living biomass in perennial woody crops (vigorously-growing & dwarfish apple and currant). Annual carbon stock change is determined by country specific data, as the difference between annual biomass accumulation and loss (caused by thinning and removals of old plants).
	Tier 1 method is used for emissions from mineral soils. Estimation of C stock changes relay on country specific reference soil carbon stocks and IPCC C stock change default factors, over a period of 20 years.Tier 2 is approached for calculating CO_2 emissions from cropland on organic soils, national emission factors are used (different between grassland and other crop types).
France	An approach 2/3 of land representation is in use, allowing an explicit land use and land use change, which allows using a Tier 3 activity data. In France metropolitaine system combines aerial photographs and annually repreatead field checks in permanent plots which allow establishing both current cover and the use of land, on annual basis. In French Guyana teledection techniques are used to determine land use change (deforestation, in principal). Method I IPCC is used to determine the emission/removal from living biomass. Only woody biomass stock change is considered in permanent crops (still considering that emission equals removal). As weel, the change of stocks in DOM and SOM are considered neutral.
Germany	Cropland area is multi-source provided via GIS digitized maps, within “wall to wall” approach, built by the landscape model (ATKIS - Amtliches Topographisch-Kartographisches Informationssystem), CORINE land cover (CLC – 1990, 2000), digital soil map of Germany (BUEK 1000) and German Official Statistic data (land use surveys in 1991, 1999, 2003), harvests survey in 1989 – 2005, revision of NUTS 3 in 1998, NFIs). Approach allows estimating the area of land uses and organic/mineral soils share. Mineral soils removal/emissions are considered neutral.
	Organic soils emission is computed under Tier 3, with country specific emission factors.
Great Britain	Land use data is provided from statistics, breakdown on geographical regions.
	Non-forest living biomass carbon densities is assumed increasing in time (as yield improvements with new species strains or management), with annual emission/removal estimation based on area changes. A dynamic model of carbon stock is used to estimate time change.
	Tier 3 land use change matrices are matched with soil carbon density database of UK.
Greece	Area data on croplands dynamic is provided by national statistics (under Approach 1), 20 years land use matrix is constructed. Method I IPCC with a Tier 2 methodology is used to estimate carbon stock changes in living biomass in permanent crops (i.e. olive orchards). Tier 1 emission factor data is used for the estimation of carbon stock changes in mineral soils, with IPCC default C stock change factors and C stock reference in mineral soils. A weighted average value for reference soil organic carbon stock is computed at national level, based on default reference data. Tier 1 reporting on organic soils emission, activity data by national studies and default EF.
Ireland	Annual statistics for tillage crops are used, under Approach 2.
	For C stock change in living biomass, Tier 1 is assumed.
	Tier 1 for C stock change in mineral soils. Soil types on land uses are derived from GIS analysis of the 2004 dataset of Land Parcel Information System, superimposed on the General Soil Association Map of Ireland. Reference C stocks are established

	in details for each soil type, and then assimilated with IPCC default type, while adjusted by unique national values of stock change factors.
Italy	Time series of national land use statistics is available.
	Tier 1 based on highly aggregated area estimates for generic perennial woody crops has been used to compute only aboveground biomass carbon stock change. For mineral or organic soils no change was assumed.
Netherlands	Activity data is given based on land use maps complemented with digitized and digital topographical maps that allow constructing land use change matrix. Soil carboncontentisbasedonthesoilmapoftheNetherlandscombinedwith detailed descriptions ofrandomly selected and analysed soil profiles. C stock change is considered neutral in all pools.
Portugal	Area data is given by Corine Land Cover maps (1990, 2000) combined National Forest Inventory (1982, 1995 and 2006), involving linear interpolations and extrapolations to obtain full time series of land use remaining in the same category. All polls are considered stable in time.
Spain	Activity data is obtained from CLC 1990 and 2000 and Forest Maps of Spain.
	C stock change in living biomass is computed for perennial crops based on IPCC default factors, butannual sink is considered zero.
Sweden	Activity data is provided by a national level systematic grid of permanent monitoring plots.
	Tier 3 for mineral soils. A carbon loss factor is computed from oxidation rate, soil bulk density and soil carbon concentration.
	Tier 2 for organic soils. Annual carbon loss is calculated based on: crop type country specific emission factor and total area of organic soils under agricultural production (according national survey in 2005).

Activity data is without exception the “area”, the methods used to determine it are similar or closely integrated with methods used for other sub/categories. Heterogeneity of this land use category is given by the high dynamic of management approaches (annually tillaged, set aside land, perennial non woody crops), which seems not be captured so far by the GHG inventories.

Difference in C stock change factors in living biomass is given by different types of permanent crops and management across Europe, especially from North (i.e. bushes type currant crops) to South (i.e. olives crops and agroforestry systems). At EU-15 level, living biomass is a sink of0.07 MgC/ha/year (with the highest values in Italy and Portugal 0.4 MgC/ha/year), and, for SOM the C stock change is neutral on over the period since 1990, but it shows annual variation within limits - 0.18 to 0.25 MgC/ha/year. On organic soils under cropland, at the EU-15 level the multiyear average emissions is 6.7 MgC/ha/year, with a range between 2 to 11 MgC/ha/year (MS that relay on IPCC default emission factors show more than double carbon stock change factors compared to those which use own’s). IEF values are also influenced by the type of what sources are counted here (i.e. UK includes emissions from drainage and lime application under the cropland).

Stratification of MS’s cropland area is always done on organic and mineral soils (if relevant), with further breakdown on other criteria (i.e. soil’s activity, management types). For estimation of C stock changes in **mineral soils**, most countries apply Tier 1 or 2 for emission factors and method, while for activity data is usually Tier is 2 or 3, while few MS report on Tier 3 based on models (i.e. Denmark). Reference C stock (t C/ha) in mineral soils varies between countries: Finland (59.1 (t C/ha) for high activity soils and 74.6 (t C/ha) for sandy soils, for 20 cm top soil), Austria (60 (t C/ha) for 0–50 cm depth and 50 (t C/ha) for 0-30 cm depth), Greece (a national average of 48 (t C/ha), IPCC based), France (40 (t C/ha) for 0-30 cm depth, while 70 (t C/ha) in forest and 65 in pastures), Italy (44,5 (t C/ha) ± 10 for grassland or cropland, for depth of 30 cm), UK developed reference C stock for all regions but for 1 m soil depth, for all land use categories. Noteworthy that none of 15 EU’s MS developed its own carbon stock change factors and relay on default IPCC ones, as such or slightly modified by always expert guess (i.e. Austria developed own factors which shown an increasing trend in time). Factors are in all cases selected from IPCC tables (GPG LULUCF 2003): tillage/management factor (F_{MG}), a land use factor (F_{LU}) and an organic material input factor (F_I).

Organic soils have regional distribution with the highest share in Northern Europe. In estimating emissions, Tier 1 (involving IPCC default EF) or Tier 2 (involving own EF) are used by MS countries which relays on own data (Finland, Sweden, UK). In Ireland there are no annual crops on organic soils. Greece uses IPCC default emission factors which are very high comparative with those used by Nordic MS.

7.3.2.2 Conversions to cropland (5B2)

Area under conversions to cropland is some 14 % of total cropland area. Most of conversions occur from grassland. France and UK report ~ 30 - 40 % of their 5B area as being under conversion. Emission/removal is reported for living biomass (in case of deforestation) and soils. Methods for estimating the stock changes and emissions of CO_2 from these categories have specific particularities which are shown in table 7.38.

Table 7.37 Background information on C stock change estimation methods in subcategory 5B1

Member State	*Methods for estimating*
Austria	Activity data is provided by land statistics (compilation from Statistic Austria and IACS data base). Conversions between and within cropland and grassland is assessed based on "land use factor" determined by a field estimation fulfilled in 2001–2003, then extrapolated to all years in the time series 1990–2007. C stock change in biomass for conversions between perennial and annual cropland, grassland and forest to cropland, the annual change estimation is based on default and country specific parameters under Tier 2 method. Annual change of C stock in the soils is generated from soil references C stocks for different land uses and a default transition period of 20 years**,** while for the initial stocks of biomass in grassland and forestland country specific value are available.
Belgium	No land use change occur
Denmark	Land data is provided from a thorough GIS analysis of country's agricultural area in 1998, combined with databases used for Common Agricultural Policy implementation and detailed soil maps, stratified both in mineral & organic soils and cropland & grasslands (further on breakdown in: annual crops, set-a-side, grass in rotation and permanent grassland), which allows establishing a constant ratio for all over 1990-2007 time series.
Finland	Area is included under 5B1.
France	An approach 2/3 of land representation is in use, allowing an explicit land use change data, which allows using a Tier 3 activity data. In case of deforestation it is considered that 20 % of biomass is burned on the place. In case of DOM, whole stock is emiited in years of event occurrence (DOM is country specific, determined from NFI). For SOM there are established reference C stocks under each main type of land use, so any conversion among them is considered linearly over 20 years period.
Germany	Cropland area is multi-sources provided via GIS digitized maps, within "wall to wall" approach, built by the landscape model (ATKIS - Amtliches Topographisch-Kartographisches Informationssystem), CORINE land cover (CLC 1990 and 2000), digital soil map of Germany (BUEK 1000) and German Official Statistic (land use surveys in 1991, 1999, 2003), harvests survey in 1989 – 2005, revision of NUTS 3 in 1998, NFI). Approach allows estimating the area of organic soils and their land use.For living biomass and soils the difference between initial and final country specific carbon stocks (according the land use) is linearly distributed over 20 years period.
Great Britain	Land use data is provided from statistics, breakdown on geographical regions. Changes in soil carbon due to land use change relays on a matrix of change based on repeated land surveys, linked to a dynamic model of carbon stock change and a database of soil carbon density for the UK, which is a joint harmonized database (built on three soil surveys, field data, soil classifications and laboratory methods). Model is developed on principle of "change in equilibrium carbon density from the initial to the final land use" (peer reviewed). For living biomass, initial carbon densities was assigned to each of 5 land use type identified, then based on weighted occurrences of these land in each country of UK, there were calculated mean carbon densities for IPCC land categories, with any changes assumed to occur in a single year.
Greece	na
Ireland	Land use matrix provides annual data on conversions to cropland, based on a GIS database and assumption correlation between soil type and grassland use. It is a spatially explicit Approach 3. Only above-ground biomass change is estimated as the difference between initial and final carbon content of (IPCC default) biomass for the lands converted. SOM emissions are estimated based Tier 1.
Italy	Time series of national land use statistics is available. Tier 1 based on highly aggregated area estimates for generic perennial woody crops has been used to compute only aboveground biomass carbon stock change. For mineral or organic soils no change was assumed.
Netherlands	Activity data is derived from land use matrix and soil maps. Method description: digitized soil map combined with soil profile details based on randomized field check of map units and detailed descriptions of soil profiles to obtain top soil C content in 1990 and 2000. Then annual change is interpolated between 1990-2000 and after 2000 by extrapolation.
Portugal	Area data is given by Corine Land Cover maps (1990, 2000) combined National Forest Inventory (1982, 1995, 2006), involving linear interpolations and extrapolations to obtain full time series of land use remaining in the same category. N_2O emissions from soil disturbance associated with changes are estimated, with IPCC default EF. Country specific living biomass and DOM stocks are established for numerous types of lands uses (aggregated under IPCC categories) and further used for estimation of changes over 1 year transition period in case of conversions. SOM emission is estimated based on IPCC reference stock and carbon stock change factors.
Spain	There are no detected conversions to croplands.
Sweden	Activity data is provided by NFI. Tier 3 in SOM: A carbon loss factor is computed from oxidation rate, soil bulk density and soil carbon concentration. Tier 2 for organic soils. Annual carbon loss is calculated based on: crop type country specific emission factor and total area of organic soils under conversion to agricultural production

Under 5B2, emissions occur in case of conversion from forestland and grassland. Lower tiers are used in estimating and reporting of emissions, especially Tier 2 and enhanced Tier 1 by using country specific data with default methods. Most conversions to cropland occur from grassland and much less from forest land.

At EU level, multiyear average of the C stock change *in case of conversions from forestland* to other land uses is around 25 MgC/ha*year, with a range from 60-100 MgC/ha*year for the Member States which report all emissions (including whole tree biomass stock) in the initial year of the event (i.e. Germany, The Netherlands). Values around 4 MgC/ha*year are reported by those Member States which report emission from biomass loss under 5A1 and DOM under 5B2 in the year of the conversion (i.e. France). In case that the biomass emissions are reported under 5A1, C stock change factors are less than 1 MgC/ha*year.

In case of *conversions from grassland to cropland,* in the majority of cases emissions from soils are reported but those from the loss of biomass are not (i.e. France, The Netherlands). When reported, grassland biomass emission is estimated according to the GPG for LULUCF, 2003, as there is a lack of country specific data. Few reporting Member States provide small sinks in the biomass pool (0.09 MgC/ha*year in Austria, 0.7 MgC/ha*year in Sweden and 1.7 MgC/ha*year in Germany), while for SOM in mineral soils, the stock change differences are large from one Member State to another (between 22 in Germany and -1 MgC/ha*year in Austria).

7.3.3 Grassland (5C)

The definition of grassland is not always transparent in the NIRs, but available descriptions shows a good match with IPCC definition, despite different management approaches across EU-15 (table 7.39).

Table 7.38 Information on grassland definitions and/or description

Member State	Definition/description
Austria	Once/two/several cut meadows, cultivated pastures, litter meadows, rough pastures, alpine meadows and pastures and abandoned grassland
Denmark:	Area with permanent grass
Finland	Grasslands and meadows more than five years old; abandoned agricultural area which cannot be included yet in the Forest land category; small roads and other small areas with tree cover less than 10% inside cropland are also placed under the Grassland category
Greece	Rangeland and pasture with vegetation that falls below the threshold of national forest definition and are not expected to exceed that without human intervention. Pastures that have been fertilised or sown are considered as cropland.
Ireland	Improved grassland (pasture and areas used for the harvesting of hay and silage) and unimproved grassland (rough grazing) in use as recorded by survey
Netherlands	Rangeland and pasture land that is not considered as croplands
Spain	Pasture land, including grazing land not included in cropland. It includes also pastures and meadows in the dehesa that do not comply with the definition of forest
Sweden	Agricultural land that is not regularly tilled
Belgium France Germany Italy Luxembourg Portugal United Kingdom – definition/description is not available in NIR 2009	

Quite often, grassland may not be clearly separated from cropland and/or wetlands, especially on land under conversion (e.g., in France and the UK where a rolling conversion from and to cropland and grassland is reported up to 70 – 100 % of the total 5C area). The ability of the national GHG estimating systems to accurately assess the status of the land varies from one Member States to another. The methods used by the Member States to estimate the emissions related to grassland remaining grassland and conversions to grassland are described under the following subchapters. Some Member States report unmanaged grassland (i.e. Ireland).

7.3.3.1 Grassland remaining grassland (5C1)

The estimation of emissions especially covers soils, while for biomass, data is less available. Lower tiers are used for reporting emissions and removals for this land use category (Table 7.39).

Table 7.39 MS's background information on C stock change estimation in 5C1

MS	Description of method
Austria	Grassland area comprising all forms of managed grassland is available from national statistics (repeated Austrian farm structure survey). Time series relays on actual data in surveyed years and interpolated data for other years. Tier 2 based on country specific data for biomass and soil carbon stocks are used. Till, annual biomass C stock change is considered zero. Annual C stock change in mineral soils is computed based on national reference C stock and C stock change factors (IPCC's adjusted as management & technology changed in time), assuming a 20 years transition period. Area of organic soils under grassland was estimated with soil inventories and compiled in the Austrian Soil Information System. IPCC Tier 1 method was used to estimate the emissions with IPCC default emission factor.
Belgium	Same methodology as in 5B1
Denmark	Grassland area is given by a detailed GIS analysis of country's agricultural area in 1998 (then expanded to entire time series as a fix ratio betweenmineral & organic soils and land uses), combined with land census and soil maps. It provides permanent grass area. Due to small areas with permanent grassland on mineral soils, changes in C stock in grassland are included in the emissions from Cropland (5B), only emission from organic soils on grassland is reported under Grassland (5C). For organic soils emission factors are under Tier 1, as adapted from neighboring countries.
Finland	Area estimate of grasslands was derived from national statistics (Farm statistics for cropland area) and NFI data. NFI8, NFI9 and NFI10 plots were classified in IPCC land-use categories from which resulted forestland, cropland was subtracted and then grassland area was estimated for mid-inventory years, then annual aea was interpolated for other years. C stock change in biomass is not yet estimated. Tier 1 method for mineral soils. IPCC default carbon stocks for high activity and sandy grassland soils for wet temperate

MS	Description of method
	climate were used together with the default carbon stock change factors (IPCC, 2003) For organic soils the IPCC default emission factor is used. To get activity data it is assumed that the percentage of organic soils (under grassland) is the same as that under croplands
France	Grassland area is determined with an approach between 2 and 3, allowing following an explicit land use and land use change, which allows use of a Tier 3 activity data. System allows counting both managed and unmanaged grasslands. Transition period to grassland is considered 20 years. For living biomass the C stock change is estimated only for woody biomass attached to this land category. Tree data is delivered by NFI. Other pools are considered neutral. For conversions from forests the emission is due in the event year and computed based on NFI data.
Germany	Cropland area from landscape model (ATKIS - Amtliches Topographisch-Kartographisches Informationssystem) with CORINE land COVER (CLC), digital soil map of Germany (BUEK 1000) and German Official Statistic. Approach allows estimating the area of organic soils and their land use. Mineral soils removal/emissions are considered under equilibrium. Organic soils emission is computed under Tier 3, with country specific emission factors.
Greece	Area is given by agricultural statistics. Tier 1 assumption that there is no change in biomass stocks is applied. The aboveground grass and trees biomass is only considered for estimating emissions in case of wildfires. According to Tier 1 approach, changes in DOM and SOM are assumed to be neutral.
Great Britain	Majority of grassland is considered under long time transition, so reported under 5C2 (less thn 1 % of total grassland is stable in time). Estimation of emissions due to peat extraction is included here.
Ireland	An approach 1 is available with Central Statistic Office's statistics. IPCC soil types on land use categories are derived by GIS analysis of superimposition of CLC 1990 with General Soil Association Map of Ireland (with peat areas entirely classified under wetlands). Tier 1 methodology assumes that there is no living biomass carbon stock change under static management practices. Tier 1 is applied for C stock change in mineral soils. Each soil type is assimilated with a IPCC default one as to establish the reference C stocks, thus corrected with F_{LU}, F_{MG} and F_I to account for land use and farming practices. On organic soils, a Tier 1 is assumed as emissions are calculated with IPCC GPG default factor.
Italy	Time series of national land use statistics is available. Tier 1 has been used, therefore no change in carbon stocks in the living biomass, SOM and DOM pools is assumed.
Netherlands	Activity data is derived from land use matrix and soil maps. C stock change in living biomass is not estimated. Land converted to grassland includes all deforestations. Country-specific Tier 2 method is used to estimate emissions from the drainage of organic soils.
Portugal	Area data is given by Corine Land Cover maps (1990, 2000) combined National Forest Inventory (1982, 1995, 2006), involving linear interpolations and extrapolations to obtain full time series of land use remaining in the same category. Country specific living biomass and DOM stocks are available. SOM is estimated based on IPCC reference stocks and carbon stock change factors.
Spain	Activity data is obtained from CLC90, CLC00 and Forest Maps of Spain. C stock changes in all pools are considered neutral.
Sweden	Activity data is provided from NFI. Tier 3 in mineral soils, where the change is estimated based on carbon amount in a certain soil layer and associated fraction of fine earth (both repeatedly measured). Tier 2 for organic soils change based on dead organic matter production from NFI and country specific annual heterotrophic respiration.

7.3.3.2 Conversions to grassland (5C2)

The area under conversions to grassland represents some 30 % of the area reported under 5C. Most of the conversions occur from cropland, wetlands and a small share from forest land. The highest area of conversion is reported by France and the UK. For other Member States, areas under conversions to grassland are rather small. The methods for estimating the stock changes and emissions of CO_2 from these categories are rather specific are summarized in Table 7.40.

Table 7.40 MS's background information on C stock change estimation in 5C2

MS	Description of methods
Austria	Area is available based on IACS database, assuming an Approch 3. For both biomass and mineral soils annual change is computed under Tier 2 as difference between country's specific soil C stock reference before and after the conversion, then linearly distributed over 20 years transition period (only 10 years in case of conversion from croplands)
Belgium	No land use change occur
Denmark	na
Finland	na
France	Grassland area is determined with an approach between 2 and 3, allowing following an explicit land use and land use change, which allows use of a Tier 3 activity data. For SOM there are established reference C stocks under each main type of land use, so any conversion among them is considered linearly over 20 years period.
Germany	Cropland area from landscape model (ATKIS - Amtliches Topographisch-Kartographisches Informationssystem) with CORINE land COVER (CLC), digital soil map of Germany (BUEK 1000) and German Official Statistic. Approach allows estimating the area of organic soils and their land use. Mineral soils removal/emissions are considered under equilibrium. For living biomass and soils the difference between initial and final country specific carbon stocks (according the land use) is linearly distributed over 20 years period.
Greece	Change in living biomass is considered as no occurring in time, as they originate in croplands which are abandoned and converted to grassland.Soil emissions are estimated based on Tier 1, with IPCC default C stock change factors and C stock reference in mineral soils.

MS	Description of methods
Great Britain	Changes in soil carbon due to land use change relays on a matrix of change based on repeated land surveys, linked to a dynamic model of carbon stock change and a database of soil carbon density. Model is developed on principle of "change in equilibrium carbon density from the initial to the final land use", peer reviewed.
Ireland	Conversions to grassland are derived from GIS analysis of CLC 1990 superimposed on the General Soil Association Map of Ireland. Tier 1 methodology is used for estimation of change in living biomass carbon stock. Also, Tier 1 is used for C stock change in mineral soils. Reference C stocks are established in details for each soil type, then assimilated with IPCC default type, further on adjusted by IPCC default factors F_{LU}, F_{MG} and $F_I$to account for land use and farming practice. On organic soils, a Tier 1 is assumed as emissions are calculated with IPCC GPG default factor.
Italy	Time series of national land use statistics is available. Tier 1 has been used, therefore no change in carbon stocks in the living biomass pool is assumed. No change in SOM and DOM is assumed.
Netherlands	Activity data is derived from land use matrix and soil maps Country-specific Tier 2 method is used to estimate CO_2 emissions from soils that result from changes in land use (Land converted to Grassland). C change in living biomass is not estimated.
Portugal	Area data is given by CLC 1990 and 2000, combined with National Forest Inventory (1982, 1995, 2006), involving linear interpolations and extrapolations to obtain full time series of land use remaining in the same category. Country specific living biomass and DOM stocks are available. SOM is estimated based on IPCC reference stocks and carbon stock change factors. Initial and final stocks are distributed linearly over a transition period of 20 years.
Spain	Activity data is obtained from CLC90, CLC00, CLC 06 (2006, soon available) and NFI. C stock changes in biomass are estimated as not changing (as there are only croplands conversions to grasslands). SOM stock change is estimated on a Tier 1, based on IPCC default soil C stock reference and stock change factors, distributed over 20 years transition period.
Sweden	Activity data is provided from NFI. Tier 2 for organic soils C stock change is based on annual dead organic matter production from NFI and country specific annual heterotrophic respiration and Tier 3 on mineral soils with use of C loss factor computed from C amount and its fine earth content of a specific soil layer.

The highest carbon stock changes are reported in biomass on grassland converted from forestland. At the EU-15 level, the overall average net change in biomass is -1.4 MgC/ha*year, with a range between 1.6 to – 12 MgC/ha*year. The average DOM stock change is -0.6 MgC/ha*year with the range from -0.01 to 2.6 MgC/ha*year. The SOM annual stock change average is 2.5 MgC/ha*year, under the influence of values reported by Italy (about 14 MgC/ha*year,) and Germany (about 9 MgC/ha*year), in both cases on land converted from cropland, and assuming that under such conversions, the entire C stock change takes place in the year of the conversion.

7.3.4 Other categories: Wetlands, Settlements and Other land (5D, 5E, 5F)

In Denmark, a net annual increase of C stock of 0.5 t C/ha*year is used for conversions to wetlands. The UK includes wetlands under other land use categories. In case of land use change to water bodies, a reference final carbon stock of 0 to C is considered, so all C from the previous land use is considered as emissions, while in case of conversion to bogs, an increase of stock to 150 t C/ha on a 50 cm depth is assumed (i.e. Austria). CO_2 emissions from peat extraction are reported under 5D and those of CH_4 and N_2O under 5(II) (i.e. Finland), and these include emissions from active and temporarily set-aside peat extraction fields, as well as abandoned non-vegetated peat extraction areas.

For the EU-27, the removal / emissions for Settlements are still difficult to be reasonably captured with a low uncertainty level. A detailed study in Austria showed an annual increase of all pools of 2.08 MgC/ha*yr. Conversions to settlements from different land uses is better reported. On average, conversion from forest land is associated with emissions from all pools, and the same applies to grassland. The reported range is nevertheless very high as it depends on the local conditions of the conversion (e.g. if trees are removed or not).

The Member States do not report, in general, emissions from the *Other land* category.

7.3.5 Methodological issues for other emissions from land uses: tables 5(I)-5(V)

7.3.5.1 Direct N_2O emissions from N fertilization – 5(I)

N_2O emissions are computed under a Tier 1. Activity data results from national or sectoral statistics, either in terms of total amount and type of synthetic fertilizer annually applied (i.e. Finland, Sweden) or fixed application rate and total annually fertilized area (i.e. UK), with IPCC default emission factor for N_2O emissions from N-inputs (= 1.25 %). IEF N_2O-N emissions per unit of fertilizer (kg N_2O-N/kg N) have a value of roughly equal to 0.01.

7.3.5.2 N_2O emissions from drainage of soils – 5(II)

In Denmark and Ireland emissions of N_2O from peatland are estimated based on organic matter's C:N-ratio and default IPCC emission factor of 1.25%, while activity data is provided by sectoral statistics. In Finland a Tier 2 is used, country specific EFs have been measured for CO_2, N_2O and CH_4, while activity data (annual area of extraction active peatlands, set aside peat lands, industrial stocks) are compiled from statistics. N_2O emission from organic soils in Denmark is estimated to 0.546 kg N_2O per 1 t C/year (C:N ratio is 20 in organic soils and 36 in peat) and CH_4-emission from the drained wetlands with a factor of 20 kg CH_4 ha-1 y-1.

7.3.5.3 N_2O emissions from disturbance associated with land-use conversion to cropland 5(III)

In general, methodology correspond to Tier 1, based on: 1) annual emission of carbon due to soil mineralization (IPCC default), 2) C:N, the average ratio in the soil (determined or IPCC default); emitted proportion N_2O from N (a constant of 1.25 %; IPCC), ratio of 44/28 to convert N to N_2O; soil carbon stock (often IPCC default reference C stock). Activity data is given by land use change statistics.

7.3.5.4 Carbon emissions from agricultural lime application - 5(IV)

Few MS report "no occurring", and some did not estimate yet the emissions from liming. Activity data are available from official national or sectoral agricultural statistics or from field studies. Emission factor used by MS is the IPCC default data (*EF limestone*= 0.120, and *EF dolomite*= 0.122). Germany uses country specific EF (= 0.16). Majority of cases EU-15 MS do not differentiate between dolomite or lime, using a unique emission factor, as the share of dolomite in total amount applied is small (~ 15 %), but commercial product is counted in terms of water content to account in the calculations (i.e. Finland). Carbon is converted to CO_2 by multiplying with 44/12.

7.3.5.5 Biomass Burning – 5(V)

Controlled burning in managed forests is not a practice, with few exceptions (UK, Spain). In general CO_2 emissions are reported under 5A if forestland, while for the other land category CO_2 and non-CO_2 gases emissions are reported under 5(V). On site burning of biomass is prohibited in most of the countries (i.e. Denmark) and therefore emissions reported as not occurring in CRF ("NO"). Emission from biomass burnt in power plants is always reported in the energy sector. Methodology is tier 2 for CO_2, with activity data provided by national statistics and country specific EF for CO_2 and Tier 1 for CH_4 & N_2O.

7.3.5.6 Harvested Wood Products

There are two MS that report HWP. Finland basically reports on the quantitative assessment of the carbon balance of all wood products which are in use in the country, calculated by the Stock Change Approach (SCA). In UK, a Tier 3 is used to compute the emission/removal associated with HWP, C-Flow, whose approach closes of Production Approach (PA). The UK method is a top-down approach that assumes that the decay of all conifer products and all broadleaf products can be approximated by separate single decay constants.

7.4 Cross-cutting issues (EU-15)

7.4.1 Uncertainties

Despite the fact that Member States have carried out some uncertainty assessment for the LULUCF sector, it is often incomplete (i.e. it is missing for some pools or entire sub/categories). Furthermore, while some Member States provide detailed estimates of uncertainty, others only give a total uncertainty value for the entire LULUCF sector, and sometimes not all the necessary information is provided in the NIRs. Most Member States applied the error propagation approach and only very few used a Monte Carlo simulation. These differences make the combination of the MS' uncertainty assessments at European Community level rather challenging,

In order to complete the currently available information, and thus assess the LULUCF uncertainty at EU 15 level, the following assumptions were made: a) the level of uncertainty provided for a higher aggregation level (i.e. sector, category) is used as a combined AD/EF uncertainty level for the next lower aggregation level (i.e. categories, subcategories); b) gap filling is applied for a subcategory by averaging the available uncertainty estimates of some Member States, for that subcategory; c) autocorrelation generated by use of IPCC default parameters is taken into consideration at the EU 15 level based on Tiers applied by each Member States.

The uncertainty of the *activity data* (e.g. land area) varies by both Member States and land use categories within the country. For lands "remaining in the same category" Member States usually report an uncertainty of less than 25 %, with highest value reported by Portugal (75 %). For lands in the "converted to" categories Member States reported an uncertainty of around 30 %, with highest uncertainties by Portugal (60 %) and Italy (75 %). In general, the uncertainty of using the Corine Land Cover and thematic maps (i.e. soil, vegetation) is by some 25 % higher compared to that of using land/forest inventories based data. Methodologies used by the Member States are connected with their own databases on land use and the available datasets usually differ depending on the original purpose of these datasets (and also on land use definitions), spatial resolution, reference years and other attributes that need to be combined by the various techniques, which usually introduce a high degree of uncertainty for the GHG estimation. Furthermore, given the relatively small area of land converted to another land use, some Member States underlined the significantly higher uncertainty associated with the emission/removal estimates of these subcategories (e.g. area of land converted to forest land is not easily estimated with sample-based forest inventories).

Overall, the uncertainty associated with the *emission factors (EF)* is higher than that of the activity data, with an average value of some 60 %, also with rather high fluctuation among Member States. The main cause of this is the high number of parameters involved in the estimation and their low level of availability at the national level, as well as the various methodological approaches. The uncertainty of the emission actor is higher for the subcategories with high disturbance levels like forest fires (i.e. PT, GR), but in general Member States reported smaller uncertainty for forest land than for any other land, as well as for the "remaining land" compared to the "converted to" lands.

Regarding the uncertainty by the Tiers used, the average uncertainty for the forest land category seems to be around 45 % when using Tier 3 and 75% when using Tier 2.

As in general Tier 2 and 3 are used by Member States to estimate C stock changes, a small *autocorrelation* (15 %) is considered among Member States estimates (i.e. caused by the occasional use of IPCC default BEFs and default transition period). For CH_4 and N_2O, a high correlation amongst Member States estimates is assumed as they usually used default data, with very few exceptions (i.e. Finland).
Across the EU 15, the aggregated uncertainty of the estimates of CO_2 emission/removal at the subcategory level varies between 30 % in 5A2 and 119 % in 5B1 (Table 7.41).

Table 7.41 LULUCF uncertainty across EU 15's Member States by subcategories

Subcategory	GHG	Uncertainty (%)	Number of reporting Member States
5A1	CO_2	38.5	14
5A2		30.5	9
5B1		119.0	13
5B2		38.4	7
5C1		55.6	9

5C2		51.9	8
5D,5E,5F*		121.7	10
5A,5B,5C*	N_2O	36.1	14
5D,5E,5F*		51.7	8
5A,5B,5C*	CH_4	69.5	2
5D,5E,5F*		71.2	2

The largest contribution to the EU 15's uncertainty for a subcategory is attributed to the uncertainty of the Member States with high GHG emission/removal and high associated uncertainty (i.e. in 5A1: DE, FI, IT; in 5A2: FR, ES, DE; in 5B1: DE, IT; in 5B2: FR, DE, GB; in 5C1: DE, NL; in 5C2: IT).
For non-CO_2 gases, the uncertainty is less for N_2O gases compared to CH_4 (with only a few pools/categories reported by only 2 reporting Member States).

Given the available information, the overall LULUCF uncertainty is preliminary estimated as 41%, with the highest contribution of category 5A1 and the merged category 5D,5E,5F (Table 7.42).

Table 7.42 The contribution of the uncertainty of various categories to the EU-15 level uncertainty

Subcategory	*GHG*	*EU 15 overall Uncertainty (%)*
5A1	CO_2	31.6
5A2	CO_2	3.9
5B1	CO_2	6.2
5B2	CO_2	4.0
5C1	CO_2	3.4
5C2	CO_2	3.9
5DEF	CO_2	24.6
5ABC	N_2O	0.2
5DEF	N_2O	0.002
5ABC	CH_4	0.1
5DEF	CH_4	0.0002
Total		***41***

The current uncertainty estimate takes into account the effects of correlations between Member States estimates (as already done in the Sector 4 – Agriculture), as well as uncertainty data available from Member States. The lack of disaggregated data makes it difficult to accurately assess the uncertainty at the EC level, with important factors being e.g. the different methodologies used by Member States and country-specific data input. As the preparation for first mandatory reports under the Kyoto Protocol is under way, it is expected that Member States will improve the uncertainty estimates for the categories whose reporting is mandatory from 2010 submission.

7.4.2 Quality Assurance and Quality control

QA/QC activities and efforts for improving reporting occurred at both the national and the EU level.

At the national level, Member States have in place quality management systems, which are part of their respective national GHG estimation systems that establish protocols for flows of data and information for compilation and reporting, data storage and archiving, detailed institutional coordination and responsibilities, as well as adequate financial allocations. The national systems are designed to be continuously improved, by taking into account new practices and suggestions coming from the review of national reports or by independent assessments (i.e. scientific papers, institutional evaluation). Quality assurance includes peer and public reviews. The purpose of such systems is to ensure adequate levels of transparency, consistency, comparability, completeness, accuracy and timeliness, as requested both by international agreements and EC GHG monitoring directive.
Furthermore, several MS improved their reports through:

- extended use of the Good Practice Guidance for LULUCF (IPCC 2003) and also AFOLU Guidelines (IPCC 2006, i.e. Finland for Harvested Wood Products);
- more complete and consistent land use transition matrix;
- key category analysis including categories and subcategories of LULUCF sector;
- using higher Tier than before (at least for some pools or subcategories, including country specific data);
- use of improved activity data and emission factors;
- developments in uncertainty estimation;
- improved documentation on methodology;
- conducting national and joint research projects.

In addition to national efforts, several activities were carried out by the Joint Research Centre of the European Commission with respect to data quality of the LULUCF sector at the EC level, including:

- Checking of Member State inventories for errors and inconsistencies, and interaction with national representatives when relevant for clarification and improvement. During the checking of the 2009 submission, 240 findings (i.e. possible problems and unclear issues, also based on the latest review of the EC inventory) were communicated to the Member States, ranging from problems in the use of notations keys, inconsistent land use data, outliers in IEF for all the categories, and various requests for clarifications.

- Efforts for improving and harmonizing Member State inventories, in close cooperation with the research community. Examples include:

- Under the intergovernmental framework for European cooperation in the field of scientific and technical research (COST), the EC initiated, in 2000, the action 'Contribution of forests and forestry to mitigate greenhouse effects' (COST E21) with the objective to exchange experience and knowledge and to improve the quality of GHG inventory compilation for forests in Europe. This action completed its work in 2004 (see the website of the action at www.efi.fi/coste21/). In COST E21 several COST actions or COST working groups stemmed: COST 21, COST E43, COST 639. COST E43 was started in 2004 under the same framework: 'Harmonisation of national forest inventories in Europe: Techniques for common reporting' also aiming at improving and harmonising the existing national forest resource inventories in Europe and at promoting the use of scientifically sound and validated methods in forest inventory designs, data collection and data analysis (http://www.metla.fi/eu/cost/e43/). One specific area of work of COST E43, in which 25 European countries participate, is the harmonised estimation procedures for carbon pools and carbon pool changes. Finally, a third action with a planned duration of four years, COST 639, was launched in December 2006 with the aim to improve the estimation and reporting of carbon stock changes and nitrogen emissions from soils (www.cost639.net)

- Recently, a study under EEC 2152/2003 "Forest Focus regulation on developing harmonized methods for assessing carbon sequestration in European forests" (MASCAREF) has been concluded. The project was conducted with the purpose to facilitate the development of a monitoring scheme for carbon sequestration in EU forests, in order to i) strengthen and harmonization of the existing national systems to better meet the requirements of international monitoring and reporting of GHG emissions and sinks, and ii) improvement the comparability, transparency and accuracy of the GHG inventory reports of the LULUCF sector of Member States, as implemented in the EC Monitoring Mechanism. The efforts undertaken under the task 1 ("LULUCF reporting requirements and realities") have also been used in the compilation of this chapter.

- For the purpose of enhancing reporting, sharing experience amongst Member States, also for the harmonization of methods for estimation, a series of technical workshops dedicated to UNFCCC reporting (including Kyoto Protocol), under the auspices of European Commission/Joint Research Center (DG ENV, DG JRC) were organized:

  - "Improving the Quality of Community GHG Inventories and Projections for the LULUCF Sector", Ispra (Italy), September 22-23, 2005,
  - "Technical meeting on specific forestry issues related to reporting and accounting under the

Kyoto Protocol" (Ispra, 27-29 November 2006, in collaboration with sink experts from EU, Japan, New Zealand and Canada,

- Technical workshop on LULUCF reporting issues under the Kyoto Protocol, Ispra (Italy), November 13-14, 2008,
- Technical workshop on projections of GHG emissions and removals in the LULUCF sector, Ispra (Italy), 27-28 January 2009.

For further information on these two workshops, see http://afoludata.jrc.ec.europa.eu/events.

- The JRC's AFOLU DATA web site (http://afoludata.jrc.ec.europa.eu/data&tools) offer interrogative databases (e.g. BEFs, conversion factors, European forest inventories and yield tables, models and other tools) to promote transparent, complete, consistent and comparable estimates of greenhouse gas fluxes in the AFOLU sector in Europe, and for the use of researchers, inventory experts and GHG inventory reviewers.

7.4.3 Time series consistency

Time series consistency has been checked for all Member States as part of the QA/QC programme of the EC GHG inventory, in terms of land categories definitions and representation in time and space. Although most of inconsistencies found had small quantitative effect on emissions/removal, Member States were strongly encouraged to correct them or at least to acknowledge and discuss the issue in their respective NIRs.

Land use category and subcategory definitions are not fully consistent across the EU-15 Member States, but they are, in general, consistent with IPCC definitions (IPCC GPG for LULUCF). Differences are given by slightly different treatment of particular lands (i.e. bush areas categorised either under the grassland or forestland; inclusion or not of the access roads in forest area), which is mainly related to various definitions used historically.

In general, within the country, land use definitions are consistent over time (Finland and Denmark show some changes, which are treated and commented under the chapter Methodological issues (EU-15), Forest land).

Total land area reported has been often found to be not fully consistent (e.g. differed from the country's official geographical area, or varied from year to year). Such small differences may occur due to improvements in the mapping precision, inherent measurement errors, feature of assessment system, but also the errors associated with the official geographical land area. In general, the land reported under UNFCCC is by 1-2 % smaller than the geographical area.

According to the GPG for LULUCF (2003), carbon stock changes and GHG emissions have to be reported for managed land, while "unmanaged" land is to be reported only if they are subject to land use conversion by human activity. In the EU-15 Member States, all forest land, cropland, grassland and settlement are assumed to be entirely managed, such as a limited area of existing wetlands (i.e. used for peat extraction: Sweden, Finland). Land included under Other land remaining other land is, in general, assumed as unmanaged, although national approaches may be very specific (i.e. 10 million ha in Spain, 4.3 million ha in Sweden, 1.6 million ha in France, 1.3 million ha in Finland). Some Member States do not report "Other land" category at all (i.e. UK).

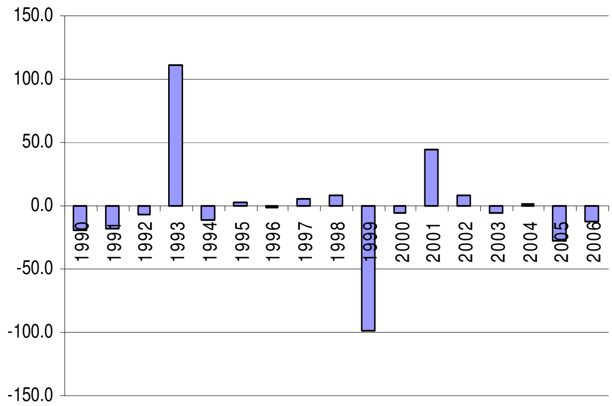
7.4.4 Recalculations

Due to many methodological improvements, revision of activity data (e.g. revision or improvement of land use matrix) and the use of new or improved factors (e.g. biomass conversion and/or expansion factors), as well as reallocation of emissions between sectors and the correction of identified errors, there have been several recalculations in the 2009 submissions. In some cases, these recalculations may also be explained by the ongoing efforts by Member States for the improvement of the estimates in the light of the upcoming reporting requirements under the Kyoto Protocol.

The quantitative effect of the recalculations over the total emission of LULUCF sector (Figure 7.10) is a decrease of net removals, especially in the early 1990s, as well as a higher inter-annual variability. The general trend of the increasing sink over time, however, was maintained. Across the entire LULUCF sector, the effect of recalculations is significant in a few single years (1993, 1999, 2001, 2005).

Figure 7.10 Overall LULUCF sector recalculations at the EU 15 level (variation % between the 2009 and the 2008 inventory)

The largest change occurs in 1993 and 1999, and is mainly due to the recalculation reported by



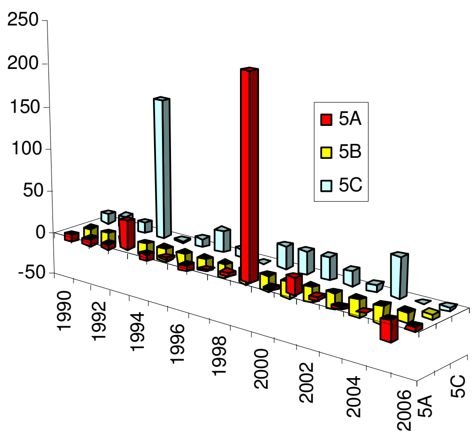
Sweden (recalculations in 5A), Spain (reduction of 5A sink by almost 20 %). There is also an overall EU 15's sink decrease in 5B and 5C (higher recalculated emissions compared to previous submission in both cases).

The 2009 recalculations mainly affected categories 5A, 5B and 5C (Figure 7.11). After the recalculations affecting 5A, there is a general decrease of the sink, with the largest influence due to the recalculations by Sweden (which have generated both increases and decreases of the annual sinks over time series since 1990), while all other countries (Spain, Italy, France, Austria) decrease the values submitted previously, at least in some years.

In category 5B, there are mainly recalculations that have resulted in a reduction of values from the previous submission at the EU 15 level. Under this category, nevertheless, The Netherlands and Italy reported a significant decrease of the emissions compared with the previously reported values (in Italy turning from source to sink), while there is an increase of emissions in France, Germany and Austria.

In category 5C, there are numerous recalculations with a small increase of the sink. France's estimates significantly increased, by more than 100%, after the recalculation for the entire time series. Recalculations also led to increased sink in Italy and Austria.

Figure 7.11 5A, B, C catgories recalculations at EC level in 2009 submission compared with previous submission (2008)

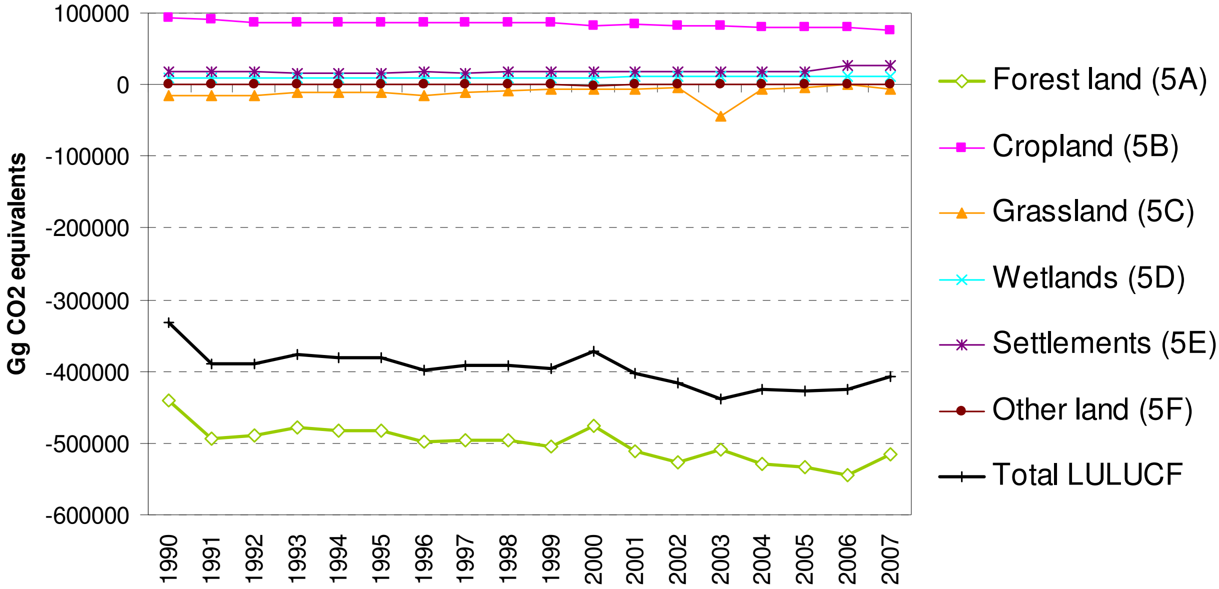


7.5 LULUCF for EU-27

7.5.1 Overview of sector (EU-27)

At the EU-27 level, the LULUCF sector is a net sink with values ranging around 500000 Gg CO_2/year (Figure 7.12), with a similar structure of removals and emissions across categories as in EU-15. The main removals are estimated for category 5A (Forest land), while the main emissions are associated with category 5B (Cropland).

Figure 7.12 Sector 5 LULUCF: EU-27 net CO_2 GHG emissions for 1990–2007 from CRF tables in CO_2 equivalents (Gg)



For the EU-27, reporting is rather complete for category 5A, while generally there are gaps in reporting for other categories (Table 7.43). For the year 2007, some new (non-EU 15) Member States reported some subcategories for the first time. Also, reporting has improved by more precisely indicating (using notation keys) where and why a certain category is reported or not reported.

Table 7.43 Sector 5 LULUCF: Coverage of CO_2 emissions and removals of the new MS in the various subcategories for the year 2007, as derived from Table 5 of CRF tables.

Member State	Reporting category											
	Forest land		Cropland		Grassland		Wetland		Settlements		Other land	
	5A1 F-F	5A2 L-F	5B1 C-C	5B2 L-C	5C1 G-G	5C2 L-G	5D1 W-W	5D2 L-W	5E1 S-S	5E2 L-S	5F1 O-O	5F2 L-O
Bulgaria	R	NE	R	NE	NE,NO	NE,NO	E	NE,NO	NE	NE,NO		NE,NO
Cyprus												
Czech R.	R	R	E	E	E	R	NO	E		E		NO
Estonia	R	NE,NO	**E**	NE	**E**	**R**	**R**	NE	NE	NE		**R**
Hungary	R	R	E	IE,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	NE,NO	IE,NE,NO	NE	IE,NE		IE,NE
Latvia	R	R	E	NE	R	NE	**R**	NE	**R**	NE		NE
Lithuania	R	R	NA,NE	NA,NE	NA,NE	NA,NE	E	NA,NE	NE	NA,NE		NE
Malta	R	NA,NO	**R**	NO	NO	NO	NO	NO	**R**	NO		NO
Poland	R	R	E	NA,NE,NO	**E**	R	**E**	**E**	R	NE,NO		NE
Romania	R	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NE	NA,NE		NA,NE
Slovakia	R	R	E	NE,NO	NE,NO	R	IE,NO	IE,NO	IE	IE		**E**
Slovenia	R	IE,NE,NO	NA,NE	NE,NO	NE,NO	NE,NO	NE,NO	NO	NE	NE,NO		NO

Legend: R: net Removal; E: net Emission; IE: included elsewhere; NE: not estimated; NO: not occurring; NA: not applicable. Bold letters/grey background cells indicate a subcategory reported this year for the first time

Regarding the pools covered, forest biomass is almost always reported under 5A1, while there are considerable gaps in reporting on other pools across all land use categories/subcategories (Table 7.44). However, several countries included new pools in current reporting.

Table 7.44 Sector 5 LULUCF: Reporting ofcarbon pools by the new MS for the most important categories for the year 2007, as derived from Table 5A, 5B and 5C of the CRF tables.

Member State	Reporting category																							
	Forest land								Cropland								Grassland							
	5.A.1. F-F				5.A.2. L-L				5.B.1. C-C				5.B.2. L-C				5.C.1. G-G				5.C.2. L-G			
	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG	Biomass	DOM	SoilMIN	SoilORG
Bulgaria	I								I															
Cyprus																								
Czech R.	I				I		D		I		I		D		D				**I**		D		I	
Estonia	I			I					**D**			**D**								**D**			**I**	
Hungary	I				I				D		I													
Latvia	I	D		**D**	I				I			D					I			D				
Lithuania	I			D	I	D																		
Malta	**I**								**I**															
Poland	I		D		I		D		I		D	**D**								**D**			I	
Romania	I																							
Slovakia	I					D																I		
Slovenia	I																							

Legend: I = net Increase of the C pool (i.e. the pool is a net sink); D = net Decrease of the C pool (i.e. the pool is a net source); Empty cells = the pool was not reported or reported as zero. Bold letters/grey background indicate a pool reported this year for the first time.DOM (dead organic matter) includes both litter and dead wood.

Most of the methodological considerations expressed for EU-15 are also valid for the new MS. It should be considered in this regard that National Forest Inventories are harmonised to a lesser degree in New EC MS, which often additionally utilise other national statistics. The lack of a harmonised system is mostly due to the political changes in most of these countries in the 90's, and also the specific changes in the forestry sector of these countries that are often unfavourable concerning developing forest inventories. On the other hand, the implementation of a new NFI system is ongoing is several new Member States (e.g. Czech Republic, Latvia, Romania, Slovenia).

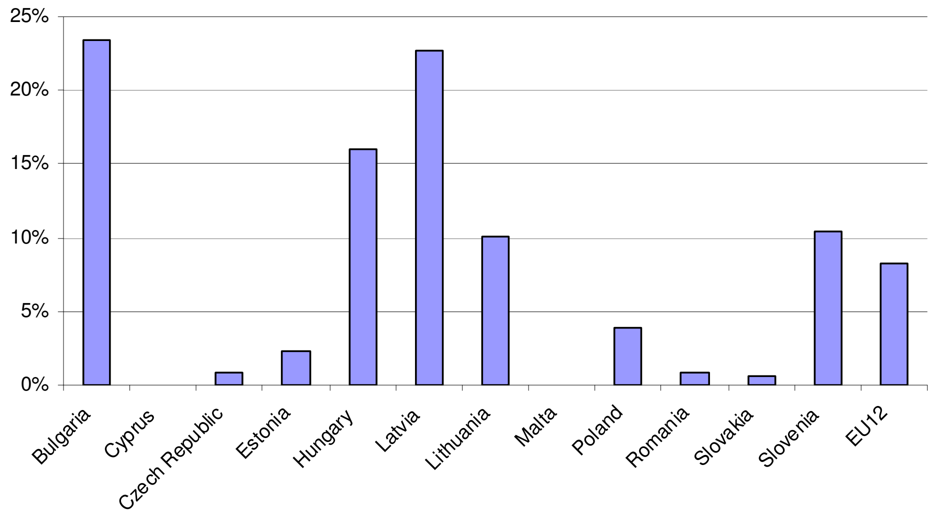
Furthermore, most new MS reported less categories and pools than most of the EU-15 MS due to less capacity to obtain reliable national statistics. However, several new MS have been making increasing efforts to achieve more complete reporting. Actions that these new MS have taken include: improving the coverage of activity data for more land use and land use change categories; improving the methodology of converting activity data to emissions and removals by the appropriate factors (e.g., adjustements of biomass expansion factors by Poland); changing the estimation methods (e.g., Hungary); frequent recalculations due to improved reporting; efforts for estimating uncertainties and improving the transparency of the reporting; and the active participation in European projects and actions aimed at improving the reporting. Several countries (e.g Hungary) indicated that additional changes are under way and will be implemented in their supplementary report under the Kyoto Protocol.

7.5.2 Source and sink categories (EU-27)

7.5.2.1 Forest land (5A; EU-27)

According to the latest submissions, EU-27 has a forest area of about 156 Million ha, 28.6 % more than EU-15's forest land. Since 1990, the new 12 MS have reported on the whole an increase of 8 % of forest area as compared to 1990, due especially to Bulgaria, Estonia, Lithuania, Latvia, Hungary and Slovenia (Figure 7.13).

Figure 7.13 The preocentual increase of the forest land area between 1990 and 2007(% compared to 1990)



In absolute terms Bulgaria reports an increase of 0.8 mn ha, Latvia of 0.6 mn ha and Poland of 0.3 mn ha. As in EU-15, category 5A contributes most to the LULUCF sector's GHG balance in the new MS, too.Subcategory 5A represents a net sink (Table 7.45, Table 7.46), of which 94,7% (in 1990) to 95,8% (in 2007) is the contribution of subcategory 5A1. The rate of removals has increased by 13% in forest land remaining forest land, but by more than two-thirds in the land converted to forest land category. Concerning the methods applied, Tier 2 and country specific methods dominate in both subcategories, and however, default data and Tier 1 are also applied.

Table 7.45 5A1 Forest Land remaining Forest Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	-278.625	-346.911	-307.833	39.079	-11%	-29.207	10%			
Bulgaria	-6.157	-6.996	-6.993	3	0%	-836	14%	T1	NS	CS
Cyprus	-120	-160	-160	0	0%	-41	34%	0,0	0,0	0,0
Czech Republic	-5.580	-4.065	-1.347	2.718	-67%	4.233	-76%	T2,	NS, PS,	CS, D
Estonia	-8.038	-8.106	-6.885	1.222	-15%	1.153	-14%	T1	CS	D
Hungary	-3.942	-4.465	-4.094	371	-8%	-153	4%	T1, T2	NS	D, CS
Latvia	-21.637	-32.458	-31.644	814	-3%	-10.007	46%	T2	NS	CS
Lithuania	-8.987	-7.539	-7.551	-12	0%	1.436	-16%	T1	NS	CS, D
Malta	-49	-49	-49	0	0%	0	0%	T1	NS	CS
Poland	-35.948	-50.835	-50.555	280	-1%	-14.607	41%	T1/T2	NS	CS/D
Romania	-35.584	-37.202	-36.229	973	-3%	-645	2%	T1, T2	NS	CS, D
Slovakia	-4.454	-2.577	-2.741	-164	6%	1.713	-38%	T2	NS	CS
Slovenia	-3.186	-4.733	-5.774	-1.041	22%	-2.589	81%	D,T2	NS, AS, Q	CS,D
EU-27	**-412.307**	**-506.098**	**-461.856**	**44.243**	**-9%**	**-49.549**	**12%**			

Table 7.46 5A2 Land converted to Forest Land: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	-23.925	-48.672	-47.289	1.382	-3%	-23.364	98%			
Bulgaria	-5	NE	NE	-	-	5	-100%	NO	NO	NO
Cyprus	0	0	0,0	-	-	0	-	NE	NE	NE
Czech Republic	-407	-414	-428	-13	3%	-20	5%	T2	NS, PS	CS, D
Estonia	NE,NO	NE,NO	NE,NO	-	-	-	-	NE	NA	NA
Hungary	-21	196	-121	-317	-162%	-100	468%	T2	NS	CS
Latvia	-23	-73	-86	-14	19%	-63	-	T2	NS	CS
Lithuania	-1.936	-1.812	-1.812	-1	0%	124	-6%	T1	NS	CS, D
Malta	NA,NO	NA,NO	NA,NO	-	-	-	-	NO	NO	NO
Poland	-2.844	-3.431	-3.577	-146	4%	-733	26%	T1/T2	NS	CS/D
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	IE,NE,NO	-519	-525	-6	1%	-525	-	T2	NS	CS
Slovenia	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	NE	NE	NE
EU-27	**-29.161**	**-54.725**	**-53.839**	**886**	**-2%**	**-24.678**	**85%**			

7.5.2.2 Cropland (5B; EU-27)

In the new 12 EC MS, cropland area (5B) decreased by 2 % since 1990. Highest decrease are in Bulgaria, of 0.9 mn ha or 21 % of 1990 cropland area; 0.4 mn ha or 37 % in Estonia, but with an increase of 0.6 mn ha or 29 % in Lithuania. Subcategory 5B1, cropland remaining cropland, is a source of GHGs in the vast majority of the countries (Table 7.47). However, reported emissions have decreased by 14% in EU-15 and 23% in EU-27 since 1990 (this figure has changed considerably from last year), which means that reported emissions decreased much more in the new MS. Similar figures (14% and 16%, respectively) apply to subcategory 5B2, land converted to cropland (Table 7.48).The methodologies are still largely based on Tier 1 in subcategory 5B1. In contrast, most new MS are unable to report on emissions from subcategory 5B2.

Table 7.47 5B1 Cropland remaining Cropland: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	27.458	24.151	23.739	-412	-2%	-3.719	-14%			
Bulgaria	-515	-396	-412	-15	4%	103	-20%	T1	NS	CS
Cyprus	0	0	0	-	-	-	-	NE	NE	NE
Czech Republic	1.089	50	55	5	10%	-1.034	-95%	T1	NS	D
Estonia	685	910	606	-304	-33%	-79	-12%	T1	CS	D
Hungary	-276	131	51	-80	-61%	327	-118%	T1	NS	D
Latvia	406	181	209	28	15%	-196	-48%	D,T2	NS	CS,D
Lithuania	93	NA,NE	NA,NE	-	-	-93	-100%	T1	NS	CS, D
Malta	-8	-10	-10	0	0%	-2	30%	T1	NS	CS
Poland	10.773	8.237	8.420	183	2%	-2.353	-22%	T1	NS	D /CS
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	3.287	1	2	1	85%	-3.285	-100%	T2	NS	D
Slovenia	NA,NE	NA,NE	NA,NE	-	-	-	-	NE	NE	NE
EU-27	**42.993**	**33.256**	**32.660**	**-596**	**-2%**	**-10.333**	**-24%**			

Table 7.48 5B2Land converted to Cropland: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	45.659	42.278	39.100	-3.178	-8%	-6.559	-14%			
Bulgaria	NE	NE	NE	-	-	-	-	NO	NO	NO
Cyprus	0	0	0	-	-	-	-	NE	NE	NE
Czech Republic	226	84	72	-12	-14%	-154	-68%	T1,T2	NS	CS, D
Estonia	921	NE	NE	-	-	-921	-100%	NE	NA	NA
Hungary	IE,NE,NO	IE,NE,NO	IE,NE,NO	-	-	-	-	---	---	---
Latvia	NE	NE	NE	-	-	-	-	NA	NA	NA
Lithuania	NA,NE	NA,NE	NA,NE	-	-	-	-	T1	NS	CS, D
Malta	NO	NO	NO	-	-	-	-	NO	NO	NO
Poland	NA,NE,NO	NA,NE,NO	NA,NE,NO	-	-	-	-	0,0	0,0	0,0
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	NE,NO	NE,NO	NE,NO	-	-	-	-	NO	NO	NO
Slovenia	NE,NO	NE,NO	NE,NO	-	-	-	-	NE	NE	NE
EU-27	**46.805**	**42.362**	**39.172**	**-3.190**	**-8%**	**-7.633**	**-16%**			

7.5.2.3 Grassland (5C; EU-27)

Grassland area decreased by 4 % compared to 1990 at new EC MS level. The highest increase of grasslands is recorded by Bulgaria (0.3 mn ha or 16%), while the highest decrease was shown by Lithuania and Poland (each with 0.6 mn ha).

Subcategory 5C1, grassland remaining grassland, is also a source of GHGs in most countries (Table 7.49). Moreover, reported emissions have increased since 1990 by roughly the same rate, 26-29% in EU-27 and EU-15. However, land conversion to grassland always means removals of carbon (Table 7.50). These removals have slightly decreased since 1990. The methodologies are largely based on Tier 1 with country specific values only in a few new MS. Of all the new MS, only three reported quantitative removal estimates for land converted to grassland.

Table 7.49 5C1Grassland remaining Grassland: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	18.021	23.206	23.336	130	1%	5.316	29%			
Bulgaria	NE,NO	NE,NO	NE,NO	-	-	-	-	NO	NO	NO
Cyprus	0	0	0	-	-	-	-	NE	NE	NE
Czech Republic	59	3	4	1	29%	-55	-93%	T1	NS	D
Estonia	67	96	97	1	2%	31	47%	T1	CS	D
Hungary	IE,NA,NE, NO	IE,NA,NE, NO	IE,NA,NE, NO	-	-	-	-	T1	NS	D
Latvia	-5	14	-39	-53	-385%	-34	719%	T1, T2	NS	CS, D
Lithuania	NA,NE	NA,NE	NA,NE	-	-	-	-	T1	NS	CS, D
Malta	NO	NO	NO	-	-	-	-	NO	NO	NO
Poland	148	131	135	4	3%	-13	-9%	0,0	0,0	0,0
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	536	NE,NO	NE,NO	-	-	-536	-100%	NO	NO	NO
Slovenia	NE,NO	NE,NO	NE,NO	-	-	-	-	NE	NE	NE
EU-27	**18.825**	**23.449**	**23.533**	**84**	**0%**	**4.709**	**25%**			

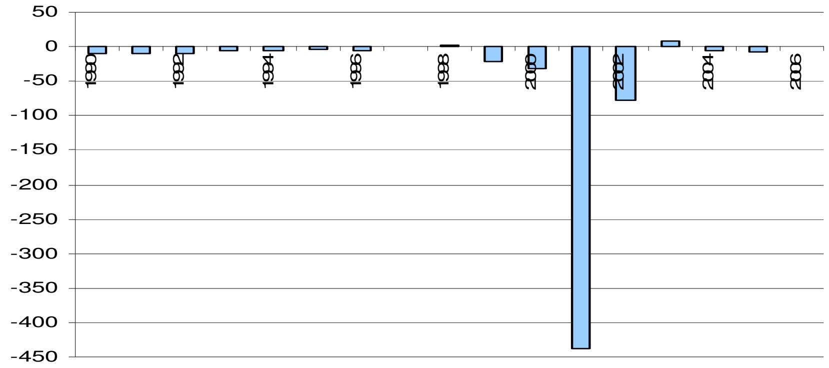
Table 7.50 5C2- Land converted to Grassland: Net CO_2 emissions of EU-27

Member State	Net CO_2 emissions (Gg)			Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007	(Gg CO_2)	(%)	(Gg CO_2)	(%)			
EU-15	-32.729	-21.726	-28.336	-6.610	30%	4.393	-13%			
Bulgaria	NE,NO	NE,NO	NE,NO	-	-	-	-	NO	NO	NO
Cyprus	0	0	0	-	-	-	-	NE	NE	NE
Czech Republic	-187	-397	-387	10	-3%	-200	107%	T1, T2	NS	CS, D
Estonia	NE,NO	-997	-1.139	-142	14%	-1.139	-	T1	CS	D
Hungary	IE,NE,NO	IE,NA,NE, NO	IE,NA,NE, NO	-	-	-	-	---	---	---
Latvia	NE	NE	NE	-	-	-	-	NA	NE	NA
Lithuania	NA,NE	NA,NE	NA,NE	-	-	-	-	T1	NS	CS, D
Malta	NO	NO	NO	-	-	-	-	NO	NO	NO
Poland	-71	NA,NE,NO	-336	-336	-	-265	375%	0,0	0,0	0,0
Romania	NA,NE	NA,NE	NA,NE	-	-	-	-	NA	NE	NA
Slovakia	NE,NO	-439	-439	0	0%	-439	-	T2	NS	D
Slovenia	NE,NO	NE,NO	NE,NO	-	-	-	-	NE	NE	NE
EU-27	**-32.986**	**-23.559**	**-30.637**	**-7.078**	**30%**	**2.349**	**-7%**			

7.5.3 Recalculations (new EC member states)

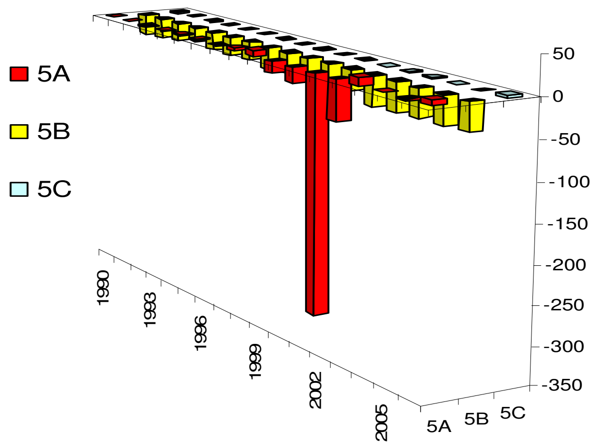
Recalculations in 2009 affected EC GHG values especially in 2001 and 2003 (Figure 7.14), mainly caused by recalculation by Estonia of category 5A.

Figure 7.14 Overall LULUCF sector recalculations for EU 12 (variation % between the 2009 and the 2008 inventory)



In 5A, after the largest influence of Estonia, the Czech Republic and Lithuania also recomputed the whole time series, showing low increases of the previous values, over the whole time series. In 5B, Bulgaria and Hungary almost halved the values previously submitted, over the whole time series since 1990, while, for Czech Republic, there is a slightly increased sink after the recalculation. In 5C, the Czech Republic slightly reduced the previous data, while most new EU MS do not report yet (figure 7.15).

Figure 7.15 Recalculations in the 5A, B, C categories for EU 12 in 2009 submission (variation % between the 2009 and the 2008 inventory)



References

Agricultural statistics, 2008 edition, Main results 2006-2007, Eurostat Pocketbooks, http://epp.eurostat.ec.europa.eu/agricultural statistics 2008

Eurostat yearbook, 2008, Europe in figures (Ed. by Schäfer G.), available at http://ec.europa.eu/eurostat

EEA Report No 3/2008, European forests - ecosystem conditions and sustainable use,

UNFCCC, Updated UNFCCC reporting guidelines on annual inventories following incorporation of the provisions of decision 14/CP.11 (document FCCC/SBSTA/2006/9)

MCFPE, 2007, EUROPE'S FORESTS 2007, available at: http://www.mcpfe.org/files/u1/publications/pdf/FE_EN.pdf

8 Waste (CRF Sector 6)

This chapter starts with an overview on emission trends in CRF Sector 6 Waste for EU-15 Member States. For each EU-15 key source, overview tables are presented including the Member States contributions to the key source in terms of level and trend, information on methodologies and emission factors. The quantitative uncertainty estimates for this sector and the sector-specific QA/QC activities are summarised in separate sections. This cchapter furthermore includes an overview of recalculations. At the end of the chapter, an overview of the sector for EU-27 is provided.

8.1 Overview of sector (EU-15)

CRF Sector 6 Waste is the fourth largest sector in the EU-15, contributing 2.6 % to total GHG emissions. Total emissions from Waste have been decreasing by 39 % from 171 Tg in 1990 to 105 Tg in 2007 (Figure 8.1). In 2007, emissions decreased by 2 % compared to 2006. The key sources in this sector are:

6 A 1 Managed Waste disposal on Land:(CH_4)
6 A 2 Unmanaged Waste Disposal Sites:(CH_4)
6 B 2 Domestic and Commercial Wastewater:(CH_4)
6 B 2 Domestic and Commercial Wastewater:(N_2O)

Figure 8.1 Sector 6 Waste: EU-15 GHG emissions 1990–2007 from CRF in CO_2 equivalents (Tg)

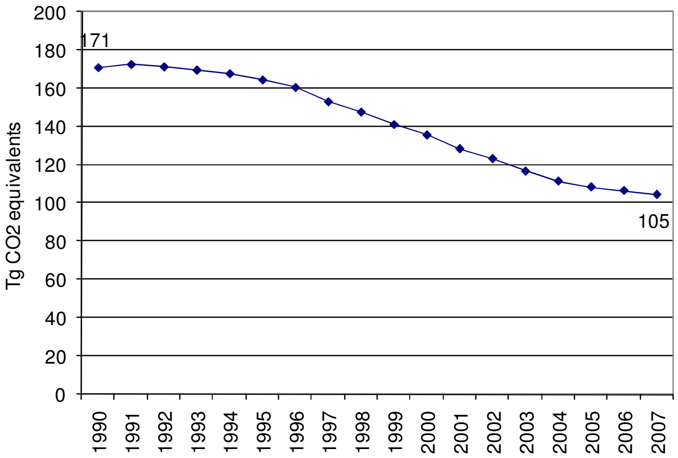
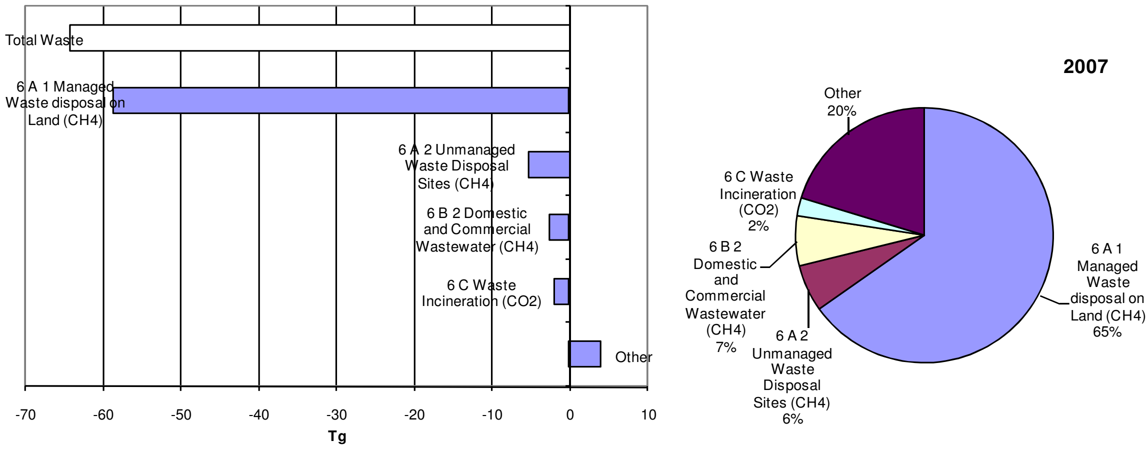


Figure 8.2 shows that CH_4 emissions from 6A1 Managed Waste Disposal on Land had the greatest decrease of all waste-related emissions, but still accounts for 65 % of waste-related GHG emissions in the EU-15 .

Figure 8.2 **Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2007 in CO_2 equivalents (Tg) and share of largest key source categories in 2007**



8.2 Source categories (EU-15)

8.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-15)

Source category 6A Solid waste disposal on land includes two key sources: CH_4 from 6A1 Managed waste disposal on land and CH_4 from 6A2 Unmanaged waste disposal on land. Methane is produced from anaerobic microbial decomposition of organic matter in solid waste disposal sites. Source category 6A1 Managed waste disposal on land includes CH_4 emission arising from managed solid waste landfills. Methane recovery can also be reflected in this category. Source category 6A2 comprises corresponding CH_4 emissions from unmanaged landfills (without methane recovery).

Table 8.1 provides total greenhouse gas and CH_4 emissions by Member State from 6A Solid Waste Disposal on Land. CH_4 emissions from this category decreased by 45 % between 1990 and 2007 in the EU-15. Eleven EU-15 Member States reduced their emissions from this source, Greece, Ireland, Italy, Portugal and Spain did not.

Table 8.1 **6A Solid Waste Disposal on Land: Member States' contributions to total GHG emissions and CH_4 emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2007 (Gg CO_2 equivalents)
Austria	3,377	1,744	3,377	1,744
Belgium	2,630	581	2,630	581
Denmark	1,335	1,063	1,335	1,063
Finland	3,645	2,061	3,645	2,061
France	7,376	5,531	7,376	5,531
Germany	35,910	8,211	35,910	8,211
Greece	1,807	2,449	1,807	2,449
Ireland	1,332	1,771	1,332	1,771
Italy	13,298	13,341	13,298	13,341
Luxembourg	48	25	48	25
Netherlands	12,011	5,260	12,011	5,260
Portugal	3,033	4,945	3,033	4,945
Spain	4,961	9,760	4,742	9,747
Sweden	2,874	1,675	2,874	1,675
United Kingdom	49,625	20,223	49,625	20,223
EU-15	**143,260**	**78,640**	**143,042**	**78,627**

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.2 provides information on emission trends of the key source CH_4 from 6A1 Managed Waste Disposal on Land by Member State. CH_4 emissions from this source account for 1.7 % of total EU-15

GHG emissions. Between 1990 and 2007, CH_4 emissions from managed landfills declined by 46 % in the EU-15. In 2007, CH_4 emissions from landfills decreased by 2 % compared to 2006. A main driving force of CH_4 emissions from managed waste disposal on land is the amount of biodegradable waste going to landfills. Total municipal waste disposal on land declined by 35 % between 1990 and 2007. In addition, CH_4 emissions from landfills are influenced by the amount of CH_4 recovered and utilised or flared. The share of CH_4 recovery increased in several EU-15 Member States.

The Member States with most emissions from this source were Germany, Spain, Italy and the UK. Nine Member States reduced their emissions between 1990 and 2007. The largest reductions in absolute terms were reported by Germany and the UK. The emission reductions are partly due to the (early) implementation of the landfill waste directive or similar legislation of the Member States. The landfill waste directive was adopted in 1999 and requires the Member States to reduce the amount of biodegradable waste disposed untreated to landfills and to install landfill gas recovery at all new sites.

Table 8.2 6A1 Managed Waste Disposal on Land:Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	3,377	1,865	1,744	2.5%	-121	-6%	-1,632	-48%	T2	NS	CS
Belgium	2,630	681	581	0.8%	-100	-15%	-2,049	-78%	CS	PS	CS
Denmark	1,335	1,081	1,063	1.5%	-18	-2%	-272	-20%	T2/CS	NS/PS	CS
Finland	2,088	1,272	1,221	1.8%	-51	-4%	-867	-42%	T2	NS	D, CS
France	4,162	4,596	4,406	6.3%	-190	-4%	244	6%	CS/ T2	NS	CS
Germany	35,910	8,988	8,211	11.8%	-777	-9%	-27,699	-77%	T2	NS	D,CS
Greece	83	761	753	1.1%	-8	-1%	670	805%	T2	NS	D, CS
Ireland	980	1,288	1,434	2.1%	146	11%	454	46%	T2	NS	D
Italy	8,697	11,934	11,721	16.8%	-213	-2%	3,024	35%	T2	NS	CS
Luxembourg	48	26	25	0.0%	-1	-2%	-23	-48%	T2	NS	D
Netherlands	12,011	5,664	5,260	7.6%	-404	-7%	-6,750	-56%	T2	AS	CS
Portugal	428	2,394	2,436	3.5%	42	2%	2,009	470%	T2	NS	CS,D
Spain	3,996	8,572	8,852	12.7%	280	3%	4,857	122%	T2	NS, Q	D, C, CS
Sweden	2,874	1,845	1,675	2.4%	-170	-9%	-1,199	-42%	T3	NS	D, CS
United Kingdom	49,625	20,261	20,223	29.1%	-38	0%	-29,403	-59%	M	AS	CS
EU-15	**128,244**	**71,227**	**69,607**	**100.0%**	**-1,620**	**-2%**	**-58,637**	**-46%**			

CH_4 emissions from 6A2 Unmanaged Waste Disposal on Land account for 0.2 % of total EU-15 GHG emissions in 2007. Between 1990 and 2007, CH_4 emissions from this source decreased by 45 % due to a decreasing amount of municipal waste going to unmanaged waste disposal sites (Table 8.3). Not all Member States reported emissions from this source. France, Italy and Greece are responsible for about 70 % of the total EU-15 emissions. France and Italy had large absolute reductions between 1990 and 2007.

Table 8.3 6A2 Unmanaged Waste Disposal on Land: Member States' contributions to CH_4 emissions and information on method applied, activity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Belgium	0	0	0	-	-	-	-	-	NA	NA	NA
Denmark	NO	NO	NO	-	-	-	-	-	0,0	Not Occuring	0,0
Finland	IE,NO	NO	NO	-	-	-	-	-	NO	NO	NO
France	3.214	1.212	1.125	17,7%	-86	-7%	-2.089	-65%	CS/ T2	NS	CS
Germany	NO	NO	NO	-	-	-	-	-	(NO)	(NO)	(NO)
Greece	1.720	1.672	1.645	25,9%	-27	-2%	-75	-4%	T2	NS	CS, D
Ireland	352	382	337	5,3%	-45	-12%	-15	-4%	T2	NS	D
Italy	4.601	1.704	1.619	25,5%	-85	-5%	-2.981	-65%	T2	NS	CS
Luxembourg	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Netherlands	NO	NO	NO	-	-	-	-	-	NA	NO	NA
Portugal	1.006	790	726	11,4%	-64	-8%	-280	-28%	T2	NS	CS,D
Spain	734	918	894	14,1%	-24	-3%	160	22%	T2	NS	D
Sweden	NO	NO	NO	-	-	-	-	-	NA	NA	NA
United Kingdom	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-15	**11.626**	**6.677**	**6.346**	**100,0%**	**-331**	**-5%**	**-5.280**	**-45%**			

Table 8.4 provides information on the contribution of Member States to EC recalculations in CH_4 from 6A Solid Waste Disposal on Land for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 8.4 6A Solid Waste Disposal on Land: Contribution of MS to EC recalculations in CH_4 for 1990 and 2006 (difference betweenlatest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	105.3	6.0	
Belgium	0.0	0.0	0.0	0.0	
Denmark	0.0	0.0	53.2	5.2	
Finland	5.7	0.2	20.3	1.0	
France	-3,737.5	-33.6	-2,947.5	-33.7	Le carbone organique dégradable (COD) a été revu sur la base de résultats de campagnes de mesure ADEME sur la composition des déchets mis en décharge.
Germany	0.0	0.0	-630.0	-6.6	
Greece	5.9	0.3	-167.6	-6.3	
Ireland	0.0	0.0	0.0	0.0	
Italy	0.0	0.0	0.0	0.0	
Luxembourg	5.2	12.2	3.1	13.7	
Netherlands	0.0	0.0	17.4	0.3	
Portugal	0.0	0.0	764.0	18.1	
Spain	543.8	13.0	1,315.8	16.1	Activita data: This recalculation is motivated by the revision of the waste disposed of in landfills. The new activity rates come from new data obtained from individual questionnaires administered to the large landfills.
Sweden	0.0	0.0	0.0	0.0	
UK	-191.2	-0.4	804.2	4.1	Method: Revision to the UK Landfill methane emissions model
EU-15	**-3,368**	**-2**	**-662**	**-1**	

8.2.2 Wastewater handling (CRF Source Category 6B) (EU-15)

Source category 6B includes two key sources: CH_4 and N_2O from 6B2 Domestic and commercial wastewater. Methane and nitrous oxide are produced from anaerobic decomposition of organic matter by bacteria in sewage facilities. N_2O may also be released from wastewater handling and human waste. Domestic and commercial wastewater includes the handling of liquid wastes and sludge from housing and commercial sources (including human waste) through wastewater collection and treatment, open pits/latrines, ponds, or discharge into surface waters. N_2O emissions from discharge of human sewage to aquatic environments are included here.

Table 8.5 shows total GHG, CH_4 and N_2O emissions by Member State from 6B Wastewater Handling. Between 1990 and 2007, CH_4 emissions from wastewater handling decreased by 19 %, N_2O emissions from wastewater handling increased by 7 %.

Table 8.5 6B Wastewater handling: Member States' contributions to total GHG, CH_4 and N_2O emissions from 6B

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CH_4 emissions in 1990 (Gg CO_2 equivalents)	CH_4 emissions in 2007 (Gg CO_2 equivalents)	N_2O emissions in 1990 (Gg CO2 equivalents)	N_2O emissions in 2007 (Gg CO2 equivalents)
Austria	210	311	102	31	108	279
Belgium	513	396	219	123	293	273
Denmark	213	303	126	256	88	47
Finland	297	234	154	133	144	101
France	1,986	2,244	789	1,239	1,197	1,005
Germany	4,450	2,447	2,226	108	2,224	2,339
Greece	2,644	735	2,319	358	325	377
Ireland	129	166	15	25	114	141
Italy	3,852	4,454	1,988	2,435	1,864	2,019
Luxembourg	15	15	6	4	9	12
Netherlands	755	659	290	203	466	456
Portugal	2,884	2,737	2,442	2,158	442	579
Spain	2,313	3,542	1,240	2,321	1,072	1,221
Sweden	195	139	IE,NE,NO	IE,NE,NO	195	139
United Kingdom	1,729	2,053	701	804	1,027	1,249
EU-15	**22,186**	**20,433**	**12,617**	**10,197**	**9,569**	**10,236**

Swedish emissions are included in 6A1
Abbreviations explained in the Chapter 'Units and abbreviations'.

CH_4 from 6B2 Domestic and Commercial Wastewater accounts for 0.2 % of total EU-15 GHG emissions. Between 1990 and 2007 emissions decreased by 27 %. Large decreases in absolute terms are reported from Germany and Greece, whereas Spain had large emission increases (Table 8.6).

Table 8.6 6B2 Domestic and commercial wastewater: Member States' contributions to CH_4 emissions and information on method applied, acitivity data and emission factor

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	102	31	31	0,5%	0	0%	-71	-69%	D	NS	D,CS
Belgium	219	127	123	1,8%	-4	-3%	-97	-44%	T1/C	PS	D/C
Denmark	126	248	256	3,8%	7	3%	130	104%	D/CS	NS	D/CS
Finland	131	106	106	1,6%	0	0%	-26	-20%	D	NS	CS, D
France	789	1.232	1.239	18,4%	7	1%	450	57%	CS/ T2	NS	CS
Germany	2.226	115	108	1,6%	-8	-7%	-2.118	-95%	CS,D	NS, CS*	CS,D
Greece	2.211	283	250	3,7%	-34	-12%	-1.962	-89%	D	NS	D
Ireland	13	19	19	0,3%	0	2%	7	51%	T1	NS	D
Italy	711	1.149	1.191	17,7%	42	4%	480	67%	D	NS	D
Luxembourg	6	4	4	0,1%	0	0%	-2	-40%	T1	NS	CS
Netherlands	190	171	176	2,6%	5	3%	-15	-8%	T2	NS	CS
Portugal	1.056	770	749	11,1%	-21	-3%	-308	-29%	D	NS	CS,D
Spain	756	1.582	1.690	25,1%	108	7%	934	124%	D	NS	D, CS
Sweden	IE,NE	IE,NE	IE,NE	-	-	-	-	-	NA	NA	NA
United Kingdom	701	801	804	11,9%	3	0%	103	15%	CS	CS	CS
EU-15	**9.238**	**6.638**	**6.745**	**100,0%**	**107**	**2%**	**-2.494**	**-27%**			

Swedish emissions are included in 6A1
Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.7 provides information on the contribution of Member States to EC recalculations in CH_4 from 6B Wastewater handling for 1990 and 2006 and main explanations for the largest recalculations in absolute terms.

Table 8.7 6B Wastewater Handling: Contribution of MS to EC recalculations in $CH_4$for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)

	1990		2006		Main explanations
	Gg	Percent	Gg	Percent	
Austria	0.0	0.0	-10.2	-24.7	
Belgium	0.0	0.0	-7.3	-5.5	
Denmark	0.0	0.0	0.0	0.0	
Finland	0.0	0.0	0.0	0.0	
France	21.4	2.8	45.8	3.9	
Germany	0.0	0.0	0.0	0.0	
Greece	0.0	0.0	-123.2	-23.7	Update of activity data
Ireland	0.0	-	0.0	-	
Italy	0.0	0.0	3.0	0.1	
Luxembourg	6.1	100,020	3.7	100,929	
Netherlands	0.0	0.0	0.0	0.0	
Portugal	0.0	0.0	433.3	23.6	
Spain	0.0	0.0	0.0	0.0	
Sweden	0.0	0.0	0.0	0.0	
UK	-8.7	-1.2	-8.9	-1.1	
EU-15	**18.9**	**0.1**	**336.1**	**3.4**	

N_2O from 6B2 Domestic and Commercial wastewater accounts for 0.2 % of total EU-15 GHG emissions. Between 1990 and 2007 emissions increased by 7 % (Table 8.8).

Table 8.8 6B2 Domestic and Commercial Wastewater: Member States' contributions to N_2O emissions and information on methd applied, activity data and emission factor

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
Austria	104	219	220	2.3%	1	0%	116	111%	CS,D	NS	CS,D
Belgium	293	272	273	2.8%	1	0%	-21	-7%	D	IS/NS	D
Denmark	88	50	47	0.5%	-3	-5%	-40	-46%	D/CS	NS	D/CS
Finland	105	79	78	0.8%	-1	-2%	-27	-26%	D	NS	CS, D
France	1,105	937	930	9.5%	-7	-1%	-175	-16%	CS/ T2	NS	CS
Germany	2,224	2,342	2,339	23.9%	-3	0%	116	5%	D	NS	CS,D
Greece	325	375	377	3.9%	2	1%	52	16%	D	NS	D
Ireland	114	138	141	1.4%	3	2%	27	24%	NE	NE	NE
Italy	1,794	1,929	1,951	20.0%	22	1%	157	9%	D	NS	D
Luxembourg	9	11	12	0.1%	0	3%	2	27%	T1	NS	CS D
Netherlands	466	444	456	4.7%	12	3%	-10	-2%	T2	NS	D
Portugal	286	354	355	3.6%	1	0%	69	24%	D	IS	D
Spain	1,072	1,187	1,221	12.5%	34	3%	149	14%	D	NS	D
Sweden	166	124	124	1.3%	0	0%	-42	-25%	CS	NS	D
United Kingdom	1,027	1,241	1,249	12.8%	8	1%	221	22%	D	CS	D
EU-15	**9,179**	**9,702**	**9,773**	**100.0%**	**71**	**1%**	**594**	**6%**			

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.9 provides information on the contribution of Member States to EC recalculations in N_2O from 6B Wastewater Handling for 1990 and 2006.

Table 8.9 **6B Wastewater Handling: Contribution of MS to EC recalculations in N_2O for 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and percent)**

	1990		2006	
	Gg	Percent	Gg	Percent
Austria	0.0	0.0	0.0	0.0
Belgium	23.2	8.6	-1.3	-0.5
Denmark	0.0	0.0	0.0	0.0
Finland	0.0	0.0	0.8	0.7
France	12.5	1.1	14.0	1.4
Germany	0.0	0.0	0.0	0.0
Greece	0.0	0.0	3.3	0.9
Ireland	0.0	0.0	0.0	0.0
Italy	0.0	0.0	0.0	0.0
Luxembourg	2.5	36.3	3.9	50.6
Netherlands	-47.7	-9.3	62.9	16.5
Portugal	0.0	0.0	-0.4	-0.1
Spain	0.0	0.0	-28.0	-2.3
Sweden	0.0	0.0	2.4	1.7
UK	-6.2	-0.6	-6.5	-0.5
EU-15	**-15.7**	**-0.2**	**51.0**	**0.5**

8.2.3 Waste incineration (CRF Source Category 6C) (EU-15)

Source category 6C Waste incineration includes one key category: CO_2 from 6C Waste Incineration. This category includes incineration of waste, not including waste-to-energy facilities. Emissions from waste burnt for energy are reported under 1A Fuel combustion activities. Emissions from burning of agricultural wastes should be reported under 4 Agriculture.

Table 8.10 and Table 8.11 summarise greenhouse gas emission trends by Member State. CO_2 emissions from waste incineration account for 0.1 % of total EU-15 GHG emissions. Between 1990 and 2007, they decreased by 45 %; France and the UK had the largest decreases in absolute terms.

Table 8.10 **6C Waste Incineration: Member States' contributions to total GHG and CO_2 emissions**

Member State	GHG emissions in 1990 (Gg CO_2 equivalents)	GHG emissions in 2007 (Gg CO_2 equivalents)	CO_2 emissions in 1990 (Gg)	CO_2 emissions in 2007 (Gg)
Austria	27	12	27	12
Belgium	253	85	253	85
Denmark	0	0	IE	IE
Finland	0	0	IE	IE
France	2,573	1,813	2,274	1,518
Germany	0	0	NO	NO
Greece	0	3	0	3
Ireland	0	0	NE	NE
Italy	785	660	537	270
Luxembourg	0	0	IE	IE
Netherlands	0	0	IE	IE
Portugal	11	2	10	1
Spain	95	10	85	4
Sweden	44	103	44	103
United Kingdom	1,389	499	1,206	448
EU-15	**5,178**	**3,188**	**4,436**	**2,445**

Emissions of Denmark are included in 1A1a.
Emissions of Finland are included in the Energy sector.
Emissions of Ireland are not reported because data for whole time series are not available.
Emissions of Luxembourg and the Netherlands are included in 1A1a.

Abbreviations explained in the Chapter 'Units and abbreviations'.

Table 8.11 6C Waste incineration: Member States' contributions to CO_2 emissions

Member State	CO_2 emissions in Gg			Share in EU15 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
Austria	27	12	12	0.5%	0	0%	-15	-54%
Belgium	253	78	85	3.5%	7	9%	-168	-66%
Denmark	IE	IE	IE	-	-	-	-	-
Finland	IE	IE	IE	-	-	-	-	-
France	2,274	1,800	1,518	62.1%	-282	-16%	-756	-33%
Germany	NO	NO	NO	-	-	-	-	-
Greece	0	2	3	0.1%	1	36%	3	-
Ireland	NE	NE	NE	-	-	-	-	-
Italy	537	267	270	11.1%	3	1%	-267	-50%
Luxembourg	IE	IE	IE	-	-	-	-	-
Netherlands	IE	IE	IE	-	-	-	-	-
Portugal	10	1	1	0.0%	0	0%	-9	-94%
Spain	85	4	4	0.2%	0	11%	-80	-95%
Sweden	44	71	103	4.2%	33	47%	59	136%
United Kingdom	1,206	430	448	18.3%	18	4%	-759	-63%
EU-15	**4,436**	**2,665**	**2,445**	**100.0%**	**-221**	**-8%**	**-1,991**	**-45%**

Emissions of Denmark are included in 1A1a.
Emissions of Finland are included in the Energy sector.
Emissions Ireland are not reported because data for whole time serie are not available.
Emissions of Luxembourg and the Netherlands are included in 1A1a.

Abbreviations explained in the Chapter 'Units and abbreviations'.

8.3 Methodological issues and uncertainties (EU-15)

The following considerations address national methods and circumstances which are available in the Member States' national inventory reports. The focus is laid on the reporting categories 6A1 CH_4 emissions from managed solid waste disposal sites and 6A2 CH_4 emissions from unmanaged solid waste disposal sites since they are EU-15 key categories and contribute 1.7 % and 0.2 % of total GHG emissions, respectively. The reporting category 6B2 CH_4 emissions from domestic and commercial wastewater, key source in the EU-15 as well, is also comprehensively analysed. Source categories 6B1, 6C and 6D are only briefly discussed.

8.3.1 Managed Solid Waste Disposal (CRF Source Category 6A1) (EU-15)

CH_4 emissions from managed solid waste disposal are key sources in all Member States, with the exception of Luxembourg. For key sources in the source category, 6A it is good practice to use the First Order Decay (FOD) method (Tier 2) to calculate the emissions and to display emissions trends over time. All EU-15 Member States applied – in line with the IPCC Good Practice Guidance – tier 2 methodologies in order to estimate CH_4 emissions from managed solid waste disposal sites, which means that 100% of all EU-15 emissions are calculated using higher tier methods (see Table 8.2). Three Member States used a country-specific emission model in accordance with the Tier 2 methodology (Denmark, United Kingdom and Belgium) and four Member States (Sweden, France, Ireland and Finland) applied country-specific methods in accordance with the Tier 2 methodology. The remaining Member States applied the tier Tier 2 methodology proposed by the IPCC Good Practice Guidance and the IPCC Guidelines. Table 8.12 summarizes the characteristics of the national methodologies for estimating CH_4 emissions from managed solid waste disposal sites.

Table 8.12 6A1 Managed Waste Disposal: Description of national methods used for estimating CH_4 emissions

Member State	Description of methods
Austria	For the calculation of emissions of solid waste disposal on land, IPCC Tier 2 method is applied. Where available, country-specific factors are used. If these were not available, IPCC defaulte values are taken.
Belgium	The methodology used to calculate the emissions from solid waste disposal on land differs between the two regions in Belgium where these sites are located (Flanders and Wallonia). In the Flemish region, a combination of two models is used: a multiphase model for the estimation of emissions of the sites which are permitted and a first order decay model for all other, old waste disposal sites which are no longer permitted to dispose, but where still emissions occur after the ban of disposal on these sites (these are the solid waste disposal sites in after-care). Walloon region: The CO_2 and CH_4 emissions from solid waste disposal on land are calculated with a first-order decay model that considers separately the emissions of industrial and municipal waste. The model, developed by the Vito, acknowledges the fact that methane is emitted over a long period of time. A first order decay model is used to take into account the various factors that influence the rate and extent of methane generation and release from landfill. The overall methodology follows the Tier 2 IPCC methodology. No waste disposal sites are located in the Brussels region.
Denmark	The CH_4 emission estimates from solid waste disposal sites (SWDSs) are based on a First Order Decay (FOD) model suited to Danish conditions and according to an IPCC Tier 2 approach.
Finland	Finland uses a IPCC Tier 2 method as a basis basis for the estimation of CH_4 emissions. However Equation 5.1 from the GPG (2000) has been slightly modified, so that the term MCF (t) has been substituted by the term MCF (x) in the calculation of the methane generation potential $L_0(x)$. Calculations are not made separately for each landfill but the total waste amount and the average common MCF value for each year have been used. It has been thought that the situation in year t defines the MCF to be used for the emissions caused by waste amounts landfilled in the previous years (and degraded later in year t) as well.
France	IPCC Tier 2 Method
Germany	IPCC Tier 2 Method
Greece	IPCC Tier 2 Method
Ireland	A modified form of the IPCC Tier 2 method was adopted as the most appropriate basis on which to assess annual CH_4 emissions where reasonable predictions could be made for decreasing waste quantities into the future. The results obtained from this revised methodology were included as an important component of the recalculations reported in the 2002 submission. The approach underlying the quantification of CH_4 from solid waste disposal uses a function to describe the CH_4 production from all contributing solid waste deposited in landfills in a particular year. This relationship is based on a two-stage first-order model for landfill gas production, incorporating a lag period of one year before CH_4 generation commences, followed by active CH_4 production over 20 years. The estimates take account of a variable allocation of wastes between well-managed landfills, where the full CH_4 potential is realised, and shallow unmanaged landfills for which 40 percent of the potential CH_4 is assumed to be emitted. To estimate annual emissions for the years 1990 to 2007, the CH_4 potential of wastes landfilled in each year from 1969 (21 years prior to 1990) is first determined. These annual CH_4 potentials are then assigned as emissions over 20 subsequent years (with an initial lag of 1 year) according to the function described and their cumulative contributions for the 20 year period give the total emissions for the end year in that period.
Italy	In order to calculate CH_4 emissions from all the landfill sites in Italy, the assumption that all the landfills started operation in the same year, and have the same parameters, has been considered, although characteristics of individual sites can vary substantially; the First Order Decay Model has been applied. Thus, the IPCC Tier 2 methodology has been followed for the emission estimation
Luxembourg	IPCC Tier 2 Method.
Netherlands	In order to calculate the CH_4 emissions from all the landfill sites in the Netherlands, the simplifying assumption was made that all the wastes are assumed to be landfilled on one landfill site, an action that started in 1945. However, characteristics of individual sites vary substantially. CH_4 emissions from this 'national landfill' are then calculated using a first-order decomposition model (first-order decay function) with an annual input of the total amounts deposited and the characteristics of the land-filled waste and the amount of landfill gas extracted. This is equivalent to the IPCC Tier 2 methodology. Since the CH_4 emissions from landfills are a key source, the present methodology is in line with the IPCC Good Practice Guidance.
Portugal	IPCC Tier 2 Method
Spain	IPCC Tier 2 Method
Sweden	IPCC Tier 2 methodology with a slightly different time factor and with some estimates on the national gas potentials. Comparison between the suggested IPCC gas potentials and Swedish estimates show that the IPCC values tend to be higher, but considering the large methodological uncertainties, which is the same in both cases, the difference should be within a reasonable interval.
United Kingdom	The UK method uses a first order decay (Tier 2) methodology based on estimates and historical data on waste quantities, composition and disposal practices over several decades. The UK method is based on Equations 4 and 5 in the Revised 1996 IPCC guidelines, which are compatible with Equations 5.1 and 5.2 in the Good Practice Guidance. A slightly modified version of Equation 5.1 is used, which takes into account the fact that the model uses a finite time interval (one year).

Source: NIR 2009

The Tier 2 FOD method requires data on current as well as historic waste quantities, composition and disposal practices for several decades. In the following section a detailed overview of the most important parameters and methodological aspects of the FOD method applied by the Member States are presented. The main factors influencing the quantity of CH_4 produced are the *amount* of waste disposed of on land and the *concentration* of biodegradable C in that waste.

Amount of waste disposed on SWDS: The FOD method requires historic data on waste generation over decades but it is difficult to achieve consistent time series for the activity data over such long periods. The data sources used for generating time series of activity data by the Member States are summarized in Table 8.13.

Table 8.13 6A1 Managed Solid Waste Disposal: Data sources used for generating time series of activity data

Member State	Data sources used for generating time series (6A1)
Austria	The quantities of "residual waste" from 1950 to 1997 were taken from national studies and the respective Bundesabfallwirtschaftsplan (Federal Waste Management Plan). However, the amount of waste from administrative facilities of industry is not considered (data from 1950 to 1999), whereas it is included in the Deponiedatenbank ("Austrian landfill database"), which is used for the activity data from 1998 onwards. Thus, to achieve a consistent time series, the two overlapping years (1998 and 1999) were examined and the difference which represents the residual waste from administrative facilities of industries and businesses calculated. The difference was then applied to the years 1950 to 1997 according to the relative change in data from residual waste from households. The quantities of "non residual waste" from 1998 to 2007 were taken from the database for solid waste disposals "Deponiedatenbank" ("Austrian landfill database"), whereas only the amount of waste with biodegradable lots was considered. There are no data available for the years before 1998. Thus extrapolation was done using the Austrian GDP (gross domestic product) per inhabitant as indicator.
Belgium	In Wallonia, the quantity of waste disposed comes from the statistics of OWD (Walloon Waste Office). It publishes each year the industrial and municipal waste disposed, based on the taxes declaration forms covering 50 solid waste disposal sites of various sizes. Those statistics are available on a yearly basis since 1994. For the years before, the amounts have been estimated using available data and OWD expert judgement assumptions. In the Flemish region the quantity of waste disposed originates from the institute responsible for waste management in Flanders (OVAM). There are no solid waste disposal sites in the Brussels Region.
Denmark	The amount of municipal solid waste deposited at solid waste disposal sites is according to official registration performed by the Danish Environmental Protection Agency in the so-called ISAG database.
Finland	Activity data for the time series is taken from different sources: The VAHTI database contains data on the total amounts of waste taken to landfills from 1997 onwards. Corresponding data for the years 1992-1996 were collected to the Landfill Registry of the Finish Environment Institute. The activity data for municipal waste for the year 1990 is based on the estimates of the Advisory Board for Waste Management (1992) for municipal solid waste generation and treatment in Finland in 1989. The disposal data (amount and composition) at the beginning of 1990s for industrial, construction and demolition waste are based on surveys and research by Statistics Finland, VTT Technical Research Centre of Finland and National Board of Waters and the Environment. Estimated data on waste amounts before the year 1990 is based on a report by VTT.
France	The amount of waste on SWDS derives from the surveys called "ITOMA" made by ADEME.
Germany	The amount of landfilled municipal waste is taken from the Federal Statistics Office (1975 – 2004). The surveys of waste quantities commenced in 1975 on the basis of the Environmental Statistics Act in 1974. Waste quantities for the period from 1950 to 1975 were extrapolated on the basis of population data. Landfilled wastes after 1 June 2005 must not, according to the legislation, contain biodegradable components and do not, therefore, contribute to the generation of landfill gas. Data for landfilled waste in the former GDR in the 1980ies were provided by a national study. According to that study the amount of landfilled waste per capita was significantly lower than in the old German Länder (190 kg/capita versus 330 kg/capita). For the years 1990 and 1993 for the new German Länder detailed data about landfilled municipal solid waste is available. Since 1996, differentiated data is available on landfilled quantities of individual fractions of industrial waste. The amount of landfilled industrial waste between 1975 and 1996 was derived on the basis of the overall amount of landfilled waste. The amount of landfilled industrial waste is kept constant between 1950 and 1975. Data on landfilled sludges from municipal and industrial wastewater treatment is available since 1975 for the Old German Länder and was extrapolated for the time period before 1975 based on population data as well as on the assumption that the amount of sludges from industrial wastewater remained constant.
Greece	Estimates on solid waste quantities generated are included in various reports from research programs and studies, but refer to specific points in time rather than to a whole period, while different assumptions have been applied in each case for the estimation of quantities generated. Therefore, data for some years are either missing or are unreliable. In the previous submission, the quantities of municipal solid wastes for the whole period 1960-2006 was estimated on the basis of population figures and coherent assumptions regarding generation rates per capita and day, in order to derive complete time series for waste quantities generated. In the current submission, similar methodology was followed for the period 1960-2000, while for the rest of the period 2001- 2007 more accurate data for the quantities of municipal solid wastes was used as they were provided by the waste management sector of the Ministry for the Environment, Physical Planning and Public Works (MINENV). In order to estimate the quantities of MSW that end up at disposal sites (managed or unmanaged), data on the recycling of paper, aluminium, metals, plastics, and glass in different regions were collected. Recycled quantities estimated, include also the part of putrescibles used for compost production. It was assumed that after the subtraction of recycled materials, the remaining quantities of municipal solid waste end up to various disposal sites (managed or unmanaged). According to the most recent data by the Ministry for the Environment, Physical Planning and Public Works, out of the various existing disposal sites, 37 fulfil the criteria set by the IPCC guidelines so as to be considered as managed. The remaining part of MSW (after the subtraction of the corresponding quantities of the recycled materials in the remaining regions) is disposed at unmanaged disposal sites.
Ireland	The waste material contributing to DOC includes MSW (household and commercial refuse) and street cleansings, as given in the National Waste Database reports together with sludges from municipal wastewater treatment that are deposited in landfills. The EPA commenced the development of the National Waste Database in the early 1990s. National statistics generated from

Member State	Data sources used for generating time series (6A1)
	this database and published on a three-year cycle, and interim reports published on a yearly basis since 2001 by the EPA, are the primary basis for establishing the historical time-series of MSW placed in landfills in Ireland. These publications provide detailed descriptions of the methods employed to compile the waste database. The results of other less comprehensive surveys undertaken in previous years (1987, 1993, and 1994) have also been used to some extent in compiling the MSW time-series.
Italy	Basic data on waste production and landfills system used for the emission inventory are those provided by the Waste Cadastre. The Waste Cadastre is formed by a national branch, hosted by ISPRA, and by regional and provincial branches. The basic information for the Cadastre is mainly represented by the data reported through the Uniform Statement Format (MUD), complemented by those provided by regional permits, provincial communications and by registrations in the national register of companies involved in waste management activities. Since 1999, ISPRA yearly publishes a report, in which waste production data, as well as data concerning landfilling, incineration, composting and generally waste life-cycle data, are reported. It has been assumed that waste landfilling started in 1950. The complete database from 1975 of waste production, waste disposal in managed and unmanaged landfills and sludge disposal in landfills is reconstructed on the basis of different sources, national legislation and regression models based on population. Since waste production data are not available before 1975, they have been reconstructed on the basis of proxy variables. Gross Domestic Product data have been collected from 1950 and a correlation function between GDP and waste production has been derived from 1975; thus, the exponential equation has been applied from 1975 back to 1950. Consequently the amount of waste disposed into landfills has been estimated, assuming that from 1975 backwards the percentage of waste landfilled is constant and equal to 80%. Apart from municipal solid waste, sludge from urban wastewater handling plants has also been considered. Sludge disposed in landfill sites has been estimated from the equivalent inhabitants treated in wastewater treatment plants, distinguished in primary and secondary plants, applying the specific per capita sludge production. The total amount of sludge per year can be treated by incineration or composting, or once digested disposed to soil for agricultural purpose or to landfills. As for the waste production, also sludge landfilled has been reconstructed from 1950. Starting from the number of wastewater treatment plants in Italy in 1950, 1960, 1970 and 1980, the equivalent inhabitants have been derived and consequently the amount of sludge disposed in landfill sites, assuming 80 kg $inhab.^{-1}$ yr^{-1} sludge production. The fraction of sludge disposed in landfill sites has been estimated to be 75% in 1990, decreasing to 55% in 2007.
Luxembourg	Activity data for managed waste disposal on land is taken from the Statistical Service of Luxembourg (STATEC).
Netherlands	The amount of waste disposed on landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly.
Portugal	Since 1999, data on MSW is available, including production amounts, final disposal and, to a less extent, waste composition. For previous years information was available from the Strategic Plan on Municipal Solid Waste which was approved by the Government in 1997. This plan includes data from annual municipal registries. Another source of information is a research study performed by Quercus. The data was based on a survey performed in 1994, which enabled the calculation of per capita generation rates for 1994, based on the amounts of waste collected and the population served by waste collection. Before 1994, data on landfill wastes had to be estimated based on expert judgment for waste generation growth rates. For the period 1960-1980 it was considered a per capita waste generation growth rate of 2.5% per year; for the following years (1980-1994) 3% per year. To take into account the fact that part of the population (rural areas) was not served by an organised waste collection and waste disposal system, values of annual production were multiplied by the percentage of population served by waste collection in each municipality. After 2000, it was assumed that all the population of the country is served by waste collecting systems. The total amount of waste disposed to SWDS was then calculated based on this estimated value minus the amounts of waste incinerated and composted.
Spain	For the calculation of emissions, the MSW quantities to consider are those deposited since 1970. In the period from 1970 to 1990, the calculation of the waste deposited at managed SWDS without biogas capture and unmanaged SWDS has been arrived at by multiplying the coefficient of MSW generation per inhabitant and day, by the population, the number of days in the year and the fraction of MSW generated that is deposited in each type of landfill. From 1990 on, the information is provided directly by the Ministry of the Environment (MMA) in the publication, "The Environment in Spain". In managed SWDS with biogas recovery, the monitoring of the waste deposited dates back to the start of activities and the information is provided via a questionnaire completed by the landfills themselves.
Sweden	Household waste: A first national survey was elaborated by EPA in 1980, similar data in 1985 and 1990 and 1994 were provided by Statistics Sweden, since 1994 an annual survey on landfilled waste is carried out by Avfall Sverige – Swedish Waste Management. Figures on sludge from wastewater treatment and garden waste are available since 1990. Industrial waste: Studies on quantities and treatment of organic waste from industry in 1993 and 1996 were carried out by the Swedish EPA. Landfilled wastewater sludge from the pulp industry (important waste fraction) was yearly documented until 2000 by the Swedish EPA. Today the sludge from the pulp industry is incinerated and composted.
United Kingdom	The estimates of historical waste disposal and composition data are based on various data sources. Until 1994 the waste arisings data are based on waste surveys in the UK using actual data combined with landfilled volume estimates, household waste composition surveys and population data to interpolate where necessary. From 1995 to 2000, data are based on a new study, which uses updated waste survey data gathered by the Environmental Agency for 1999/2000. Years between 1995 and 1998 inclusive are calculated by linear interpolation between 1994 and 1999.From 2001 the model uses a scenario of waste disposal from the Local Authority Waste Recycling and Disposal (LAWRRD) model. The LAWRRD model provides arisings for England and so the data has been scaled upwards to UK's total.

Source: NIR 2009

Some Member States explicitly describe the consistency of their time series (compare Table 8.14).

Table 8.14 6A1 Managed Solid Waste Disposal: Consistency of time series of activity data

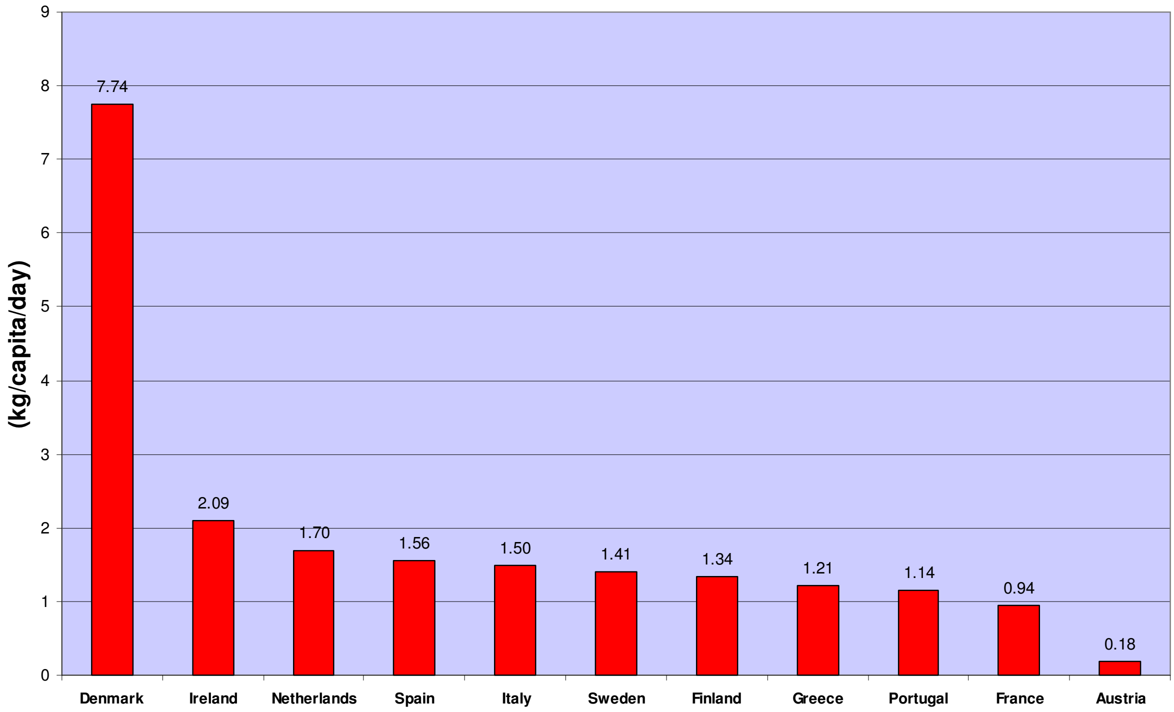
Member	Consistency of time series

State	
Austria	Concerning residual waste, to achieve a consistent time series between the data sources used before 1998 and from 1998 onwards, the two overlapping years were examined and the difference which represents the residual waste from administrative facilities of industries and businesses calculated. The difference was then applied to the years 1950 to 1997 according to the relative known change in data from residual waste from households. There is no explicit description of time series consistency for non-residual waste.
Belgium	No detailed description of time series consistency.
Denmark	Registration of the amount of waste has been carried out since the beginning of the 1990s in order to measure the effects of action plans. The activity data is, therefore, considered to be consistently long enough to make the activity data input to the FOD model reliable.
Finland	In Finland, the historical waste amount is assessed starting from the year 1900. The uncertainties in historical activity data (estimated on the basis of different weighting of the population and GDP that are assumed to be good indicators of the amount of waste) are large but the amount of waste produced at the beginning of the 1900's was fairly small, thus reducing the significance of large uncertainties. The uncertainty estimates of the current amounts of waste are based on differences between different statistics and complemented with expert judgement. In the case of municipal sludge, the uncertainties in both historical and current activity data are quite large. On the other hand, the amount of industrial waste can be fairly accurately estimated based on industrial production, and therefore these uncertainties are the smallest in historical years. In Finland, the amount of landfill gas recovered is obtained from the Finnish Biogas Plant Register, and this figure is considered accurate. An interesting note is that methane recovery describes the reduction of emissions compared with the situation where gas is emitted. In this case, the emission reduction is accurately known, though total emissions contain higher uncertainties.
France	Since 1985, ADEME ensures completeness of the surveys by providing adjustments if necessary. Surveys are not available for each year, so interpolations are made, for years 1986-1988, 1990 – 1992, 1994 and 2001. For years 1960 – 1984, consistency between 1984 and 1985 was checked to approve the times series (e-mail communication with national waste expert April 2005).
Germany	Over the long activity-data period involved, thirty years, time series inconsistencies are inevitable. In Germany, such inconsistencies are primarily a result of German reunification and the fusion of two different economic and statistical systems. Further aspects are changes of legislation and statistics in the waste sector.
Greece	No detailed description of time series consistency
Ireland	The time-series estimates given in the present submission also account for the inclusion of sewage sludge and are fully consistent over the period 1990-2007.
Italy	No detailed description of time series consistency
Luxembourg	No information available.
Netherlands	The time-series consistency of the activity data is very good due to the continuity in data provided.
Portugal	No detailed description of time series consistency.
Spain	No detailed description of time series consistency.
Sweden	The times series in the waste sector are calculated consistently, and when statistics are not produced annually, interpolation and extrapolation have been necessary tools for imputation.
UnitedKingdom	The estimates for all years have been calculated from the MELmod model and thus the methodology is consistent throughout the time series. Estimates of waste composition and quantities have been taken from different sources. This has resulted in relatively stable background trend of an annual increase of around 1 million tonnes per year. Similarly, estimates of industrial and commercial waste arising increase rapidly – from 108 million tonnes in 1995 to 169 million tonnes by 1999 (assuming a linear increase over this period). Arisings are roughly constant in the years before 1995 and after 1999; the values for 2002 are based on Environment Agency data and are assumed constant thereafter.

Source: NIR 2009.

The amount of waste disposed on SWDS depends on the one hand on the total amount of waste generated respectively on the per capita waste generation rate, Figure 8.3 provides an overview.

Figure 8.3 **6A1 Managed Waste Disposal: Waste Generation Rate**



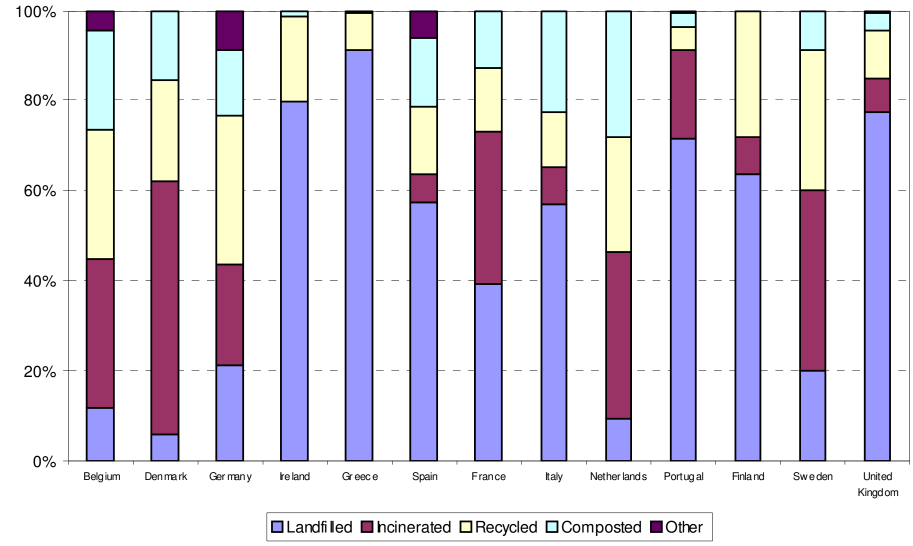
Source:CRF 2009, table 6 A, C Additional information

The waste generation rate per capita varies significantly among the Member States. Austria shows the lowest rate of 0.18 kg/capita/day, while Denmark reports the highest waste generation rate of 7.74 kg/capita/day.

In the additional information box of the CRF tables, the waste generation rate is not very well defined. No clear definition is available on which waste fractions should be included for comparability. In the case of Austria considerable amounts of composting is reported under 6D (other), which means that the composted waste amounts are excluded from 6A. For Spain large number of tourists increase the waste amounts, but are not reflected in the population numbers. It is difficult, though, to explain the differences for all Member States from the information available in the NIR. Because of the different coverage of wastes included, the waste generation rate reported does not reflect policies and measures to reduce waste generation.

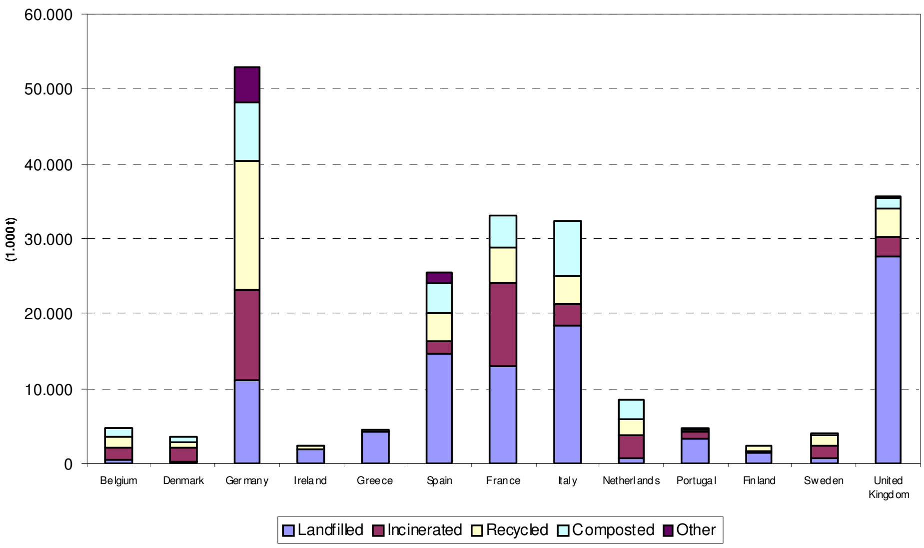
On the other hand the amount of waste generated on SWDS is strongly influenced by the waste management practices of the individual Member States: by the share of waste incinerated, recycled and composted, compare Figure 8.4 and 8.5.

Figure 8.4 6A1 Managed Waste Disposal: Waste management practices in the EU-15 (shares) in 2002



Source: EUROSTAT

Figure 8.5 6A1 Managed Waste Disposal: Waste management practices in the EU-15 (absolute values), 2002



Source: EUROSTAT

The United Kingdom, Italy, France and Spain are currently representing more than 80% of landfilling in EU-15. Many Member States experienced a reduction of waste landfilled and an increase of amounts of waste recycled, composted and increased recovery of landfill gas. Both trends have already taken place before the Landfill Directive and the Directive on packaging waste, but are further supported by these directives.

The waste management practices and policies which determine the fraction of MSW disposed to SWDS, the fraction of waste incinerated and the fraction of waste recycled differ significantly among the Member States. For example, disposing waste on SWDS is the predominant waste disposal route in Greece and Ireland with correspondingly few quantities of waste incinerated and recycled in these countries (the latter due to considerable public concern over the use of large-scale waste incineration). In Germany, Denmark and the Netherlands it is vice versa. Since 2005, landfills in Germany remaining in operation may store only waste that conforms to strict categorisation criteria. They also must reduce landfill-gas formation from such waste by more than 90% with respect to gas from untreated waste. In the Netherlands, waste policy also has the aim of reducing landfilling by introducing bans for the landfilling of certain categories of waste, e.g. the organic fraction of household waste (in the early 1990s) and by raising the landfill tariff to comply with the incineration of waste.

The amount of methane generated on SWDS depends on the Methane Correction Factor, the fraction of dissolved organic carbon (DOC) dissimilated, the fraction by volume of CH_4 in landfill gas and the waste composition, more precisely the fraction of DOC in waste. While the first three parameters do not vary strongly among the Member States, more information is provided on the DOC (Figure 8.6 and Table 8.16) as well on waste composition of land filled waste (Table 8.15). The latter parameters are again strongly influenced by waste management practices and policies.

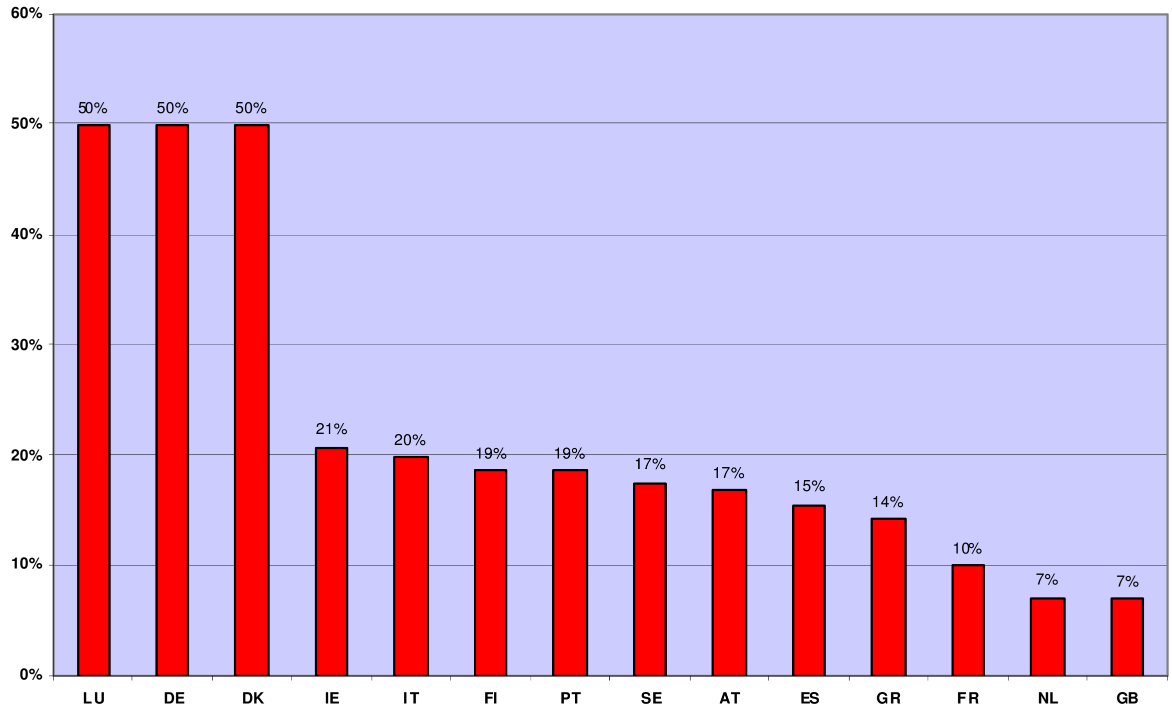
Table 8.15 6A1 Managed Solid Waste Disposal: Waste composition of landfilled waste

Member State	Composition of landfilled waste
Austria	Landfilled waste is differentiated in "residual waste" and ""non residual waste" (bulky waste, construction, mixed industrial waste, road sweeping, sewage sludge, rakings, residual matter from waste treatment). Detailed values such as for the half life period, DOC, and DOC_F are available for these waste types. The composition of residual waste is specified according to different waste fractions (such as paper, glass, or plastics).
Belgium	Waste types are differentiated into municipal and industrial categories as well as into several sub categories. Several values for DOC, DOC_F and k are given.
Denmark	The following waste types are taken into consideration: Domestic waste, bulky waste, garden waste, commercial & office waste, industrial waste, building & construction waste, sludge, ash & slag. As material fraction the following types are differentiated: Waste food, cardboard, paper, wet cardboard and paper, plastics, other combustibles, glass and other non-combustibles.
Finland	Solid municipal waste, municipal sludge, industrial sludge, solid industrial waste, construction and demolition waste, industrial and municipal inert waste, and other inert waste are considered as waste groups. These groups are further split into several subgroups. Detailed DOC values are provided in the NIR.
France	Composition of landfilled waste is not mentioned explicitly in the NIR 2009. According to the surveys of ADEME for year 2000, landfilled waste is composed of: "green waste" 0.4%, household waste 42.2% (paper 25%, food and garden waste 29%, plastics,11%, glass 13%, other inert 22%), standard industrial waste 29.1%, waste similar to household waste 4.7%, secondary waste and other (inert) 23% (e-mail communication with national waste expert April 2005).
Germany	Several studies on the waste composition were evaluated. The analysis for the Old German Länder was performed for different waste types: household waste (organic material, paper/cardboard, composites, textiles, diapers, and wood), commercial waste, and bulky waste (organic material, paper/cardboard, textiles, and wood). For the former GDR waste fractions were taken from a study. According to that study, household waste in the GDR was composed of vegetable waste, paper/cardboard, wood, rubber, composites as well as textiles.
Greece	The composition of generated MSW comprises the following fractions: Putrescibles, textiles, wood, paper, plastics, metals, glass, and rest.
Ireland	Waste constituents of MSW that contribute to DOC are organics, paper, textiles and in the category other (fine elements, unclassified materials and wood wastes). Furthermore, street cleansings and sludge from municipal wastewater treatment are considered.
Italy	An in-depth survey has been carried out, in order to diversify waste composition over the years. Three slots (1950 – 1970; 1971 – 1990; 1991 – 2007) have been individuated to which different waste composition has been assigned. On the basis of data available on waste composition, the moisture content, the organic carbon content and the fraction of biodegradable organic carbon for each waste stream, the DOC contents and the methane generation potential values (L_0) have been generated. On the basis of the waste composition, waste stream have been categorized in three main types: rapidly biodegradable waste, moderately biodegradable waste and slowly biodegradable waste. The following waste fractions are considered: food waste, sewage sludge, garden and park waste, paper and paperboard, textiles and leather, and wood.
Luxembourg	No information available.
Netherlands	An average DOC value for waste as a whole is provided as a time series in the NIR.
Portugal	SWDS include solid municipal or urban waste (household, garden, commercial-services wastes) and industrial wastes. For the fermentable fractions of urban waste the following categories apply: paper and textiles, non-food fermentable materials, food waste, and wood or straw. For industrial waste several groups exist: paper and textiles, garden waste, park waste or other non-food organic putrescibles, food waste, wood or straw, fuels, plastics, sludge from natural origin, sludge from non-natural origin or hydrocarbons, synthetic fibres, and non-natural organic substances.
Spain	The composition of municipal solid waste comprises the following categories: organic matter, paper and cardboard, plastics, glass, ferrous metals, non-ferrous metals, wood, textiles, rubber and latex, disposable and rechargeable batteries, other. For waste from origins other than direct household collection, other categories apply: compost plant refuse, waste water sludge and others.
Sweden	Landfilled waste includes includes household and similar waste, park and garden waste, industry- and non-industry specific waste (organic fractions), industry- and non-industry specific waste (organic and inorganic fractions), construction and demolition waste (organic and inorganic fractions) and sludge from wastewater handling and pulp industry..Deposited waste is further broken down into different waste fractions for household and industrial wastes.
United Kingdom	The UK method divides the waste stream into four categories of waste: rapidly degrading, moderately degrading, slowly degrading, and inert. As recommended in the Good Practice Guidance, the estimates of waste disposal quantities include commercial and industrial waste, demolition and construction waste, sewage sludge disposal to landfill as well as municipal waste.

Source: NIR 2009

Fraction of Dissolved Organic Carbon (DOC) in MSW: The DOC content of landfill waste is based on the composition of waste and can be calculated from a weighted average of the carbon content of various components of the waste stream. Different countries are known to have MSW with widely differing waste compositions. While the average DOC value in MSW are illustrated in Figure 8.6, Table 8.16 provides corresponding detailed information on the DOC values extracted from the NIR.

Figure 8.6 6A1 Managed Solid Waste Disposal: Fraction of DOC in MSW



Source: CRF 2008 Table 6A,C Additional information.

Table 8.16 6A1 Managed Solid Waste Disposal: Further information on DOC values

Member State	**Further information on DOC values**
Austria	Detailed values for DOC_F and DOC differentiated with respect to the waste type are available in the NIR. A time series of bio-degradable organic carbon content of directly deposited residual waste is indicated for the years 1950 to 2007.
Belgium	For the Walloon region, the data are classified according to 12 main categories (119 subcategories), thus allowing an accurate calculation of the amounts of waste and its degradable organic carbon content (IPCC Good Practice Guidance, which are used as an input in the model. Those statistics are available on a yearly basis since 1994. For the years before, the amounts have been estimated using available data and OWD expert judgment assumptions. The DOC value for municipal waste lies in the default value range from IPCC revised 1996 Guidelines. The value for industrial waste was estimated calculated using the detailed waste types from OWD and the IPCC Good Practice Guidance methodology.
Denmark	For the following categories, investigations of DOC content have been carried out for Danish conditions: waste food, cardboard, paper, wet cardboard and paper, plastics, other combustibles, glass, other non-combustible.
Finland	DOC fractions of different types of waste are based on the IPCC default values and national research data. DOC values of groups (solid municipal waste, municipal and industrial sludge (from dry matter), solid industrial waste, construction and demolition waste, industrial inert waste, and other inert waste) and of subgroups are provided in the NIR.
France	The OMINEA report (February 2008) fixes a DOC of 150 kg/t. In the CRF a DOC value of 0.10 is reported.
Germany	Both national and IPCC default factors were used for the DOC. The following values were chosen: Organic material: 18%, garden and park waste: 20%, paper and cardboard: 40%, wood and straw: 43%, textiles: 24%, diapers: 24%, composites: 10%, sludges from wastewater treatment: 50%
Greece	Time series of total amounts of DOC for waste on managed and unmanaged waste disposal sites as well as of sludge are provided. Degradable organic carbon (DOC): 0.4 for paper and textiles (default value), 0.3 for wood (default value), 0.15 for food waste (default value) and 0.4 for sewage sludge.
Ireland	IPCC DOC default values are used for organics (0.15), paper (0.40) and textiles (0.40). Country-specific values for street cleansings (0.25) and the category other (0.15) are indicated. The DOC contribution of sludge is determined from information on the BOD content, the BOD removal rate and the proportion of sludge disposed to landfill.
Italy	On the basis of data available on waste composition, the moisture content, the organic carbon content and the fraction of biodegradable organic carbon for each waste stream, the DOC contents and the methane generation potential values (L_0) have been generated.
Luxembourg	No information available.

Member State	Further information on DOC values
Netherlands	The change in DOC values over time is due to such factors as the prohibition of landfilling of combustible wastes.
Portugal	The estimation of DOC for urban waste is based on information on the waste composition from several sources. Figures are presented for IPCC categories A, B, C and D. Furthermore, DOC values are available for the different groups of industrial waste.
Spain	The degradable organic carbon content in MSW is obtained by applying equation 5.4 of the IPCC Good Practice Guidance to the data on the standard composition information derived from the data evaluated in the corresponding questionnaires provided by landfills that perform biogas capture as well as the information on the national mean standard composition from the remaining landfills that is provided by the publication "The Environment in Spain". For waste from origins other than direct household collection, specific values of the DOC parameter have been used: compost plant refuse (0.09), waste water sludge (0.18) and others (0.05).
Sweden	IPCC values for gas potentials are used for the different fractions of household waste, as well as garden waste. Values for the gas potential are available for different types of organic industrial waste.
United Kingdom	DOC was estimated assuming that the DOC arises solely from the cellulose and hemi-cellulose content of the waste. Cellulose and hemicellulose make up approximately 91% of the degradable fraction, whilst other potential degradable fractions which may have a small contribution (such as proteins and lipids) are ignored. The proportion of cellulose and hemi-cellulose in each waste component and the degradability of these fractions were based on a study. Each waste component (paper, food, etc) was assigned a DOC value based on the cellulose and hemi-cellulose content. The component was then split into four fractions: rapidly degrading, moderately degrading, slowly degrading and inert, each of which was assigned the appropriate degradation rate. For example, paper was taken to be 25% moderately degrading and 75% slowly degrading. The DOC value, applied to both components, was assumed to be equal to the percentage by weight of cellulose and hemi-cellulose multiplied by a factor of 72/162 (to account for the carbon content). This was around 22% for household paper waste.

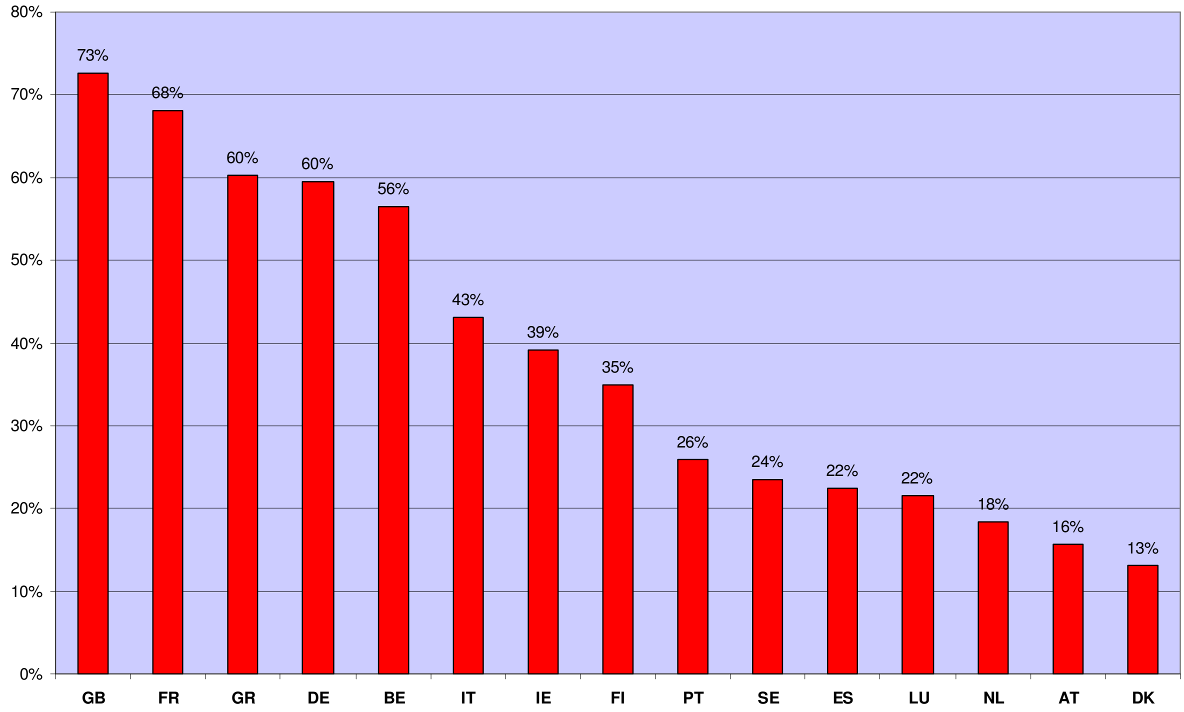
Source: NIR 2009,, CRF 2009,Table 6A,C Additional information

Figure 8.6 presents an average DOC, however usually different DOC values for individual waste fractions are used. In the case of the United Kingdom, a national model is based on a country-specific method, in which the DOC value is based on cellulose and hemi-cellulose content for each waste component and degradability. These values may lack comparability with other countries. For Austria composting of biodegradable waste is reported separately. Consequently considerable amounts of waste with high DOC are excluded from category 6A which results in a lower DOC for the remaining MSW. In Italy, DOC values are based on different national studies. In addition the DOC reflects the considerable reductions achieved in diverting biodegradable waste to other waste management methods such as composting or mechanical-biological treatment.

Besides lower quantities of organic carbon deposited into landfills, the major determining factor for the decrease in net CH_4 emissions are increasing methane recovery rates from landfills.

Methane recovery: The recovered CH_4 is the amount of CH_4 that is captured for flaring or energy use and is a country-specific value which has significant influence on the emission level. The percentage of CH_4 recovered, compare Figure 8.7, varies among the Member States between 13% in Denmark and 73% in the United Kingdom and depends on the share of solid waste disposal sites that are able to recover CH_4 (see Table 8.17).

Figure 8.7 6A1 Managed Solid Waste Disposal: Methane recovery



*CH_4 recovery in% = CH_4recovery in Gg/ (CH_4 recovery in Gg + CH_4 emissions in Gg)*100*
Source: CRF 2009 Table 6A,C

Table 8.17 6A1 Managed Solid Waste Disposal: Further information on methane recovery

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
Austria		Excavated-soil landfills: 377 Construction-waste landfills: 87 Residual waste/treated waste landfills: 31 Mass waste landfills: 53	In 2004, the Umweltbundesamt investigated the amount of annual collected landfill gas by questionnaires sent to landfill operators. In 2008, a further study was conducted again sending questionnaires to landfill operators. These new data led to new updated values for the years 2002 to 2006.
Belgium	12 (Wallonia, 2002)		For Wallonia, each year all the landfills with CH_4 recovery (12 in 2002) are contacted to collect data on the amount and CH_4 content of the biogas recovered (for flaring or energy purposes). The CH_4 content is measured by landfill owners as it determines the possible use of the biogas (only "rich" biogas" is used in engines, the rest is flared). Following a 1997 legal decree, a contract with a research institution also organises a close monitoring of the environmental impacts of the Solid Waste Disposal Sites on Air, Water and Health. Seven main sites are monitored for the time being and the report includes biogas analysis. Methane recovery takes place in the Flemish region from 1994 on. Recovery data of the Flemish waste disposal sites are included for the first time in the 2009 submission.
Denmark	26 (2003)	134 (2001)	Data for landfill gas plants are reported according to Energy Statistics from the Danish Energy Authority.
Finland	33		Data on landfill gas recovery are obtained from Finnish Biogas Plant Register.
France	93%		93% of the solid waste disposal is landfilled on SWDS with biogas capturing.
Germany	95%	150	For 2004, it was assumed that methane is captured on 95% of all landfills and that the corresponding capturing efficiency is 60%. The Federal Statistical Agency will consider landfill gas recovery in its survey for the next years, which allows taking the value for methane recovery from data of individual plants.
Greece	4		According to data from the Ministry for Environment, recovery and flaring of biogas constitute management practices in the 4 major managed SWDS of Greece (in the cities of Athens, Patra, Thessalonica and Larissa). For 3 of these sites (in Patra, Thessalonica and Larissa) the collection of data on the amount of biogas flared has not been possible yet. The estimation of biogas recovered in these sites was based on the assumption that for technical reasons, 60% of biogas released is finally recovered and flared. Detailed

Member State	Number of SWDS recovering CH_4	Total number of SWDS	Further information on methane recovery
			measurements data have been collected only for the SWDS of Athens, in which almost 50% of total waste going to managed sites is disposed. The quantities of waste disposed in the 3 sites for which the CH_4 recovery is based on assumptions, the volume of biogas flared in the SWDS of Athens and methane that is totally recovered, are presented. For the estimation of methane recovered in the SWDS of Athens, the fraction of methane in landfill gas (F) was calculated at 0.5 and methane density at 0.7 kg CH_4/m^3, based on the data collected
Ireland			Based on annual reports on renewable energy use using a top-down analysis, the amount of CH_4 captured for energy use is estimated from the reported electricity production from this source in the national energy balance, assuming assigned percentage conversion efficiency factors. Furthermore, bottom-up estimates on CH_4 utilized and flared from 65 individual landfills that were producing CH_4 in appreciable quantities are available.
Italy		269	Landfill gas recovered data have been reconstructed on the basis of information on extraction plants and electricity production.
Luxembourg	No information available.	No information available.	No information available.
Netherlands	51	24 operating, few thousand old sites which still are reactive	The amount of waste disposed on landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. The data can be found in the Internet; a corresponding documentation is also available, which contains the amount of methane recovered from landfill sites yearly.
Portugal			Data on landfill gas recovered refer to the amounts of biogas consumed in electrical production in landfill systems. This information is collected annually by DGEG (annual inquiry), together with data on electric energy produced and sold, typology of equipments, etc. The quantities of biogas that are reported in Nm^3 where converted into CH_4 amounts, considering a density of 0.72 kg/m^3 and a percentage of 60% of CH_4 in biogas. Concerning uncontrolled dumping sites, it was considered that there is gas burning when a dumping site has been closed and is associated with a managed landfill having recovery of CH_4. For industrial waste, data on quantities of CH_4 recovered and combusted were considered jointly with urban waste, as all industrial waste was considered to be disposed together with urban waste in SWDS.
Spain	33		33 landfills in Spain have landfill gas recovery systems. Landfill gas is partly flared, partly utilized for energy purposes.
Sweden	70	140	Information on recovered gas (in energy units) is provided by Avfall Sverige and converted to use quantities by Statistic Sweden.
UnitedKingdom			The fraction of methane recovered was derived from a survey of statistics on gas use for power generation, and a survey of installed flare capacity. Flares (other than those used to back up power generation, which are assumed to operate only when needed) are taken to have a load factor of 85% (i.e. 15% downtime), and 7% of the flares are assumed to be replaced every year, so that the flare lifetime is 15 years. This approach was taken because suitable metering data were not available. In 2005, the estimates were that 32% of generated methane was utilised and 38% was flared.

Source: NIR 2009.

CH_4 recovery in EU-15 amounts to 57 % of generated CH_4. Methane recovery is further enhanced by the Landfill Directive, and monitoring programmes will need to be established. The recovery potential depends on the waste management strategies, e.g. diverting organic fractions to composting leaves more inert materials on landfills and reduces the potentials to recover and use CH_4 (as in the case of the Netherlands, Austria or Denmark).

Moreover, Member States use different methods to determine CH_4 recovery. Belgium, Finland, Ireland, the Netherlands and Spain use measured plant-specific data. In Austria, Italy, Portugal and the United Kingdom surveys are carried out. Denmark, Ireland and Sweden take the corresponding data from their energy statistics. France and Germany use general assumptions concerning the methane recovery.

Industrial waste: Data on industrial waste may be difficult to obtain in many countries. DOC default values for industrial waste are not provided by the IPCC. Table 8.18 illustrates how industrial waste is considered in the individual Member States. Five Member States do not consider industrial waste in the NIR.

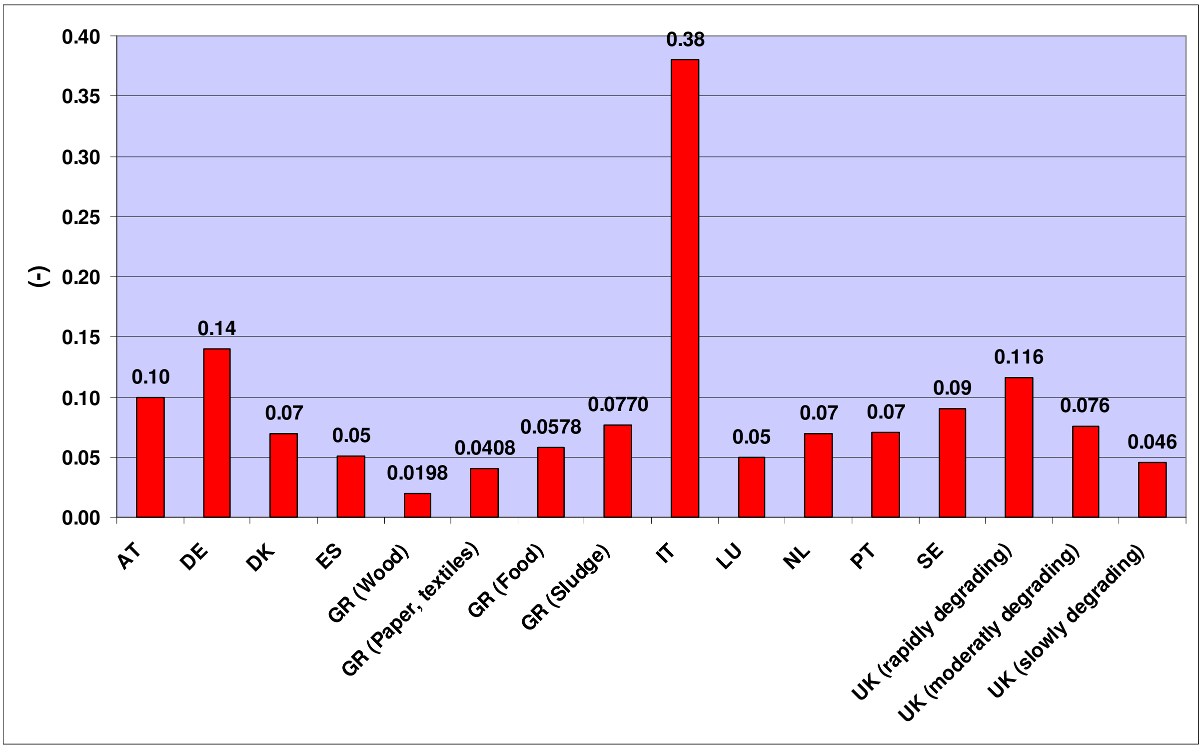
Table 8.18 6A1 Managed Solid Waste Disposal: Methodological issues regarding industrial waste

Member State	Industrial waste
Austria	"Mixed industrial waste" is considered under "non residual waste". Several waste types with their respective waste identification numbers are described. These are not clearly referenced as industrial wastes, though.
Belgium	Emissions from industrial waste are calculated with the same model as municipal waste. The DOC value for industrial waste was estimated calculated using the detailed waste types from OWD and the IPCC Good Practice Guidance methodology. This detailed estimation led to a complete recalculation, as the new estimated DOC values were much lower than the default value previously used.
Denmark	Industrial waste is considered and data on its composition and amount deposited are used in the emission model.
Finland	Industrial solid waste and industrial sludge as well as industrial inert waste are considered as waste types. Activity data and several DOC values are provided in the NIR.
France	Industrial waste is neither mentioned nor considered explicitly.
Germany	The Federal Statistical Office provides detailed data about landfilling of industrial waste since 1996. In the inventory, waste quantities from the following industry branches are considered: wastes from agriculture, horticulture, forestry, fishery and food processing, wastes from wood processing, wastes from the production of cellulose, paper and cardboard, wastes from the textiles industry, packaging wastes as well as the wood fraction from construction and demolition wastes.
Greece	Industrial waste is neither mentioned nor considered explicitly.
Ireland	Industrial waste is mentioned, but not considered explicitly.
Italy	Industrial waste is neither mentioned nor considered explicitly.
Luxembourg	Industrial waste is neither mentioned nor considered explicitly.
Netherlands	Industrial waste is neither mentioned nor considered explicitly.
Portugal	The fermentable part of industrial waste is considered. Historical time series are based on 1999 data which refer to annual registries relating to industrial unit declarations sent to the regional environment directorates which have been estimated on expert judgment. For the period 1960-1990 it was considered a growth rate of 1.5% per year; for the following years (1990-1998) 2% per year. Data for the years 2000, 2002 and 2003 refer to annual registries. The years 2001, 2004 and 2005 are also estimates based on interpolation (2001) and last available data (2004-07 refer to 2003 data). All industrial waste generated was considered to be disposed in SWDS together with urban waste. However, as there is no available information concerning final industrial waste disposal, it was assumed that all estimated waste produced has followed the urban disposal pattern between uncontrolled and controlled SWDS. Except for DOC, the same parameters are used for industrial waste as for municipal waste.
Spain	Industrial waste is not mentioned. Construction wastes have been excluded from the total quantity of waste landfilled.
Sweden	Detailed description available in the NIR of how activity data and emissions of relevant industrial wastes and sludges are generated.
United Kingdom	The estimates of waste disposal quantities include industrial waste. Waste quantities are obtained from studies, surveys, and models.

Source: NIR 2009

Methane generation rate constant: CH_4 is emitted on SWDS over a long period of time rather than instantaneously. The tier 2 FOD model can be used to model landfill gas generation rate curves for individual landfill over time. One important parameter is the methane generation rate constant. It is determined by a large number of factors associated with the composition of waste and the conditions at the site. Rapid rates which are associated with a high moisture content and rapidly degradable material can be found for example in part of the waste in Finland, France and Italy. Figure 8.8 provides some CH_4 generation rate constants reported by the Member States, while Table 8.19 summarizes information on the applied country specific approach.

Figure 8.8 6A1 Managed Solid Waste Disposal: Methane generation rate constant



Source: CRF 2009, Table 6 A,C Additional information, NIR 2009, OMINEA 2008 (France)

Table 8.19 6A1 Managed Solid Waste Disposal: Further information on the methane generation rate constant

Member State	Information on the half-time respectively the methane generation rate constant
Austria	Several values for the half life period of different waste types (residual waste, wood, paper, sludges, bulky waste and other waste, bio waste, textiles, construction waste and fats) are presented.
Belgium	Several values for the biodegradation rate are given.
Denmark	Assumption is that the half-life of the carbon in the waste is 10 years.
Finland	Methane generation rate constants are divided into four categories: k1= 0.185 for wastewater sludges and food waste, k2=0.03 for wood waste and de-inking sludge, k3=0.1 paper waste and textile waste, and k4=0.06 for garden waste, napkins, fibre and coating sludges.
France	In the OMINEA report (February 2008) three values are provided: k1=0.5 for 15 % of the waste, k2=0.1 for 55 % of the waste and k3=0.04 for 30 % of the waste.
Germany	Several values for the half life are provided (years): food waste: 4, garden and park waste: 7, paper and cardboard: 12, wood: 23, textiles/diapers: 12, composites: 12, sludges from wastewater treatment: 4.
Greece	The estimation of k is determined by the conditions in the disposal sites (e.g. moisture content, temperature, soil type) and by the composition of waste landfilled. Considering the fact that climate in Greece is dry temperate (the ratio of mean annual precipitation to potential evapotranspiration is around 0.5), half life was estimated at 17 years for paper and textiles, 35 for wood, 12 years for food waste and 9 years for sewage sludge disposed on land. This corresponds to the following values: k1=0.0408 (paper, textiles), k2=0.0578 (food), k3=0.0198 (wood) and k4=0.077 (sludge).
Ireland	A time-dependent rate of release of CH_4 is provided in the NIR. The emissions in a particular year are simply the cumulative contribution for that year arising from managed landfills and from unmanaged landfills separately over the period of 21 years that ends in the year concerned.
Italy	The methane generation rate constant k in the FOD method is related to the time taken for DOC in waste to decay to half its initial mass (the 'half life' or t½). The maximum value of k applicable to any single SWDS is determined by a large number of factors associated with the composition of the waste and the conditions at the site. The most rapid rates are associated with high moisture conditions and rapidly degradable material such as food waste. The slowest decay rates are associated with dry site conditions and slowly degradable waste such as wood or paper. Thus, for each rapidly, moderately and slowly biodegradable fraction, a different maximum methane generation rate constant has been assigned. National half-life values are suggested in a study. Accordingly, waste streams have been categorized in three main types: rapidly biodegradable waste (food waste, sewage sludge, k1=0.69), moderately biodegradable waste (garden and park waste, k2=0.14) and slowly biodegradable waste (paper and paperboard, textile and leather, wood and straw, k=0.05). Methane emissions have been estimated separately for each mentioned biodegradable class and the results have been consequently added up. The weighted average CH_4 methane generation constant of the three different values corresponding to each waste category is k=0.38.
Luxembourg	No information available.
Netherlands	Methane generation rate constant: 0.094 up to and including 1989, decreasing to 0.0693 in 1995 and constant thereafter, this corresponds to half-life times of 7.4 and 10 years, respectively. The change in k-values is caused by

Member State	Information on the half-time respectively the methane generation rate constant
	a sharp increase in the recycling of vegetable, fruit and garden waste in the early 1990s.
Portugal	The value of CH_4 generation rate constant (k) depends on several factors as the composition of the waste and the conditions of the SWDS. In the absence of national studies to determine this parameter, and following the recommendations of the in-depth review, the values used in the previous submissions were revised in order to apply the guidance from IPCC 2000. The k value considered was 0.07 (half life of about 10 years), which represents a higher decay rate compared to the k default value proposed by the IPCC 2000 (0.05 - half life of about 14 years).
Spain	The constant rate of methane generation takes the value recommended by the IPCC Good Practice Guidance (0.05) with the exception of three managed landfills whose fraction is 0.07, 0.043 and 0.049, respectively.
Sweden	National value for half-life time of 7.5 years.
United Kingdom	The UK method divides the waste stream into four categories of waste: rapidly degrading, moderately degrading, slowly degrading, and inert. These categories each have a separate decay rate. They range from 0.046 (slowly degrading waste) to 0.076 (moderately degrading waste) to 0.116 (rapidly degrading waste), within the range of 0.030 to 0.200 quoted in the Good Practice Guidance.

Source: NIR 2009,, CRF 2009 Table 6 A,C Additional information, OMINEA 2008 (France)

Concerning the magnitude of the methane generation factor, Italy explains its high weighted average degradation rate with high moisture contents. The weighted averages of k should reflect the waste composition as well as the moisture content or average temperatures. In general, a comparison is difficult since many parameters have influence on the average value.

8.3.2 Unmanaged Solid Waste Disposal (CRF Source Category 6A2) (EU-15)

CH_4 emissions from unmanaged solid waste disposal were reported in only six Member States in 2009 (France, Greece, Ireland, Italy, Portugal and Spain). Three of these six Member States (Spain, Greece and Ireland) still dispose MSW to unmanaged SWDS, compare column 'Annual MSW to unmanaged SWDS' in Table 8.20, while in France, Italy and Portugal waste disposals from the past still emits (see Table 8.3). 100% of all EU-15 emissions from this category are calculated using higher tier methods. The Methane Correction Factor (MCF) reflects the way in which MSW is managed and the effect of management practices on CH_4 generation. According to the Revised 1996 IPCC Guidelines, the MCF for unmanaged disposal of solid waste depends of the type of site – shallow, deep or uncategorized. Table 8.20 gives an overview of the MCF applied the relevant Member States.

Table 8.20 6A2 Unmanaged Solid Waste Disposal: Selected parameters for calculating emissions from source category 6A2

Member State	Emissions reported from unmanaged SWDS	Annual MSW to unmanaged SWDS (Gg)	MCF CH_4		
			Unmanaged SWDS	Deep	Shallow
France	X	0.00	0.50	IE	0.50
Greece	X	1,280.36	0.60	0.60	IE
Ireland	X	508.47	0.40	NA	0.40
Italy	X	NO	0.60	NO	0.60
Portugal	X	NO	0.60	IE	0.60
Spain	X	593.69	0.60	0.80	0.40

Source: CRF 2009 table 6 and 6A,C

Table 8.21 6A2 Unmanaged Solid Waste Disposal: Further information

Member States	Unmanaged waste disposal on SWDS
France	The difference between managed and unmanaged MSWD is only if MSWD use compacting or not (e-mail communication with national waste expert April 2005). No further information given.
Greece	Out of the various existing disposal sites, it is estimated that 37 of them fulfill the criteria set by the IPCC guidelines so as to be considered as managed. The remaining waste is disposed at unmanaged disposal sites. Time series of DOC and MSW quantities disposed on unmanaged SWDS are given for 1960-2007. Unmanaged wastes are considered to be landfilled in sites of similar characteristics concerning their composition and management (depth of sites), while the starting year of disposal and degradation of total unmanaged waste is assumed to be 1960. A large number of unmanaged SWDS exists: in 1987 and for a number of about 6000 local authorities, almost 4690 unmanaged SWDS were registered. According to the Ministry for Environment, 2182 unmanaged SWDS were still operating in 2000. Following the National and Regional

Member States	Unmanaged waste disposal on SWDS
	Planning of Solid Waste Management (compiled in the end of 2003), the process of closure and rehabilitation of unmanaged sites is in progress and is expected to be completed in 2010, along with the construction of managed SWDS, following to the standards set by the EU directives, in order to cover the needs of the country.
Ireland	In the period 1990-1995, 40% of DOC is assigned a MCF of 0.4, on the assumption that 40 percent of MSW is placed in unmanaged SWDS of less than 5 m depth. The MSW split between managed and unmanaged sites in 1969 is taken to be the reverse of that adopted for the years 1990-1995 and an appropriate adjustment is made for the intervening years and for the years after 1995 to reflect a gradual increase for managed landfills. The MSW split adopted for 2007 is 0.97 for managed sites and 0.03 for unmanaged sites on the basis that over the coming years all landfills in Ireland will be classified in the managed category as defined by the IPCC.
Italy	From 2000, municipal solid wastes are disposed only into managed landfills, due to the enforcement of regulations. The share of waste disposed of into uncontrolled landfills has gradually decreased thanks to the enforcement of new regulations, and in the year 2000 it has been assumed equal to 0; emissions still occur due to the waste disposed in the past years. The unmanaged sites have been considered shallow.
Portugal	The share of final disposal destiny (inter alia uncontrolled dumping sites) for the first years of the time series was calculated having as a basis the Quercus survey. Data for recent years (mainly since 1999) refer to data collected from management systems. There have been significant efforts at national level to deactivate and close all uncontrolled dumping sites. This effort was concluded in 2002 when all uncontrolled dumping sites had been closed. Concerning uncontrolled dumping sites, it was considered that there is gas burning when a dumping site has been closed and is associated with a managed landfill having recovery of CH_4. It was assumed that all estimated industrial waste produced have followed the urban disposal pattern between uncontrolled and controlled SWDS.
Spain	With respect to unmanaged SWDS, there is no statistical information available for the characterization of the parameter of depth, so in the absence of said information it is assumed that 50% are deep and the remaining 50% are shallow. At the same time, within unmanaged SWDS, whether they are deep or shallow, burn coefficients were assumed for the reduction in volume. These coefficients have decreased during the inventory period.

Source: NIR 2009.

8.3.3 Waste water handling (CRF Source Category 6B) (EU-15)

CH_4 Emissions from domestic and commercial waste water handling (6B2) are a significant emission source in category 6B and key source in the EU. CH_4 emissions from waste water handling are calculated with the help of diverse methods (C, CS, D, M, T1 and T2). 25.7% of all EU-15 CH_4 emissions from wastewater handling (6B) are calculated using higher tiers (i.e. all methods besides default and T1 methods). Table 8.22 provides an overview of the CH_4 emission sources in wastewater handling which have been identified by the Member States. Furthermore methods applied to determine CH_4 emission from municipal wastewater and sludge handling are described in detail.

Table 8.22 6B2 Domestic and Commercial Waste Water Handling: CH_4 emission sources and methods for determining CH_4 emissions

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Austria	Municipal wastewater treatment in Austria uses mainly aerobic procedures. As a result no or negligible methane emissions are produced since such emissions only occur under anaerobic conditions. Mainly due to the structure of area of settlement in Austria there is still a small amount of inhabitants not connected to sewage systems and wastewater treatment plants. This wastewater is discharged in septic tanks and cesspools. As in there occur anaerobic processes, methane emissions are produced. CH_4 emissions from cesspools and septic tanks are calculated pursuant to the IPCC method. The following parameters were used: Average organic load: 60 g BOD_5 per inhabitant and day, methane producing capacity B_o: 0,6 kg CH_4/ kg BoB_5, methane conversion factor MCF: 0.27. The amount of inhabitants not connected to sewage systems and wastewater treatment plants was taken from the respective Austrian reports on water pollution control. Data for the years 1971, 1981, 1991, 1995 and 1998, 2001, 2003, and 2006 were available. The missing data were interpolated. The share of inhabitants connected to septic tanks has to be extrapolated from the year 2000 onwards. In Austria sewage sludge treatment is carried out on the one hand by aerobic stabilisation and on the other hand by anaerobic digestion. As sludge stabilisation is carried out aerobicly, the amount of methane emissions produced is negligible. Methane gas produced in the digestion processes is usually used for energy recovery or is flared. As the CH_4 emissions from both processes are negligible, they are not estimated.
Belgium	In this category, two sources of methane emissions are taken into account: the municipal wastewater treatment plants and the septic tanks. The methodology for the septic tanks is based on an article, which describes the characteristics and parameters of individual septic tanks. In the Walloon region, after discussion with the regional responsible for municipal wastewater treatment plants, it appears that most of the plants are conducted aerobically. Those who use anaerobical digestion of the sludge recover

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
	the CH_4 for energy purpose. Consequently, no CH_4 emissions are accounted in this subcategory. In the Brussels region, there are two municipal wastewater treatment plants. One is conducted aerobically and the other anaerobically. The CH_4 produced by the anaerobical digestion is recovered for energy purpose. No CH_4 emissions are consequently estimated for this subcategory. In the Flemish region the emissions of CH_4 of the municipal waste water treatment plants are estimated by using the methodology as described in the EMEP/CORINAIR guidebook.
Denmark	The methodology for estimating emission of methane from wastewater handling follows the IPCC Guidelines (1996) and IPCC Good Practice Guidance (2000). According to IPCC GL the emission should be calculated for domestic and industrial wastewater and the resulting two types of sludge, i.e. domestic and industrial sludge. The information available for the Danish wastewater treatment systems does not fit into the above categorisation as a significant fraction of the industrial wastewater is treated at centralised municipal wastewater treatment plants (WWTPs) and the data available for the total organic waste (TOW) does not differentiate between industrial and municipal sewage sludge. The IPPC default methodology for household wastewater has been applied by accounting and correcting for the industrial influent load. Of the total influent load of organic wastewater, the separated sludge has different final disposal categories. The fractions that are used for biogas, combustion or reuse including combustion include methane potentials that are either recovered or emitted as CO_2. These fractions have been subtracted from the calculated (theoretical) gross emission of CH_4. An EF value given in an IPCC background paper has been used for calculating the theoretical methane potential not emitted by the remaining disposal categories.
Finland	A national methodology that corresponds to the methodology given in the Revised 1996 Guidelines is used in the estimation of the CH_4 emissions. Emission sources cover municipal (domestic) and industrial wastewater handling plants and uncollected domestic waste water for CH_4 emissions. For uncollected domestic wastewaters the Check method with default parameters (IPCC Good Practice Guidance) has been used.
France	On the basis of the statistics of the wastewater treatment plants in France, the emissions are calculated according to the IPCC tier 2 method, distinguishing between natural lagoons and cesspools.
Germany	Municipal wastewater treatment in Germany uses aerobic procedures (municipal wastewater-treatment facilities, small wastewater-treatment facilities), i.e. it produces no methane emissions, since such emissions occur only under anaerobic conditions. Treatment of human sewage from persons not connected to sewage networks or small wastewater treatment facilities represents an exception: in cesspools, uncontrolled processes (partly aerobic, partly anaerobic) may occur that lead to methane formation. Organic loads from cesspools are calculated pursuant to the IPCC method, in which the relevant population is multiplied by the average organic load per person.
Greece	CH_4 from waste water handling was estimated according to the default methodologies suggested by IPCC. Considering the fact that there are not sufficient data regarding all the wastewater handling facilities of the country and as a result methane emissions are calculated based on the total population served, emissions from wastewater treatment and the sewage sludge removed from wastewater are not considered separately. However, methane emissions from sewage sludge disposed in managed sites have been estimated for the first time in the present inventory. Therefore, in order to avoid double counting of emissions from sludge treatment, the organic load (in biochemical oxygen demand) of sludge that is actually disposed on land was subtracted by the organic load of wastewater treated.
Ireland	It is assumed that all wastewaters sent to wastewater treatment plants are treated aerobically in both urban and industrial situations and as a result emissions of CH_4 do not occur. A national study indicates that 3 percent of sludge is anaerobically treated and is therefore an emission source. Emissions are derived using national statistics, country-specific values and the IPCC Guidelines.
Italy	In Italy wastewater handling is managed mainly using a secondary treatment, with aerobic biological units. The stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery. It is assumed that domestic and commercial wastewaters are treated 95% aerobically and 5% anaerobically, whereas industrial wastewaters are treated 85% aerobically and 15% anaerobically. CH_4 emissions from sludge generated by domestic and commercial wastewater treatment have been calculated using the IPCC default method on the basis of national information on anaerobic sludge treatment system. Emissions from methane recovered, used for energy purposes, in wastewater treatment plants are estimated and reported under category 1A4a. A percentage of 2.4% of domestic and commercial wastewater is actually treated in Imhoff tanks, where the digestion of sludge occurs anaerobically without gas recovery.
Luxembourg	The emission estimation of waste water handling is based on the annual population numbers and corresponding emission factors. A country-specific methodology was applied. Activity data for wastewater handling, i.e. the number of inhabitants, have been taken from national statistics STATEC.
Netherlands	In general, the emissions are calculated according to the IPCC guidelines, with country-specific parameters and emission factors being used for CH_4 emissions from wastewater handling (including sludge). The calculation methods are equivalent to the IPCC Tier 2 methods.
Portugal	CH_4 emissions from domestic wastewater handling were estimated using a methodology adapted from IPCC 1996 Revised Guidelines and Good Practice Guidance, which follows three basic steps: 1. Determination of the total amount of organic material originated in each wastewater handling system, 2. Estimation of emission factors and 3. Calculation of emissions.
Spain	The methodology in Section 5.2 of the IPCC Good Practice Guidance has been applied. Computing the contributions of the water and sludge lines, the emissions are obtained as a product of the degradable organic load (water and sludge) and the methane emission factors, discounting from this product the amount of methane recovered. The methane emission factors are expressed as the product of the respective parameter B_0 of maximum capacity for methane production times the weighted methane conversion factor, WMCF. For domestic/commercial waste water, the organic load is the activity variable selected, expressed in mass of Biochemical Oxygen Demand (BOD_5). For the calculation of this variable, the population data currently served by waste-water treatment stations has been used, as detailed in the publication "The Environment in Spain" from the Ministry of the Environment. For the degradable organic load, a value of 300 mg BOD_5/litre of waste water and a flow of 200 litres/inhabitant equivalent per day, and 365 operating days per year, have been assumed.

Member State	CH_4 emission sources and description of methods (municipal wastewater and sludge)
Sweden	Considerable quantities of heat and bio-energy are recovered from sewage and wastewater. The rest of the methane generated in the wastewater treatment process may be insignificant because of flaring, but is reported as NE (not estimated) in the CRF tables. Methane generated from landfilling of sludge is reported as IE (included elsewhere) because it is included in CRF 6A.
United Kingdom	The methodology of the UK model differs in some respects from the IPCC default methodology. The main differences are that it considers wastewater and sewage together rather than separately. It also considers domestic, commercial and industrial wastewater together rather than separately. Emissions are based on empirical emission factors derived from the literature expressed in kg CH_4/tonne dry solids rather than the BOD default factors used by IPCC. The model complies with the IPCC Good Practice Guidance as a national model. Emissions from sewage are calculated by disaggregating the throughput of sewage into 14 different routes. The routes consist of different treatment processes each with specific emission factors. The allocation of sludge to the treatment routes is reported for each year.

Source: NIR 2009; CRF 2009 Tables 6, 6Bs1 and 6Bs2

CH_4 emissions from industrial wastewater and sludge handling are not key sources, but the reporting of these emissions by Member States is very inhomogeneous and seems to be difficult.

Emissions from industrial wastewater handling are reported by six Member States (Finland, Greece, Italy, Netherlands, Portugal, Spain), but nine Member States indicate either that emissions are not estimated or not applicable or not occurring (Austria, Belgium, France, Germany, Ireland, Luxembourg, Sweden, United Kingdom), or that emissions are reported elsewhere (Denmark).

Emissions from sludge handling are reported by two Member States (Ireland and Spain), other Member States either reported emissions as not estimated or not occurring (eight Member States: Belgium, France, Germany, Greece, Luxembourg, the Netherlands, Portugal and the United Kingdom) or reported the emissions elsewhere (five Member States: Austria, Denmark, Finland, Italy, and Sweden).

An overview of methodological issues regarding CH_4 emissions from industrial wastewater and sludge handling is provided in Table 8.23.

Table 8.23 6B1 Industrial Waste Water Handling: CH_4 emissions and methods applied

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Austria	**NA**	**IE**	Industrial wastewater treatment and sewage sludge treatment is carried out under aerobic as well as anaerobic conditions. Due to lack of data the overall amount of industrial wastewater can not be estimated. But according to national experts the amount of CH_4 emissions from industrial wastewater treatment and sewage sludge treatment is negligible because CH_4 gas is usually used for energy recovery or is flared.
Belgium	**NE, NO**	**NE, NO**	
Denmark	**IE**	**IE**	The methodology for estimating emission of methane from wastewater handling follows the IPCC Guidelines (1996) and IPCC Good Practice Guidance (2000). According to IPCC GL the emission should be calculated for domestic and industrial wastewater and the resulting two types of sludge, i.e. domestic and industrial sludge. The information available for the Danish wastewater treatment systems does not fit into the above categorisation as a significant fraction of the industrial wastewater is treated at centralised municipal wastewater treatment plants (WWTPs) and the data available for the total organic waste (TOW) does not differentiate between industrial and municipal sewage sludge. The IPPC default methodology for household wastewater has been applied by accounting and correcting for the industrial influent load. Of the total influent load of organic wastewater, the separated sludge has different final disposal categories. The fractions that are used for biogas, combustion or reuse including combustion include methane potentials that are either recovered or emitted as CO_2. These fractions have been subtracted from the calculated (theoretical) gross emission of CH_4. An EF value given in an IPCC background paper has been used for calculating the theoretical methane potential not emitted by the remaining disposal categories.
Finland	**X**	**IE**	A national methodology that corresponds to the methodology given in the Revised (1996) Guidelines is used in estimation of the CH_4 emissions. The emissions from industrial wastewater treatment are based on the COD load.
France	**NO**	**NE**	Due to the major use of aerobic treatment system in industrial wastewater treatment plants CH_4 emissions are very small. Due to the lack of data CH_4 emissions from industrial sludge are not estimated (e-mail communication with national waste expert April 2005).

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
Germany	**NO**	**NO**	The composition of industrial wastewater, in contrast to that of household wastewater, varies greatly by industrial sector. In Germany, the biological stage of industrial wastewater treatment is partly aerobic and partly anaerobic. Anaerobic wastewater treatment is especially useful for industries whose wastewater has high levels of organic loads. This treatment method has the advantages that it does not require large amounts of oxygen, produces considerably smaller amounts of sludge requiring disposal and generates methane that can be used for energy recovery. As in treatment of municipal wastewater, treatment of industrial wastewater releases no methane emissions into the environment. The processes include aerobic treatment and anaerobic digestion; gas formed in the latter is either used for energy recovery or is flared.
Greece	**X**	**NE**	The methodology for calculating methane emissions from industrial wastewater is similar to the one used for domestic wastewater. In order to estimate the total organic waste produced through anaerobic treatment, the following basic steps were followed: Collection of data regarding industrial production of approximately 25 industrial sectors / sub-sectors for the period 1990 – 2007. Data on industrial production for 2007 were not available and for this reason production was estimated through linear extrapolation. Calculation of wastewater generated, by using the default factors per industrial sector (m^3 of wastewater/t product) as suggested by the IPCC Good Practice Guidance. Calculation of degradable organic fraction of waste, by using the default factors (kg COD/m^3 wastewater) suggested by the IPCC Good Practice Guidance for each sector / sub-sector. The distribution between aerobic and anaerobic treatment of industrial wastewater for each industrial sector was estimated on the basis of data derived from a relevant project. The maximum methane production potential factors and the methane conversion factors for aerobic and anaerobic treatment, which were used for the final estimation of methane emissions, are similar to those used for domestic wastewater handling.
Ireland	**NO**	**X**	It is assumed that all wastewaters sent to wastewater treatment plants are treated aerobically in both urban and industrial situations and as a result emissions of CH_4 do not occur. A national study indicates that 3 percent of sludge is anaerobically treated and is therefore an emission source. Emissions are derived using national statistics, country-specific values and the IPCC Guidelines.
Italy	**X**	**IE**	In Italy wastewater handling is managed mainly using a secondary treatment, with aerobic biological units. It is assumed that domestic and commercial wastewaters are treated 95% aerobically and 5% anaerobically, whereas industrial wastewaters are treated 85% aerobically and 15% anaerobically. The methane estimation concerning industrial wastewaters makes use of the IPCC method based on wastewater output and the respective Degradable Organic Carbon for each major industrial wastewater source. No country-specific emission factors of methane per Chemical Oxygen Demand are available so the default value of 0.25 kg CH_4 kg^{-1} DC, suggested in the IPCC Good Practice Guidance, has been used for the whole time series. As recommended by the Good Practice Guidance for key source categories, data have been collected for several industrial sectors (iron and steel, refineries, organic chemicals, food and beverage, paper and pulp, textiles and leather industry). The total amount of organic material for each industry selected has been calculated multiplying the annual production by the amount of wastewater consumption per unit of product and by the degradable organic component. Moreover, the fraction of industrial degradable organic component removed as sludge has been assumed equal to zero. The yearly industrial productions are reported in the national statistics, whereas the wastewater consumption factors and the degradable organic component are either from Good Practice Guidance or from national references. National data have been used in the calculation of the total amount of both COD produced and wastewater output for refineries, organic chemicals, beer production, wine, milk and sugar sectors, the pulp and paper sector, and the leather sector. CH_4 emissions from sludge generated from industries are included in the industrial wastewaters.
Luxembourg	**NO**	**NE**	The emission estimation of waste water handling is based on the annual population numbers and corresponding emission factors. A country-specific methodology was applied. Activity data for wastewater handling, i.e. the number of inhabitants, have been taken from national statistics STATEC.
Netherlands	**X**	**NE**	The source category „wastewater handling" also includes the CH_4 emissions from anaerobic industrial wastewater treatment plants (WWTP), but these are small compared to urban wastewater treatment plants (WWTP).
Portugal	**X**	**NE**	Methane emissions from industrial wastewater handling also follow the default methodology proposed in the 1996 IPCC Guidelines and the Good Practice Guidance. The organic wastewater load (TOW) is estimated using statistical production data on industries (ton product/yr) multiplied by pollution coefficients (kg O_2/ton product). These coefficients were developed from field monitoring data at installations in Portugal.
Spain	**X**	**X**	For industrial point sources, with individualized questionnaires sent to each plant, the methane emission factor selected, with regard to the volume of waste water treated, is derived from the EMEP/CORINAIR Guidebook. For the area sources, using information based on studies or sectorial statistics without individualized data for plants, the methodology in Section 5.2 of the IPCC Good Practice Guidance has been applied. Computing the contributions of the water and sludge lines, the emissions are obtained as a product of the degradable organic load (water and sludge) through the methane emission factors, discounting from this product the amount of methane recovered. The methane emission factors are expressed as the product of the respective parameter B_0 of maximum capacity for methane production times the weighted methane conversion factor, WMCF. The activity variable taken for the point sources, comprising oil refineries and paper pulp manufacturing plants, has been the volume of treated waste water about which information has been obtained by means of individualized questionnaires. For area sources, covering the sectors of food and beverage and the chemical industry, the activity variable considered has been the organic load in both

Member State	CH_4 emissions from industrial wastewater		Methods for determining CH_4 emissions from industrial wastewater and sludge handling
	Waste water	Sludge	
			the water line and the sludge line, expressed in terms of chemical oxygen demand (COD), and the data are derived from discharge regulation studies. From these studies, information was compiled on production or consumption of main raw material, discharge ratio, volume discharged, ratio of organic load per unit discharged, and a parameter indicating the fraction of the organic waste load removed as sludge from the treated discharge.
Sweden	NE	IE	Considerable quantities of heat and bio-energy are recovered from sewage and wastewater. The rest of the methane generated in the wastewater treatment process may be insignificant because of flaring, but is reported as NE (not estimated) in the CRF tables. Methane generated from landfilling of sludge is reported as IE (included elsewhere) because it is included in CRF 6A.
United Kingdom	NE	NE	Industrial waste water is considered together with commercial and domestic wastewater. Emissions from private industrial treatment plants are not estimated, but are believed to be small.

Source: NIR 2009, CRF 2009 Tables 6, 6.Bs1 and 6.Bs2

According to the IPCC Good Practice Guidance, the emission factor for determining CH_4 emissions from wastewater and sludge handling is composed of the maximum methane producing potential (B_0) and the methane conversion factor (MCF). There is an IPCC default value available for the maximum methane producing potential which is applied in most of the Member States. In contrast, the MCF has to be determined country specifically and varies strongly among the Member States depending on wastewater and sludge treatment systems used; Table 8.24 provides an overview of the MCF applied by the Member States.

Table 8.24 6B Waste Water Handling: Methane Conversion Factors

Member State	MCF	Specification of MCF	Further information on MCF
Austria	**0.27**	Cesspools and septic tanks	Value is taken from a national study.
Belgium	-	-	No information provided.
Denmark	**0.20**	Anaerobic treatment of sludge	Value for the year 2002.
Finland	**0.01** **0.005**	Municipal (domestic) wastewaters Industrial wastewaters	The estimated methane conversion factors for collected wastewater handling systems (industrial and domestic) are low in Finland because the handling systems included in the inventory are either aerobic or anaerobic with complete methane recovery. The emission factors mainly illustrate exceptional operation conditions. The MCF is based on expert knowledge.
France			No information provided.
Germany	**0** **0.5**	Municipal wastewater treatment Cesspools	Aerobic conditions. The MCF for cesspools has been estimated on the basis of experience gained in other countries (septic tanks in the U.S., anaerobically treated municipal wastewater in the Czech Republic).
Greece	**-**	-	The default values for these factors are 0 for aerobic conditions and 1 for anaerobic conditions (and these values were applied in the calculations).
Ireland	**0**	Wastewater	All aerobic treatment.
Italy	**0.5** **0.25**	Domestic and commercial wastewater sludge Industrial wasterwater	CH_4 emissions from sludge generated by domestic and commercial wastewater treatment have been calculated; the stabilization of sludge occurs in aerobic or anaerobic reactors; where anaerobic digestion is used, the reactors are covered and provided of gas recovery. For industrial wastewaters, no country-specific emission factors of methane per Chemical Oxygen Demand are available, so the default value of 0.25 kg CH_4 kg^{-1} DC, suggested in the IPCC Good Practice Guidance, has been used for the whole time series.
Luxembourg			No information available.
Netherlands	**0.5**	Septic tank	
Portugal	**0.8** **0.2** **0.17** **0**	Imhoff tank Lagoon with anaerobic pond Percolation beds with anaerobic sludge digestion Oxidation pond	The MCF for wastewater treatment systems were weighted by the percentage of population connected to each type of treatment system, and using the MCF values established by expert judgement for each treatment type. More detailed MCF values are available in the NIR.
Spain	**0.15** **0.3**	industrial wastewater industrial sludge	The Weighted Methane Conversion Factor, WMCF, is calculated in accordance with Equation 5.8 in the IPCC Good Practice

	0.005 **0.3**	domestic wastewater domestic wastewater sludge	Guidance.
Sweden	**-**	-	Not applicable (no CH_4 emissions reported in this category).
United Kingdom	**-**	-	No information available.

Source: NIR 2009.

Most Member States report N_2O emissions from waste water handling. Different methods are applied (C, CS, D, T1 and T2). 4.9% of N_2O emissions from domestic wastewater handling are estimated by higher tier methods. In Table 8.25 the methods for determining N_2O emissions from wastewater handling applied by the Member States are described in detail.

Table 8.256B Waste Water Handling: Methods for determining N_2O emissions

Member State	N_2O emissions from wastewater [1)]		Description of methods used (N_2O)
	Industrial	**Domestic**	
Austria	**X**	**X**	N_2O emissions from domestic and commercial wastewater handling are calculated by differing between wastewater arising from households connected and from households not connected to the municipal sewage system. N_2O emissions resulting from households not connected to the public sewage system were calculated according to the IPCC default method, as described in revised 1996 IPCC Guidelines. The data for the daily protein intake per person are taken from FAO statistics. The number of inhabitants is provided by *Austria Statistics.* Emission factor (0.01) and fraction of nitrogen in protein (0.16) are IPCC default values. N_2O emissions arising in waste water treatment plants are calculated by using a country-specific method based on IPCC. According to a national study, the amount of wastewater that is treated in sewage plants and the amount of nitrogen that is denitrificated should be considered. Finally the N_2O emissions arising from waste water treatment plants and other treatment are summed up. It is assumed that industrial wastewater handling additionally contributes 30% of N_2O emissions from municipal wastewater treatment plants. As this share represents only the situation in the 1990ies, the ERT recommended a survey to verify this share. In this survey, several methods and different international approaches were compared and a literature review was undertaken. It resulted in the conclusion that the consideration of industrial N_2O with 30% of N_2O emissions from domestic wastewater treatment plants, is still justified. Data for the amount of wastewater that is treated in sewage plants as well as on the denitrification rate were taken from the Austrian reports on water pollution control and and situation reports on the disposal of urban wastewater and sludge; missing data in between were interpolated.
Belgium	**NE, NO**	**X**	The N_2O emissions from human sewage are estimated by using the methodology described in the IPCC Guidelines. The figure of protein consumption originates from the FAO statistics. The population figures come from the National Institute of Statistics.
Denmark	**IE**	**X**	Emissions of N_2O are divided into direct and indirect emission contributions, i.e. from wastewater handling and effluents, respectively. Indirect emissions are divided into contributions from industrial discharges, rainwater conditioned effluents, effluents from scattered houses, from aquaculture and fish farming and from WWTPs.
Finland	**NE**	**X**	In Finland, the N input from fish farming and from municipal and industrial wastewaters into the waterways is collected into the VAHTI database. For municipal wastewaters the measured values have been considered more reliable than the N input according to population data. In addition to the IPCC approach, also nitrogen load from industry and fish farming were taken into account. For uncollected wastewaters the nitrogen load is based on population data. The assessed N_2O emissions cover only the emissions caused by the nitrogen load to waterways. In addition to the emissions caused by nitrogen load of domestic and industrial wastewaters also the emissions caused by the nitrogen load of fish farming have been estimated. N_2O emission calculations are consistent with the IPCC method for discharge of sewage nitrogen to waterways.
France	**X**	**X**	No information available.
Germany	**NA**	**X**	IPCC Default Method
Greece	**NE**	**X**	N_2O from waste water handling were estimated according to the default methodology suggested by IPCC.
Ireland	**NA, NE**	**X**	Estimates of emissions of N_2O from human sewage discharges are made using the IPCC methodology.
Italy	**X**	**X**	N_2O emissions from domestic and commercial wastewater treatment are reported in human sewage. The default approach suggested by the IPCC Guidelines and updated in the Good Practice Guidance, based on population and per capita intake protein has been followed. Fraction of nitrogen protein of 0.16 kg N kg^{-1} protein and an emission factor of 0.01 kg N-N_2O kg^{-1} N produced have been used, whereas the time series of the protein intake is from the yearly FAO Food Balance.
Luxembourg	**X**	**X**	The emission estimation of waste water handling is based on the annual population

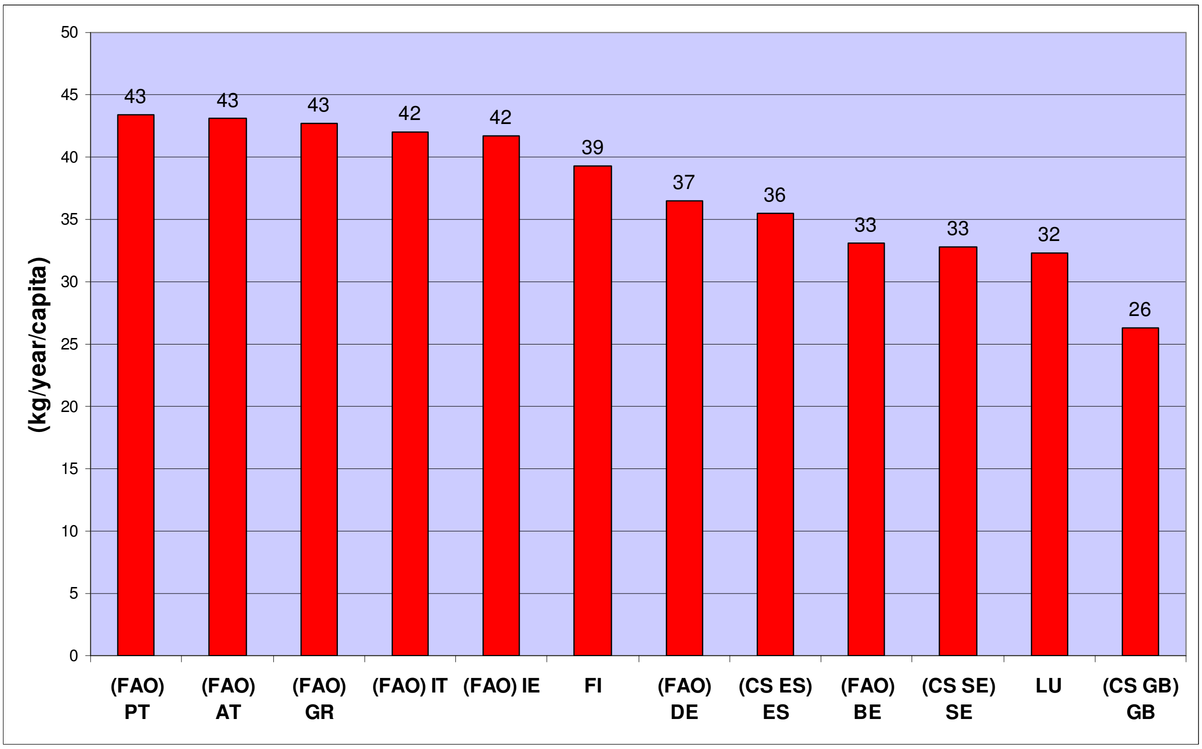
Member State	N_2O emissions from wastewater 1)		Description of methods used (N_2O)
	Industrial	Domestic	
			numbers and corresponding emission factors. A country-specific methodology was applied. Activity data for wastewater handling, i.e. the number of inhabitants, have been taken from national statistics STATEC.
Netherlands	**NE**	**X**	N_2O emissions from the biological N-removal processes in urban WWTP as well as indirect N_2O emission from effluents are calculated using the IPCC default emission factor of 0.01 tons N_2O-N per ton N removed or discharged. Since N_2O emissions from wastewater handling was identified in previous NIRs as a key source, the present Tier 2 methodology complies with the IPCC Good Practice Guidance. Because of their insignificance compared to N_2O from domestic wastewater treatment, no N_2O emissions were estimated for industrial wastewater treatment and from septic tanks.
Portugal	**X**	**X**	Emissions of N_2O from domestic wastewater were estimated following the proposal of IPCC 1996 Revised Guidelines. Activity data results of protein intake, according to FAO database, multiplied by total population. For industrial wastewater, the methodology proposed in the CORINAIR/EMEP Handbook, based on the knowledge of total production of wastewater, expressed in equivalent inhabitants, and the use of a simple and unspecific emission factor, was chosen.
Spain	**NE**	**X**	The methodology followed for the calculation of nitrous oxide emissions is the IPCC Reference Manual. Protein consumption has been obtained from the publication "Nutrition in Spain" by the Ministry of Agriculture, Food and Fisheries" (MAPA). The values of parameters required to calculate the emissions estimation algorithm are those suggested in the Manual. The nitrogen fraction present in protein is 0.16 kg N/kg protein and the emission factor is 0.01 kg N_2O-N/kg N in waste water.
Sweden	**X**	**X**	National activity data on nitrogen in discharged wastewater from municipal wastewater treatment plants and industries are used, in combination with a model estimating nitrogen in human sewage from people not connected to municipal wastewater treatment plants.
United Kingdom	**NE**	**X**	Nitrous oxide emissions from the treatment of human sewage are based on the IPCC default methodology.

1) according to table 6.Bs1in CRF 2009; X= emissions are reported; NA=not applicable; NE= not estimated; IE= included elsewhere; NO=not occuring

Source: *NIR 2009, CRF 2009 Tables 6, 6.Bs1 and 6.Bs2*

One important parameter for the determination of N_2O emissions from wastewater handling, the daily per capita protein consumption is country-specific and applied by almost all Member States; an overview of the values is given in Figure 8.9.

Figure 8.9 6B Waste Water Handling: Protein consumption



Source: CRF 2009, Table 6 B; NIR 2009
CS= Country-specific value; FAO= FAO data basis
CS ES: Publication "Nutrition in Spain" by the Ministry of Agriculture, Food and Fisheries" (MAPA); CS SE: National value, National Food Administration. 2002; CS GB: DEFRA, 2007: The Expenditure and Food Survey.

8.3.4 Waste Incineration (CRF Source Category 6C) (EU-15)

Emissions from waste incineration are reported by ten Member States in 2007 (Austria, Belgium, France, Greece, Sweden, United Kingdom, Italy, Luxembourg, Spain and Portugal). 84.8% of EU-15 CO_2 emissions are calculated using higher tier methods. In Table 8.26 an overview of category descriptions and methodological issues is provided.

Table 8.26 6C Waste Incineration: Emissions reported and methodological issues

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
Austria	X	In this category, emissions from incineration of waste oil are included as well as emissions from municipal waste incineration without energy recovery. In Austria waste oil is incinerated in especially designed so called "USK-facilities". The emissions of waste oil combustion for energy recovery (e.g. in cement industry) are reported under fuel combstion. In general, municipal, industrial and hazardous waste are combusted for energy recovery in district heating plants or in industrial sites and therefore the emissions are reported under fuel combustion. There is only one waste incineration plant without energy recovery which has been operated until 1991 with a capacity of 22 000 tons of municipal waste per year. This plant has been rebuilt as a district heating plant starting operation in 1996. Therefore the emissions since the re-opening of this plant are reported under fuel combustion from 1996 onwards.
Belgium	X	N_2O emissions from domestic waste incineration are calculated using activity data known from the individual companies involved combined with the emission factor of CITEPA. CH_4 emissions are not relevant. For CO_2 emissions, each region applies its own methodology according to the available activity data. In Flanders, only the fraction of organic-synthetic waste is taken into consideration (assuming that organic waste does not give any net CO_2 emissions). For the municipal waste, the institute responsible for waste management in Flanders (OVAM) is given the analysis of the different fractions in the waste. Based on this information, the amount of non-biogenic waste (excluding the inert fraction) is determined. The carbon emission factor is based on data from literature for the different fractions involved. For industrial waste, the amount of biogenic waste is considered to be the same as in municipal waste. The remaining amount is considered to be the non-biogenic part in which no inert fraction is present. For industrial waste, it is more difficult to determine the content of C and therefore the results of a study are used. This study gives a content of C of the industrial waste of 65.5 %. In Wallonia, following a legal decree in 2000, the air emissions from waste incineration are measured by ISSEP and the results are validated by a Steering Committee. These results allow a crosscheck with the results of measurements directly transmitted by the incinerators to the environmental administration. There is a distinction between the emission from municipal waste incineration and hospital waste incineration. The CO_2 emissions of municipal waste incineration are reported assuming that 68 % of the waste is composed of organic material. This is based on the average garbage composition in Wallonia and the use of IPCC equation on organic content of the various materials. The CO_2 emissions from hospital waste incineration are measured and are integrated in the waste incineration sector. The emissions of CO_2 from the flaring in the chemical industry in Wallonia are reported in Category 6C according to IPCC Guidelines. In Brussels, the emission factors for the incineration of hospital and municipal waste and corpses are estimated by measurements in situ in connection with EPA and EMEP/CORINAIR emission factors.
Denmark	IE	In Denmark, all municipal waste incineration is utilised for heat and power production. Thus, incineration of waste is included as stationary combustion in the IPCC Energy sector.
Finland	IE	Emissions of greenhouse gases CO_2, N_2O and CH_4 from Waste Incineration (CRF 6C) are reported in the energy sector (CRF 1A) in the Finnish inventory. There is no waste incineration on landfills in Finland and waste incineration for energy production is included in the energy sector. Waste incineration without energy recovery is nearly zero in combustion plants and it is also included in the energy sector. Waste incineration in households is quite small. In annual reporting of the recycling of wastepaper, the incineration of wastepaper is estimated to be only 23,000 tons. The incineration of paper and paperboard in households is estimated to be 31,000 tons together.
France	X	Emissions from waste incineration are reported for four categories: dangerous industrial waste incineration, municipal waste incineration without energy recovery, agricultural plastic film burning and incineration of other non-specified wastes. Furthermore, non-CO_2 emissions of incineration of biogenic waste are reported.
Germany	NO	Reported in the energy sector (CRF 1).
Greece	X	Carbon dioxide emissions from the incineration of clinical waste produced in the Attica region have been estimated. For the estimation of CO_2 emissions, the default method suggested by the IPCC Good Practice Guidance was used. CH_4 and N_2O emissions have not been estimated because there are not any available relevant emission factors. However, according to the IPCC Good Practice Guidance, these emissions are not likely to be significant. Data related to the amount of clinical waste incinerated derive from the ACMAR, which is operating the incinerator. The relevant parameters and emission factor used are the ones suggested in the IPCC Good Practice Guidance.
Ireland	NE, NO	
Italy	X	Existing incinerators in Italy are used for the disposal of municipal waste, together with some industrial waste, sanitary waste and sewage sludge for which the incineration plant has been authorized from the competent authority. Other incineration plants are used exclusively for industrial and sanitary waste, both

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		hazardous and not, and for the combustion waste oils, whereas there are few plants that treat residual waste from waste treatments, as well as sewage sludge. Emissions from waste incineration facilities with energy recovery are reported under category 1A4a, whereas emissions from other types of waste incineration facilities are reported under category 6C. For 2007, nearly 95% of the total amount of waste incinerated is treated in plants with energy recovery system.CH_4 emissions from biogenic, plastic and other non-biogenic wastes have been calculated. Regarding GHG emissions from incinerators, the methodology reported in the IPCC Good Practice Guidance has been applied, combined with that reported in the CORINAIR Guidebook. A single emission factor for each pollutant has been used combined with plant-specific waste activity data. Emissions have been calculated for each type of waste: municipal, industrial, hospital, sewage sludge and waste oils. A complete data base of these plants has been built, on the basis of various sources available for the period of the entire time series, extrapolating data for the years for which there was no information. For each plant a lot of information is reported, among which the year of the construction and possible upgrade, the typology of combustion chamber and gas treatment section, if it is provided of energy recovery (thermal or electric), and the type and amount of waste incinerated (municipal, industrial, etc.). Different procedures were used to estimate emission factors, according to the data available for each type of waste. As regards municipal waste, a distinction was made between CO_2 from fossil fuels (generally plastics) and CO_2 from renewable organic sources (paper, wood, other organic materials). Only emissions from fossil fuels, which are equivalent to 35% of the total, were included in the inventory. On the other hand, CO_2 emissions from the incineration of sewage sludge were not included at all, while all emissions relating to the incineration of hospital and industrial waste were considered. CH_4 and N_2O emissions from agriculture residues removed, collected and burnt ‘off-site’, are reported in the waste incineration sub-sector. Removable residues from agriculture production are estimated for each crop type taking into account the amount of crop produced, the ratio of removable residue in the crop, the dry matter content of removable residue, the ratio of removable residue burned, the fraction of residues oxidised in burning, the carbon and nitrogen content of the residues. CO_2 emissions have been calculated but not included in the inventory as biomass. All these parameters refer both to the IPCC Guidelines and country-specific values.
Luxembourg	IE	The only existing incinerator of municipal waste, SIDOR, is a major CO_2 emission source in that sector. CO_2 emissions were estimated at 125 kt in 1990, however a big part of those emissions result from biomass combustion. It is estimated that 10 kt of CO_2 (non-biomass combustion) should be included into the national total. This value is reported every year though the quantities of refusals incinerated vary from year to year. The reason stems from the fact that the emissions are a first relatively rough estimation of the non-biogenic fraction that is burned in the sole incinerator of the country. A more precise calculation remains to be done. Also, it is worth noticing that waste incineration in Luxembourg is nowadays going with heat/energy recovery. It should then be investigated more deeply where this energy recovered is used and, consequently, whether emissions should be reported in CRF/IPCC sector 6.C or 1.A.1.a.
Netherlands	IE	The source category Waste incineration is included in source category 1A1 Energy industries since all waste incineration facilities also produce electricity or heat used for energetic purposes. Total CO_2 emissions – i.e. the sum of organic and fossil carbon – from waste incineration are reported per facility in the annual environmental reports. The fossil-based and organic CO_2 emissions from waste incineration (e.g. plastics) are calculated from the total amount of waste incinerated. Per waste stream (residential and several others) the composition of the waste is determined. For each of these types a specific carbon content and fossil carbon fractions are assumed, which will yield the CO_2 emissions. The method is described in detail in a national study and in a monitoring protocol.
Portugal	X	CO_2 emissions from incineration are calculated according to IPCC Guidelines, for each waste type (e.g. municipal solid waste (MSW), hazardous waste, clinical waste, and sewage sludge). Until 1999, incineration of solid wastes refers exclusively to incineration of hospital hazardous wastes. The figure for 1995 was used as an estimated for the former years. In 1999, two new incineration units started to operate in an experimental regime. Their industrial exploration started at the end of the same year or early January 2000. More recently another unit started operating. These units are dedicated to the combustion of MSW which is composed of domestic/commercial waste. Emissions associated with the components of fossil origin – plastics, synthetic fibres, and synthetic rubber – are accounted for in the net emissions, which include also the non-CO_2 emissions from the combustion of organic materials (e.g. food waste, paper). CO_2 emissions from the biogenic component are only reported as a memo item. Data on clinical waste incinerated refers only to Mainland Portugal and corresponds to data declared in registry maps of public hospital units (there is no incineration in private units). The quantities of clinical waste incinerated decreased strongly in recent years. 25 incinerators were closed in recent years in Mainland Portugal, only remaining at present one hospital incinerator. Other clinical wastes receive alternative treatment or are treated abroad. The non-biogenic components fractions are considered to be different for MSW, and clinical waste. Data refer to combustion of industrial solid waste in industrial units which were collected from INR. Data for the years 2000, 2002 and 2003 refer to industrial units declarations. The figure for 2001 is interpolated, and 2004-07 refer to latest available data (2003). Data for the period 1990-98 are based on the same assumptions used for Industrial Solid Waste Disposed on Land: a per year growth rate of 2%. CH_4, N_2O and other emissions were estimated as the product of the mass of total waste combusted, and an emission factor for the pollutant emitted per unit mass of waste incinerated. Emission factors applied are either country-specific, being obtained from monitoring data in incineration units, or obtained from other references (US data, EMEP/CORINAIR).
Spain	X	Within this category, the emissions produced by the following activities have been estimated: incineration of corpses and clinical waste, municipal solid waste incineration in incinerators in case there is no energy recovery and wastewater sludge incineration. Emissions deriving from industrial waste incineration have not

Member State	Emissions reported in CRF	Type of waste incinerated and methods applied
		been estimated yet. For the incineration of human corpses in crematories, the combustion of a supporting fuel and some other material elements incinerated during the process also account for emissions. The clinical waste streams suitable for treatment by incineration are those with a low infection potential and those named "cytotoxic waste" which present a high infection potential. The estimation of the amount of this type of waste produced is calculated by considering the number of hospital beds and a waste production factor per bed and day. Since 2004, all municipal waste incinerators are equipped with energy recovery. Sludge incineration includes sludges from urban and industrial wastewater treatment. The main source of emission factors is the EMEP/CORINAIR Guidebook.
Sweden	X	Emissions from incineration of hazardous waste, and in later years also MSW and industrial waste, from one large plant are reported in CRF 6C. Reported emissions are for the whole time series obtained from the facility's Environmental report or directly from the facility on request. CO_2, SO_2 and NO_x are measured continuously in the fumes at the plant. In 2003 capacity was increased substantially at the plant by taking one new incinerator into operation. The new incinerator incinerates a mixture of MSW, industrial waste and hazardous waste. Only a minor part (less than 0.5%) of the total amount of MSW incinerated for energy purposes in Sweden are incinerated in the facility included in 6C. All other emissions from incineration of MSW are reported in CRF 1.Emissions reported are CO_2, NO_x, SO_2 and NMVOC. The CO_2 emission of biogenic origin of the MSW fraction of the waste, has since 2003 (when the incineration capacity increased dramatically, in order to treat MSW) been estimated using published information. According to information from the facility, occasional measurements concerning CH_4 and N_2O have been performed. The CH_4 measurement showed very low or non-detectable amounts. CH_4 is therefore reported as NE in the CRF tables. For N_2O the occasional measurements showed levels giving emissions in the approximate order of 0.2 Mg N_2O/year. N_2O is also reported as NE in the CRF tables.
UnitedKingdom	X	Incineration of chemical wastes, clinical wastes, sewage sludge and animal carcasses is included here. There are approximately 70 plants incinerating chemical or clinical waste or sewage sludge and approximately 2600 animal carcass incinerators. Animal carcass incinerators are, typically, much smaller than the incinerators used to burn other forms of waste. This source category also includes emissions from crematoria. Emissions are taken from research studies or are estimated on literature-based emission factors, IPCC default values, or data reported by the Environment Agency's Pollution Inventory.

X = Emissions are reported in source category 6C, IE = included elsewhere, NE=not estimated, NO=not occuring
Source: NIR 2009, CRF 2009.

8.3.5 Waste – Other (CRF Source Category 6D) (EU-15)

Under CRF source category 6D ten Member States report emissions for 2007. Emissions from composting have been reported by eight Member States (Austria, Belgium, Finland, France, Germany, Italy, Luxembourg and the Netherlands), Denmark and France determine emissions from biogas production, Spain indicates emissions from sludge spreading, Germany from mechanical-biological waste treatment plants and the Netherlands from recycling activities, compare Table 8.27.

Table 8.27 6D Other: Reported emissions

Member State	Specification of "other waste"	6 D CO_2	6 D CH_4	6 D N_2O	6 D NO_x
Austria	Compost production	NA	1.67	0.24	NA
Belgium	Compost production	NA	2.05	NA	NA
Denmark	Biogas production	NO	NO	NO	NO
Finland	Compost production	NO	3.30	0.22	NO
France	Compost production	NA	5.22	1.04	NA
France	Biogas production	NA	0.53	NA	NA
Germany	Compost production	NO	25.61	0.66	NO
Germany	Mechanical-biological waste treatment	NO	0.20	0.37	NO
Italy	Compost production	NA	0.22	NA	NA
Luxembourg	Compost production	NO	0.34	0.02	NE
Netherlands	Compost production	NA	3.18	0.13	0.00
Netherlands	Recycling activities	NA	NO	NO	NA
Spain	Sludge spreading	NE	31.68	NE	NE

Source: CRF 2009 Table 6

In Table 8.28 the source category is described further in detail

Table 8.28 6D Other: Description and methodological issues

Member State	Waste – Other

Member State	Waste – Other
Austria	Emissions were estimated using a country-specific methodology. To estimate the amount of composted waste it was split up into two fractions of "other waste": 1) residual waste treated in mechanical-biological treatment plants, 2) composted waste: bio waste collected separately, loppings, home composting. Emissions were calculated by multiplying the quantity of waste with the corresponding emission factor (CH_4 and N_2O) based on national references.
Belgium	CH_4 emissions from compost production are estimated using regional activity data combined with a default emission factor of 2.4 kg CH_4/ton compost.
Denmark	Emission from combustion of biogas in biogas production plants is included in CRF sector 6D. The fuel consumption rate of the biogas production plants refers to the Danish energy statistics. The applied emission factors are the same as for biogas boilers (see Energy sector).
Finland	Emissions from composting have been calculated using the methoden given in the 2006 IPPC Guidelines for Greenhous Gas Inventories. Activity data are based on VAHTI database and the Water and Sewage Works Register. The activity data for composted municipal biowaste for the year 1990 are based on the estimates of the Advisory Board for Waste Management for municipal solid waste generation and treatment in Finland in 1989. Data on 1997, 2004 and 2005 are from the VAHTI database and the intermediate years have been interpolated. In addition, composted solid biowaste in the years 1991-1996 has been interpolated using auxiliary information from the National Waste Plan until 2005.
France	CH_4 and N_2O emissions from composting as well as CH_4 emissions from biogas production are considered. Emissions are estimated by multiplying emission factors with the amount of waste composted and the amount of waste used for the production of biogas, respectively.
Germany	In Germany, yearly increasing amounts of organic waste are composted. For this purpose, CH_4 and N_2O emissions from composting of municipal solid waste are estimated using a national method. Acitivity data is provided by the National Statistical Agency. Emission factors stem from a national study. Composting of garden and organic waste in individual households is not considered in this category. Since 1 June 2005, landfilling of biologically degradable waste is not permitted in Germany anymore. MSW has to be treated, therefore, prior to landfilling. Mechanical-biological treatment of waste is one of the options. A national method has been developed for the calculation of CH_4 and N_2O emissions in which the amount of waste treated in mechanical-biological treatment plants is multiplied with emission factors from a national study. Acitivity data is provided by the National Statistical Agency.
Italy	Under this source category CH_4 emissions from compost production have been reported. The composting plants are classified in plants that treat selected waste (food, market, garden waste, sewage sludge and other organic waste, mainly from the agro-food industry) and the mechanical-biological treatment plants, that treat the unselected waste to produce compost, refuse derived fuel (RDF), and a waste with selected characteristics for landfilling or incinerating system. It is assumed that 100% of the input waste to the composting plants from selected waste is treated as compost, while in mechanical-biological treatment plants 30% of the input waste is treated as compost on the basis of national studies and references. Information on input waste to composting plants are published yearly by ISPRA since 1996, including data for 1993 and 1994, while for 1987 and 1995 only data on compost production are available; on the basis of this information the whole time series has been reconstructed. Since no methodology is provided by the IPCC for these emissions, literature data have been used for the emission factor, 0.029 g CH_4 kg^{-1} treated waste, equivalent to compost production.
Luxembourg	Compost production sites generate CO_2 and CH_4 emissions. The CORINAIR (simple) methodology is applied. The mass of dry compost is 33.3% of the mass of humid sludge. CO_2 emissions are accounted for, but composting is biological decomposition of organic material, so it's biogenic. CH_4 emissions for composting are missing. Activity data for compost production have been taken from the Environment Agency (internal report).
Netherlands	This source category consists of the CH_4 and N_2O emissions from composting separately collected organic waste from households. A country-specific methodology for this source category is used with activity data based on the annual survey performed by the Working Group on Waste Registration at all the industrial composting sites in the Netherlands and emission factors based on the average emissions (per ton of composted organic waste) of some facilities in the late 1990s (measured during a large-scale monitoring programme in the Netherlands). Emissions from small-scale composting of garden waste and food waste by households are not estimated as these are assumed to be negligible. Since this source is not considered as a key source, the present methodology level complies with the IPCC Good Practice Guidance.
Spain	In this activity, emissions from the spreading of sludge from waste water treatment plants are covered. It was assumed that all sludges from wastewater treatments plants are dried by sludge spreading.

Source: NIR 2009

8.4 EU-15 uncertainty estimates (EU-15)

Table 8.29 shows the total EU-15 uncertainty estimates for the sector Waste and the uncertainty estimates for the relevant gases of each source category. The highest level uncertainty was estimated for N_2O from 6B and the lowest for CH_4 from 6C. With regard to trend N_2O from 6D shows the highest uncertainty estimates, CO_2 and N_2O from 6C the lowest. For a description of the Tier 1 uncertainty analysis carried out for the EU-15 see Chapter 1.7.

Table 8.29Sector 6 -Waste: EU-15 uncertainty estimates

Source category	Gas	Emissions 1990	Emissions 2007	Emission trends 1990-2007	Level uncertainty estimates based on MS uncertainty estimates	Trend uncertainty estimates based on MS uncertainty estimates
6.C Waste incineration	CO_2	4 436	2 445	-45%	20.1%	7
6.A Solid waste disposal on land	CH_4	143 042	78 627	-45%	19.0%	11
6.B Waste water handling	CH_4	12 617	10 197	-19%	52.7%	20
6.C Waste incineration	CH_4	477	453	-5%	1.3%	22
6.D Other	CH_4	378	1 554	312%	34.3%	279
6.B Waste water handling	N_2O	9 569	10 236	7%	112.2%	14
6.C Waste incineration	N_2O	265	290	10%	67.3%	2
6.D Other	N_2O	133	829	525%	48.3%	435
Total Waste	**all**	**171 149**	**104 645**	**-39%**	**18.4%**	**9**

Note: Emissions are in Gg CO_2 equivalents; trend uncertainty is presented as percentage points; the sum of the source category emissions may not be the total sector emissions because uncertainty estimates are not available for all source categories;uncertainty estimates include for Spain 2006 data.

8.5 Sector-specific quality assurance and quality control (EU-15)

Under the Climate Change Committee a workshop was conducted in Spring 2005 on inventories and projections of greenhouse gas emissions from waste. The main objectives of the workshop were: (1) to provide an opportunity to learn about the methods used for inventories and projections in the different Member States, to share information, experience and best practice; (2) to compare the parameters chosen in the estimation methodologies across EU-15 Member States; (3) to compare emissions and methods used for GHG inventories with data and methods for EPER; and (4) to strengthen links between assessment of air pollution under the IPPC and emissions under the UNFCCC. In addition, the workshop provided an opportunity to discuss potential methodological changes or improvements of the draft 2006 IPCC inventory guidelines. The recommendations and presentations of this workshop can be downloaded from the Internet under the following link: http://air-climate.eionet.eu.int/docs/meetings/050502_GHGEm_Waste_WS/meeting050502.html. Clarifications from discussions of individual parameters used in the estimation of emissions from waste were incorporated in this report.

A second expert meeting under the Climate Change Committee on the estimation of CH_4 emissions from solid waste disposed to landfills was conducted in March 2006. This meeting was targeting in particular those EC Member States that do not yet use the IPCC FOD methods for their inventories (mostly new EC Member States). The objective of the expert meeting was to use the new default model provided by draft 2006 IPCC Guidelines for national GHG inventories in order to calculate CH_4 emissions for the participants' countries. 11 Member States, 2 EEA Member countries, and one accession country participated. 9 of the 14 countries had previously not estimated CH_4 emissions with a FOD method. The meeting enabled those Member States that still used Tier 1 method to use the FOD model with national/default data as available. Other Member States used the IPCC FOD model as quality check and for comparison with the results of the country-specific model with usually minor differences compared to the national model. The meeting also contributed to the exchange of experiences of specific circumstances regarding waste generation, composition and solid waste disposal in new Member States and on the estimation of CH_4 recovery in the absence of monitored data. In addition, the meeting provided recommendations to IPCC for further improvement and corrections of the draft default model.

8.6 Sector-specific recalculations (EU-15)

Table 8.30 shows that in the waste sector the largest recalculations in 1990 and 2006 were made for CH_4.

Table 8.30 Sector 6 Waste: Recalculations of total GHG and recalculations of GHG emissions for 1990 and 2006 by gas (Gg CO_2 equivalents and percentage)

1990	CO_2		CH_4		N_2O		HFCs		PFCs		SF_6	
	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent	Gg	percent
Total emissions and removals	52,779	1.7%	-3,539	-0.8%	-12,813	-3.2%	11	0.0%	-680	-3.9%	0	0.0%
Waste	-21	-0.5%	-3,356	-2.1%	-60	-0.6%	NO	NO	NO	NO	NO	NO
2006												
Total emissions and removals	48,847	1.6%	299	0.1%	-16,160	-5.2%	58	0.1%	-299	-6.9%	165	1.9%
Waste	42	1.6%	-330	-0.4%	-20	-0.2%	NO	NO	NO	NO	NO	NO

NO: not occurring

Table 8.31 provides an overview of Member States' contributions to EU-15 recalculations. France had the largest recalculations for CH_4 in 1990 and 2006.

Table 8.31 Sector 6 Waste: Contribution of Member States to EU-15 recalculations for 1990 and 2006 by gas (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990						2006					
	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6	CO_2	CH_4	N_2O	HFCs	PFCs	SF_6
Austria	0	0	0	NO	NO	NO	0	96	1	NO	NO	NO
Belgium	0	0	-21	NO	NO	NO	0	-3	-18	NO	NO	NO
Denmark	IE,NA,NE,NO	0	0	NO	NO	NO	0	53	0	NO	NO	NO
Finland	NE,NO	6	0	NO	NO	NO	NE,NO	20	1	NO	NO	NO
France	-21	-3,714	12	NO	NO	NO	19	-2,896	1	NO	NO	NO
Germany	NE	0	0	NO	NO	NO	NE	-644	-44	NO	NO	NO
Greece	0	6	0	NO	NO	NO	1	-291	3	NO	NO	NO
Ireland	NA,NE,NO	0	0	NO	NO	NO	NA,NE,NO	0	0	NO	NO	NO
Italy	0	0	0	NO	NO	NO	33	3	2	NO	NO	NO
Luxembourg	0	3	2	NO	NO	NO	0	6	4	NO	NO	NO
Netherlands	IE,NA,NO	0	-48	NO	NO	NO	IE,NA,NO	17	63	NO	NO	NO
Portugal	0	0	0	NO	NO	NO	0	1,197	0	NO	NO	NO
Spain	0	544	0	NO	NO	NO	0	1,316	-28	NO	NO	NO
Sweden	0	0	0	NO	NO	NO	0	0	2	NO	NO	NO
UK	0	-200	-6	NO	NO	NO	-12	795	-7	NO	NO	NO
EU-15	**-21**	**-3,356**	**-60**	**NO**	**NO**	**NO**	**42**	**-330**	**-20**	**NO**	**NO**	**NO**

NO: not occurring; NE: not estimated; NA: not applicable; IE: included elsewhere

8.7 Waste for EU-27

8.7.1 Overview of sector (EU-27)

Figure 8.10 Sector 6 Waste: EU-27 GHG emissions 1990–2007 from CRF in CO_2 equivalents (Tg)

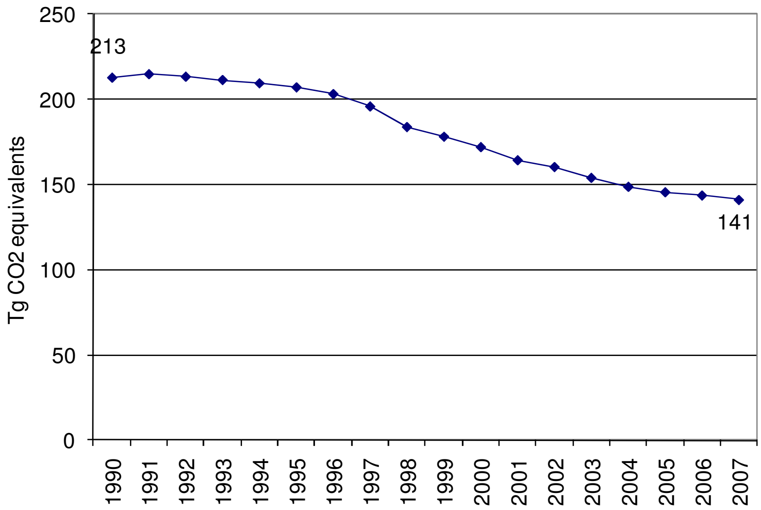
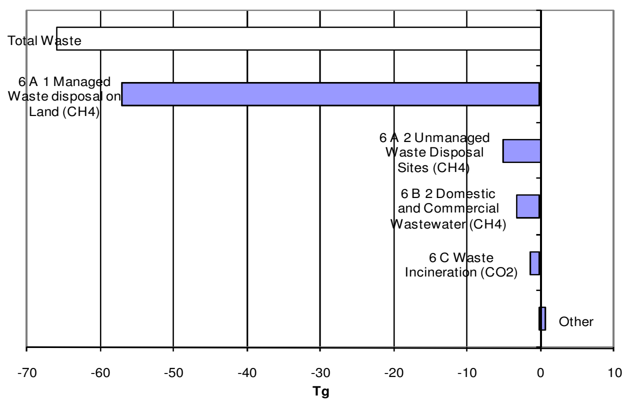
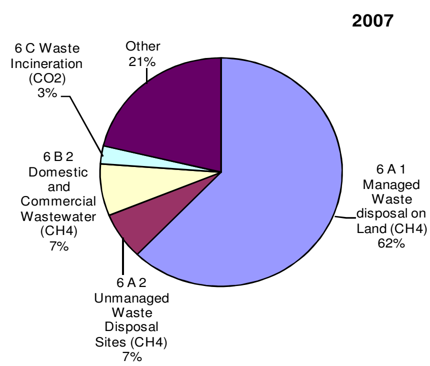


Figure 8.11 Sector 6 Waste: Absolute change of GHG emissions by large key source categories 1990–2007 in CO_2 equivalents (Tg) and share of largest key source categories in 2007





8.7.2 Source categories (EU-27)

8.7.2.1 Solid waste disposal on land (CRF Source Category 6A) (EU-27)

Table 8.32 6A1 Managed Waste Disposal on Land: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents	(%)	(Gg CO_2 equivalents	(%)			
EU-15	128.244	71.227	69.607	79,0%	-1.620	-2%	-58.637	-46%			
Bulgaria	10.712	6.847	6.674	7,6%	-173	-3%	-4.037	-38%	T2	NS	CS, D
Cyprus	305	508	521	0,6%	13	3%	215	71%	T1	NS, Q	D
Czech Republic	1.663	2.367	2.417	2,7%	50	2%	754	45%	T2	NS	D
Estonia	600	542	516	0,6%	-26	-5%	-84	-14%	the FOD	CS	D
Hungary	2.264	2.957	2.956	3,4%	-2	0%	692	31%	T2	NS	D
Latvia	279	514	533	0,6%	19	4%	254	91%	T2	NS	D
Lithuania	690	588	581	0,7%	-7	-1%	-109	-16%	T2	NS	D
Malta	NA	164	172	0,2%	8	5%	172	-	CS	NS, PS	CS
Poland	IE	IE	IE	-	-	-	-	-	0,0	0,0	0,0
Romania	NO	2.618	2.711	3,1%	93	4%	2.711	-	T1	NS	D
Slovakia	IE	976	975	1,1%	-1	0%	975	-	T2	NS	CS
Slovenia	345	476	453	0,5%	-23	-5%	108	31%	T2	NS, PS	D
EU-27	**145.101**	**89.783**	**88.116**	**100,0%**	**-1.667**	**-2%**	**-56.986**	**-39%**			

Table 8.33 6A2 Unmanaged Waste Disposal on Land: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents	(%)	(Gg CO_2 equivalents	(%)			
EU-15	11.626	6.677	6.346	43,5%	-331	-5%	-5.280	-45%			
Bulgaria	NE	NE	NE	-	-	-	-	-	NO	NO	NO
Cyprus	70	96	98	0,7%	2	3%	28	41%	T1	NS, Q	D
Czech Republic	NO	NO	NO	-	-	-	-	-	0,0	0,0	0,0
Estonia	NO	NO	NO	-	-	-	-	-	NO	NA	NA
Hungary	NA,NO	NO	NO	-	-	-	-	-	---	---	---
Latvia	NE	NO	NO	-	-	-	-	-	NO	NO	NO
Lithuania	387	329	325	2,2%	-4	-1%	-61	-16%	T2	NS	D
Malta	82	NA,NO	NA,NO	-	-	-	-82	-100%	CS	NS, PS	CS
Poland	5.157	5.047	5.203	-	-	-	-	-	0,0	0,0	0,0
Romania	2.393	2.867	2.615	17,9%	-252	-9%	222	9%	T1	NS	D
Slovakia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
Slovenia	NO	NO	NO	-	-	-	-	-	NO	NO	NO
EU-27	**19.714**	**15.017**	**14.588**	**100,0%**	**-429**	**-3%**	**-5.126**	**-26%**			

8.7.2.2 Wastewater handling (CRF Source Category 6B) (EU-27)

Table 8.34 6B2 Domestic and commercial wastewater: CH_4 emissions of EU-27

Member State	CH_4 emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9.238	6.638	6.745	64,9%	107	2%	-2.494	-27%			
Bulgaria	498	441	440	4,2%	-1	0%	-58	-12%	D	NS	D
Cyprus	18	24	24	0,2%	0	1%	6	35%	D	NS, Q	D
Czech Republic	214	185	188	1,8%	3	2%	-26	-12%	D	NS	CS
Estonia	IE,NO	IE,NO	IE,NO	-	-	-	-	-	NO	NA	NA
Hungary	786	526	484	4,7%	-42	-8%	-302	-38%	CS	NS	D
Latvia	294	183	182	1,7%	-1	-1%	-113	-38%	T1	NS	D
Lithuania	605	352	376	3,6%	24	7%	-229	-38%	T1	NS	D
Malta	20	17	17	0,2%	0	1%	-3	-16%	CS	NS, PS	CS
Poland	1.134	841	859	8,3%	18	2%	-276	-24%	0,0	0,0	0,0
Romania	228	615	613	5,9%	-2	0%	385	169%	D	NS	D
Slovakia	388	372	371	3,6%	-1	0%	-17	-4%	T1	NS	CS
Slovenia	102	96	97	0,9%	0	0%	-5	-5%	T1	NS, Q	D
EU-27	**13.526**	**10.291**	**10.396**	**100,0%**	**105**	**1%**	**-3.130**	**-23%**			

Table 8.35 6B2 Domestic and Commercial Wastewater: N_2O emissions of EU-27

Member State	N_2O emissions (Gg CO_2 equivalents)			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007		Method applied	Activity data	Emission factor
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)			
EU-15	9.179	9.702	9.773	81,5%	71	1%	594	6%			
Bulgaria	224	145	144	1,2%	0	0%	-79	-35%	D	NS	D
Cyprus	IE,NE	IE,NE	IE,NE	-	-	-	-	-	NE	NE	NE
Czech Republic	162	200	201	1,7%	1	1%	40	25%	D	NS	D
Estonia	40	39	39	0,3%	0	0%	-2	-4%	T1	CS	D
Hungary	214	206	206	1,7%	0	0%	-8	-4%	D	NS	D
Latvia	57	49	49	0,4%	0	-1%	-8	-14%	T1	NS	D
Lithuania	80	76	76	0,6%	0	0%	-4	-5%	T1	NS	D
Malta	10	11	11	0,1%	0	1%	1	13%	D	NS	CS
Poland	1.096	1.083	1.083	9,0%	0	0%	-13	-1%	0,0	0,0	0,0
Romania	174	291	294	2,5%	3	1%	120	69%	D	NS	D
Slovakia	78	50	50	0,4%	0	0%	-28	-	T1	NS	CS
Slovenia	60	63	63	0,5%	0	1%	4	6%	T1	NS, IS	D
EU-27	**11.373**	**11.915**	**11.989**	**100,0%**	**74**	**1%**	**616**	**5%**			

Abbreviations explained in the Chapter ‘Units and abbreviations’.

8.7.2.3 Waste incineration (CRF Source Category 6C) (EU-27)

Table 8.36 6C Waste incineration: CO_2 emissions of EU-27

Member State	CO_2 emissions in Gg			Share in EU27 emissions in 2007	Change 2006-2007		Change 1990-2007	
	1990	2006	2007		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
EU-15	4.436	2.665	2.445	68,0%	-221	-8%	-1.991	-45%
Bulgaria	NO	NO	NO	-	-	-	-	-
Cyprus	NA	NA	NA	-	-	-	-	-
Czech Republic	IE,NE	386	413	11,5%	27	7%	413	-
Estonia	NA	NA	NA	-	-	-	-	-
Hungary	63	382	388	10,8%	6	2%	325	517%
Latvia	NE,NO	2	1	0,0%	0	-22%	1	-
Lithuania	4	5	2	0,0%	-4	-72%	-2	-61%
Malta	0	0	0	0,0%	0	0%	0	-63%
Poland	459	309	312	8,7%	2	1%	-147	-32%
Romania	NE,NO	383	28	0,8%	-355	-93%	28	-
Slovakia	67	23	8	0,2%	-14	-63%	-58	-87%
Slovenia	NO	IE	IE	-	-	-	-	-
EU-27	**5.028**	**4.155**	**3.597**	**100,0%**	**-558**	**-13%**	**-1.431**	**-28%**

Abbreviations explained in the Chapter 'Units and abbreviations'.

9 Other (CRF Sector 7)

The 2009 GHG inventory does not include any GHG emissions anymore in CRF sector 7. The 2008 inventory had included negative emissions related to non-EC territory; they were deducted from the EU-territory because the data for the UK for the other sectors included these territories. In 2009, the UK provided a GHG inventory at sectoral level for the EC territory; therefore no negative emissions have to be deducted this year.

10 Recalculations and improvements

10.1 Explanations and justifications for recalculations

Tables 10.1 to 10.4 provide an overview of the main reasons for recalculating emissions in the year 1990 and 2006 for each Member State, which provided the relevant information, and by source categories, for the largest recalculations. For more details see the information provided by the Member States' submissions in Annex 13.

Table 10.1 Main recalculations by EC Member States for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
MS	**Source category**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
AT	1.AA.3.B-Road Transportation,,Diesel Oil,CO_2,,(Gg)	1990	5344	4013	1331	33	AD	Update of statistical energy data, particularly the biodiesel consumption. As the new study for off-road traffic (see description for 1.A.4 Other sectors – mobile) concludes that less fuel is used by off-road vehicles, especially in industry and forestry, and that the overall fuel consumption is known, this decrease in fuel consumption had to be counterbalanced by an increase of fuel tourism.
DE	4.D.3.2-Nitrogen Leaching and Run-off,,,N_2O,,(Gg)	1990	12	39	-8198	-68	EF	A lower emission factor has been used.
DE	4.A-Enteric Fermentation,,Dairy Cattle,CH_4,,(Gg)	1990	457	603	-3050	-24	M EF	Estimation of a new MCF. Use of a different mean emission factor
DE	4.D.1.2-Animal Manure Applied to Soils,,,N_2O,,(Gg)	1990	16	24	-2605	-34	EF	New emission factor according to 2006 IPCC guidelines.
DE	4.D.1.1-Synthetic Fertilizers,,,N_2O,,(Gg)	1990	34	41	-2176	-17	EF	Changed emission factors (in IPCC 2006) for direct emissions from synthetic fertilizers.
DE	4.B-Manure Management,,,N_2O,Solid storage and dry lot,(Gg)	1990	5	12	-2165	-59	EF	Change of emission factor, according to IPCC 2006.
DE	6.B.2.1-Domestic and Commercial (w/o human sewage),,Wastewater,CH_4,,(Gg)	1990	54	106	-1090	-49	EF	Latest year is correct. Previous year is the result of a misentry, which had no effect to time serie as a whole.
DE	6.B.2.1-Domestic and Commercial (w/o human sewage),,Sludge,CH_4,,(Gg)	1990	52	NO	1090	inf+	EF	Latest year is correct. Previous year is the result of a misentry, which had no effect to time serie as a whole.
DE	4.B-Manure Management,,Swine,CH_4,,(Gg)	1990	130	77	1106	68	AD	Activity data has been updated.
FR	6.A.1-Managed Waste Disposal on Land,,,CH_4,,(Gg)	1990	198	299	-2116	-34	AD	Le carbone organique dégradable (COD) a été revu sur la base de résultats de campagnes de mesure ADEME sur la composition des déchets mis en décharge.
FR	6.A.2-Unmanaged Waste Disposal Sites,,,CH_4,,(Gg)	1990	153	230	-1621	-34	AD	Le carbone organique dégradable (COD) a été revu sur la base de résultats de campagnes de mesure ADEME sur la composition des déchets mis en décharge.
FR	1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	1990	17867	16401	1466	9	M	la prise en compte de l'utilisation de castine (calcaire) dans le procédé d'agglomération de minerai, qui pour des raisons techniques est imputée en combustion pour cette édition de l'inventaire, une révision des consommations des ateliers annexes tels que les fours de réchauffage à partir de données fournies par la fédération française de l'acier ;
FR	1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	1990	18963	17095	1867	11	EF	
GB	7 OTHER:(CO_2)	1990	NA	-2901	2901	-100	M	Change to geographical coverage used.
HU	4.B-Manure Management,,Swine,CH_4,,(Gg)	1990	95	26	1446	262	M	Implementation of Tier 2

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
MS	**Source category**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
RO	6.B.2.1-Domestic and Commercial (w/o human sewage),,Wastewater,CH_4,,(Gg)	1990	0	64	-1325	-99	AD	new data have been provided regarding to the aerobic and anaerobic treatment
RO	6.B.2-Domestic and Commercial Wastewater,,,CH_4,,(Gg)	1990	11	64	-1106	-83	AD	new data have been provided regarding to the aerobic and anaerobic treatment
SK	1.AA.2.A-Iron and Steel,,Gaseous Fuels,CO_2,,(Gg)	1990	1301	6526	-5225	-80	All	Reallocation of blasr-furnace gas from gaseous fuel to solid fuels.
SK	1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	1990	7672	2447	5225	214	All	Reallocation of blasr-furnace gas from gaseous fuel to solid fuels.

Table 10.2 Main recalculations by EC Member States for 2006 and Member States' explanations for recalculations given in the CRF or in the NIR

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
MS	**Source category**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
CZ	1.AA.2.C-Chemicals,,Solid Fuels,CO_2,,(Gg)	2006	505	9938	-9433	-95	M AD	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector Recalculated from the final Energy balance
CZ	1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	2006	1196	2372	-1177	-50	M	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector
CZ	1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2,,(Gg)	2006	53844	52264	1580	3	M AD	In the 2008 submissions activity data were used from the preliminary energy balance. These data were in the 2009 submission substituted by the activity data fro the final energy balance Activity data revised from the final Energy balance, explanation given in NIR
CZ	1.AA.4.B-Residential,,Solid Fuels,CO_2,,(Gg)	2006	3464	1735	1729	100	M AD	In the 2008 submissions activity data were used from the preliminary energy balance. These data were in the 2009 submission substituted by the activity data fro the final energy balance Activity data revised from the final Energy balance, explanation given in NIR
CZ	1.AA.2.C-Chemicals,,Liquid Fuels,CO_2,,(Gg)	2006	3027	1186	1840	155	M	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector
CZ	1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	2006	4970	1176	3794	323	M	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector
CZ	1.AA.2.F-Other (please specify),,Solid Fuels,CO_2,,(Gg)	2006	7009	3099	3910	126	M	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector
DE	1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2,,(Gg)	2006	277484	284723	-7239	-3	M AD	improvement of the calculation method as a result of quality control new available data

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
MS	**Source category**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
DE	4.D.3.2-Nitrogen Leaching and Run-off,,,N_2O,,(Gg)	2006	11	32	-6692	-67	EF	A lower emission factor has been used.
DE	1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	2006	11715	16635	-4920	-30	EF	Revision of activity data from 2003 onwards
DE	1.AA.4.B-Residential,,Gaseous Fuels,CO_2,,(Gg)	2006	53750	56951	-3202	-6	AD	new available data
DE	1.AA.3.A-Civil Aviation,,Jet Kerosene,CO_2,,(Gg)	2006	2238	5290	-3051	-58	AD	Recalculations are due to a) separate reporting of Aviation Gasoline and b) a changed split factor used for separating national and international aviation.
DE	1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	2006	4343	7393	-3051	-41	AD	new available data
DE	4.A-Enteric Fermentation,,Dairy Cattle,CH_4,,(Gg)	2006	372	480	-2272	-23	M AD EF	Estimation of a new MCF. Use of a different mean emission factor Population data has been updated.
DE	4.D.1.2-Animal Manure Applied to Soils,,,N_2O,,(Gg)	2006	14	20	-2001	-32	EF	New emission factor according to 2006 IPCC guidelines.
DE	1.AA.2.F-Other (please specify),,Gaseous Fuels,CO_2,,(Gg)	2006	48438	50241	-1802	-4	EF	Revision of activity data from 2003 onwards
DE	4.B-Manure Management,,,N_2O,Solid storage and dry lot,(Gg)	2006	3	9	-1656	-63	EF	Change of emission factor, according to IPCC 2006.
DE	4.D.1.1-Synthetic Fertilizers,,,N_2O,,(Gg)	2006	28	33	-1655	-16	EF	Changed emission factors (in IPCC 2006) for direct emissions from synthetic fertilizers.
DE	1.AA.3.B-Road Transportation,,Gasoline,CO_2,,(Gg)	2006	66894	68536	-1642	-2	AD	Changes are due to recalculations because of the newly reported use of bio-ethanol which is reported under biomass.
DE	1.AA.4.A-Commercial/Institutional,,Gaseous Fuels,CO_2,,(Gg)	2006	24350	25925	-1575	-6	AD	new available data
DE	1.AA.2.F-Other (please specify),,Solid Fuels,CO_2,,(Gg)	2006	16258	17816	-1558	-9	EF	Revision of activity data from 2003 onwards
DE	1.AA.1.A-Public Electricity and Heat Production,,Liquid Fuels,CO_2,,(Gg)	2006	3916	5050	-1134	-22	AD	new available data
DE	4.D.1.4-Crop Residue,,,N_2O,,(Gg)	2006	9	5	1135	74	M EF	Emissions from crop residues have been estimated dependent on harvest. Transcription error has been corrected. It is considerred that parts of the straw has been used as litter in animal husbandry.
DE	1.AA.1.B-Petroleum Refining,,Liquid Fuels,CO_2,,(Gg)	2006	21872	19304	2568	13	EF	new available data
DE	1.AA.2.F-Other (please specify),,Other Fuels,CO_2,,(Gg)	2006	6617	3856	2760	72	AD	Revision of activity data from 2003 onwards
DE	1.AA.1.A-Public Electricity and Heat Production,,Gaseous Fuels,CO_2,,(Gg)	2006	39591	30236	9356	31	EF	new available data
ES	1.AA.2.F-Other (please specify),,Gaseous Fuels,CO_2,,(Gg)	2006	15540	16577	-1037	-6	EF	Revision of energy balance
ES	6.A.1-Managed Waste Disposal on Land,,,CH_4,,(Gg)	2006	408	346	1316	18	EF	This recalculation is motivated by the revision of the waste disposed of in landfills. The new activity rates come from new data obtained from individual questionnaires administered to the large landfills.
FR	6.A.1-Managed Waste Disposal on Land,,,CH_4,,(Gg)	2006	219	330	-2328	-34	EF	Le carbone organique dégradable (COD) a été revu sur la base de résultats de campagnes de mesure ADEME sur la composition des déchets mis en décharge.
FR	4.A-Enteric Fermentation,,Non-Dairy Cattle,CH_4,,(Gg)	2006	763	811	-1014	-6	EF	Les facteurs d’émission de la fermentation entérique ont été revus et appliqués à toute la série temporelle des émissions.

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
MS	**Source category**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
FR	4.A-Enteric Fermentation,,Dairy Cattle,CH_4,,(Gg)	2006	455	405	1053	12	EF	Les facteurs d'émission de la fermentation entérique ont été revus et appliqués à toute la série temporelle des émissions.
FR	1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	2006	15103	13497	1606	12	M	la prise en compte de l'utilisation de castine (calcaire) dans le procédé d'agglomération de minerai, qui pour des raisons techniques est imputée en combustion pour cette édition de l'inventaire, une révision des consommations des ateliers annexes tels que les fours de réchauffage à partir de données fournies par la fédération française de l'acier ;
FR	1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	2006	14820	13040	1779	14	EF	une révision des consommations des GIC; la mise à jour du bilan énergétique national produit par l'Observatoire de l'énergie; non decompte des brais de cimenterie du bilan energie
GB	1.AA.3.B-Road Transportation,,Gasoline,N_2O,,(Gg)	2006	624	3751	-3127	-83	EF	Change to N_2O factors, revised from COPERT4 and Emissions Inventory Guidebook
GB	1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2,,(Gg)	2006	125957	128541	-2584	-2	M EF AD	Change to geographical coverage used. Introduction of EUETS based emission factors for coal fired power stations Revision to activity data presented in UK National Statistics (DUKES)
GB	1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	2006	19699	21949	-2250	-10	M AD	Revision to the reported geopraphical coverage.Overall, fuel from this category did not change but the coverage of emissions reported has Revision to the methodology to reflect the significant reduction in the use of lubricants due to the Waste Incineration Directive Revision to activity data presented in UK National Statistics (DUKES)
GB	1.AA.2.F-Other (please specify),,Gaseous Fuels,CO_2,,(Gg)	2006	33912	32744	1168	4	M	Reallocation of gas use to coke in the lime industry following updated information from industry
GB	7 OTHER:(CO_2)	2006	NA	-3026	3026	-100	M	Change to geographical coverage used.
GR	2.E.1-By-product ,,Actual HFCs,,(Gg CO_2 equivalent)	2006	NA,NO	2290	-2290	-100	M	The one plant existing in Greece has closed in 2006.
GR	2.F.1-Refrigeration and Air Conditioning Equipment,,,Actual HFCs,,(Gg CO_2 equivalent)	2006	596	2357	-1761	-75	M	As requested by the ERT the National Association of Refrigerating and Cooling Technicians and main refrigerant importers have been contacted. In the meeting held on the21rst of November 2008 the main assumptions have been investigated and re-estimated so as to depict the reality. All the time series have been recalculated according to the latest expert opinion.
IT	1.AA.3.B-Road Transportation,,Diesel Oil,N_2O,,(Gg)	2006	3	7	-1432	-64	M	The whole time series has been revised due to the application of the updated version of COPERT model (COPERT 4)
IT	1.AA.3.B-Road Transportation,,Gasoline,N_2O,,(Gg)	2006	2	5	-1051	-65	M	The whole time series has been revised due to the application of the updated version of COPERT model (COPERT 4)

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
MS	**Source category**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
NL	1.AA.4.C-Agriculture/Forestry/Fisheries,,Gaseous Fuels,CO_2,,(Gg)	2006	6299	7469	-1171	-16	Oth	For 2006 an erroneous allocation of gaseous fuels and corresponding emissions was removed from 1.AA.4.C Agriculture/Forestry/Fisheries to 1.AA.4.A Commercial/Institutional.
NL	1.AA.4.A-Commercial/Institutional,,Gaseous Fuels,CO_2,,(Gg)	2006	11480	10309	1171	11	Oth	For 2006 an erroneous allocation of gaseous fuels and corresponding emissions was removed from 1.AA.4.C Agriculture/Forestry/Fisheries to 1.AA.4.A Commercial/Institutional.
PL	1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2,,(Gg)	2006	169472	172612	-3140	-2	AD	Activity data on fuel consumption for years 1990-2006 were updated due to correction made in EUROSTATdatabase.
PL	1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	2006	5656	7583	-1927	-25	M	For 2005-2006 CO_2 emission values were verified for 2.C.1 sub-categories as follows: Iron Ore Sintering,. Blast Furnaces Process, Basic Oxygen Furnace Steel and Electric Furnace Steel. For the sub-categories listed above, CO_2 emission values were taken from verified reports. For the reason, that these emissions include also emissions from fuel consumption in the mentioned processes, this fuel consumption was subtracted from 1.A.2.a)
PL	2.C.1-Iron and Steel Production,,,CO_2,,(Gg)	2006	8367	4096	4271	104	M	For 2005-2006 CO_2 emission values were verified for 2.C.1 sub-categories as follows: Iron Ore Sintering,. Blast Furnaces Process, Basic Oxygen Furnace Steel and Electric Furnace Steel. For the sub-categories listed above, CO_2 emission values were taken from verified reports. For the reason, that these emissions include also emissions from fuel consumption in the mentioned processes, this fuel consumption was subtracted from 1.A.2.a)
PT	1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	2006	4609	3581	1029	29	AD All	Update of activity data for several industries. Introduction of biodiesel.
RO	6.B.2.1-Domestic and Commercial (w/o human sewage),,Wastewater,CH_4,,(Gg)	2006	0	60	-1252	-99	EF	new data have been provided regarding to the aerobic and anaerobic treatment
SK	1.AA.2.A-Iron and Steel,,Gaseous Fuels,CO_2,,(Gg)	2006	921	4898	-3978	-81	M	Reallocation of blasr-furnace gas from gaseous fuel to solid fuels.
SK	1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	2006	6350	2357	3993	169	M	Reallocation of blasr-furnace gas from gaseous fuel to solid fuels.

Table 10.3 Main recalculations by source category for 1990 and Member States' explanations for recalculations given in the CRF or in the NIR

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
Source category	**MS**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
1.AA.2.A-Iron and Steel,,Gaseous Fuels,CO_2,,(Gg)	SK	1990	1301	6526	-5225	-80	M	Reallocation of blast-furnace gas from gaseous fuel to solid fuels.

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
Source category	**MS**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	FR	1990	17867	16401	1466	9	M	la prise en compte de l'utilisation de castine (calcaire) dans le procédé d'agglomération de minerai, qui pour des raisons techniques est imputée en combustion pour cette édition de l'inventaire, une révision des consommations des ateliers annexes tels que les fours de réchauffage à partir de données fournies par la fédération française de l'acier ;
1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	SK	1990	7672	2447	5225	214	M	Reallocation of blast-furnace gas from gaseous fuel to solid fuels.
1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	FR	1990	18963	17095	1867	11	EF All	une révision des consommations des GIC; la mise à jour du bilan énergétique national produit par l'Observatoire de l'énergie; non decompte des brais de cimenterie du bilan energie; un transfert d'une partie des consommations des chaudières <50MW dans les engins mobiles de l'industrie et du BTP.
1.AA.3.B-Road Transportation,,Diesel Oil,CO_2,,(Gg)	AT	1990	5344	4013	1331	33	AD	Update of statistical energy data, particularly the biodiesel consumption. As the new study for off-road traffic concludes that less fuel is used by off-road vehicles, especially in industry and forestry, and that the overall fuel consumption is known, this decrease in fuel consumption had to be counterbalanced by an increase of fuel tourism.
4.A-Enteric Fermentation,,Dairy Cattle,CH_4,,(Gg)	DE	1990	457	603	-3050	-24	M EF AD	Estimation of a new MCF Use of a different mean emission factor Population data has been updated.
4.B-Manure Management,,,N_2O,Solid storage and dry lot,(Gg)	DE	1990	5	12	-2165	-59	EF	Change of emission factor, according to IPCC 2006.
4.B-Manure Management,,Swine,CH_4,,(Gg)	DE	1990	130	77	1106	68	AD	Activity data has been updated.
4.B-Manure Management,,Swine,CH_4,,(Gg)	HU	1990	95	26	1446	262	M	Implementation of Tier 2
4.D.1.1-Synthetic Fertilizers,,,N_2O,,(Gg)	DE	1990	34	41	-2176	-17	EF	Changed emission factors (in IPCC 2006) for direct emissions from synthetic fertilizers.
4.D.1.2-Animal Manure Applied to Soils,,,N_2O,,(Gg)	DE	1990	16	24	-2605	-34	EF	New emission factor according to 2006 IPCC guidelines.
4.D.3.2-Nitrogen Leaching and Run-off,,,N_2O,,(Gg)	DE	1990	12	39	-8198	-68	EF	A lower emission factor has been used.
6.A.1-Managed Waste Disposal on Land,,,CH_4,,(Gg)	FR	1990	198	299	-2116	-34	AD	Le carbone organique dégradable (COD) a été revu sur la base de résultats de campagnes de mesure ADEME sur la composition des déchets mis en décharge.
6.A.2-Unmanaged Waste Disposal Sites,,,CH_4,,(Gg)	FR	1990	153	230	-1621	-34	AD	Le carbone organique dégradable (COD) a été revu sur la base de résultats de campagnes de mesure ADEME sur la composition des déchets mis en décharge.
6.B.2.1-Domestic and Commercial (w/o human sewage),,Sludge,CH_4,,(Gg)	DE	1990	52	NO	1090	inf+	EF	Latest year is correct. Previous year is the result of a misentry, which had no effect to time serie as a whole.
6.B.2.1-Domestic and Commercial (w/o human sewage),,Wastewater,CH_4,,(Gg)	RO	1990	0	64	-1325	-99	AD	new data have been provided regarding to the aerobic and anaerobic treatment
6.B.2.1-Domestic and Commercial (w/o human sewage),,Wastewater,CH_4,,(Gg)	DE	1990	54	106	-1090	-49	EF	Latest year is correct. Previous year is the result of a misentry, which had no effect to time serie as a whole.
6.B.2-Domestic and Commercial Wastewater,,,CH_4,,(Gg)	RO	1990	11	64	-1106	-83	AD	new data have been provided regarding to the aerobic and anaerobic treatment

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
Source category	**MS**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
7 OTHER:(CO_2)	GB	1990	NA	-2901	2901	-100	M	Change to geographical coverage used.

Table 10.4 Main recalculations by source category for 2006 and Member States' explanations for recalculations given in the CRF or in the NIR

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
Source category	**MS**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
1.AA.1.A-Public Electricity and Heat Production,,Gaseous Fuels,CO_2,,(Gg)	DE	2006	39591	30236	9356	31	AD	new available data
1.AA.1.A-Public Electricity and Heat Production,,Liquid Fuels,CO_2,,(Gg)	DE	2006	3916	5050	-1134	-22	AD	new available data
1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2,,(Gg)	DE	2006	277484	284723	-7239	-3	M AD	improvement of the calculation method as a result of quality control new available data
1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2,,(Gg)	PL	2006	169472	172612	-3140	-2	M AD	Activity data on fuel consumption for years 1990-2006 were updated due to correction made in EUROSTATdatabase. CO_2 emissions for individual sub-sectors of 1.A category for 2006 were verified forharmonization of distribution of particular ETS installations into given sub-categories for the years 2005, 2006 and 2007
1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2,,(Gg)	GB	2006	125957	128541	-2584	-2	M EF, AD	Change to geographical coverage used. Introduction of EUETS based emission factors for coal fired power stations Revision to activity data presented in UK National Statistics (DUKES)
1.AA.1.A-Public Electricity and Heat Production,,Solid Fuels,CO_2,,(Gg)	CZ	2006	53844	52264	1580	3	M AD	In the 2008 submissions activity data were used from the preliminary energy balance. These data were in the 2009 submission substituted by the activity data fro the final energy balance Activity data revised from the final Energy balance, explanation given in NIR
1.AA.1.B-Petroleum Refining,,Liquid Fuels,CO_2,,(Gg)	DE	2006	21872	19304	2568	13	AD	new available data
1.AA.2.A-Iron and Steel,,Gaseous Fuels,CO_2,,(Gg)	SK	2006	921	4898	-3978	-81	M	Reallocation of blasr-furnace gas from gaseous fuel to solid fuels.
1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	DE	2006	4343	7393	-3051	-41	AD	new available data
1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	PL	2006	5656	7583	-1927	-25	M	For 2005-2006 CO_2 emission values were verified for 2.C.1 sub-categories as follows: Iron Ore Sintering,. Blast Furnaces Process, Basic Oxygen Furnace Steel and Electric Furnace Steel. For the sub-categories listed above, CO_2 emission values were taken from verified reports. For the reason, that these emissions include also emissions from fuel consumption in the mentioned processes, this fuel consumption was subtracted from 1.A.2.a)

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
Source category	**MS**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	FR	2006	15103	13497	1606	12	M	la prise en compte de l'utilisation de castine (calcaire) dans le procédé d'agglomération de minerai, qui pour des raisons techniques est imputée en combustion pour cette édition de l'inventaire, une révision des consommations des ateliers annexes tels que les fours de réchauffage à partir de données fournies par la fédération française de l'acier ;
1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	CZ	2006	4970	1176	3794	323	M	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector
1.AA.2.A-Iron and Steel,,Solid Fuels,CO_2,,(Gg)	SK	2006	6350	2357	3993	169	M	Reallocation of blasr-furnace gas from gaseous fuel to solid fuels.
1.AA.2.C-Chemicals,,Liquid Fuels,CO_2,,(Gg)	CZ	2006	3027	1186	1840	155	M	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector
1.AA.2.C-Chemicals,,Solid Fuels,CO_2,,(Gg)	CZ	2006	505	9938	-9433	-95	M AD	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector Recalculated from the final Energy balance
1.AA.2.F-Other (please specify),,Gaseous Fuels,CO_2,,(Gg)	DE	2006	48438	50241	-1802	-4	EF	Revision of activity data from 2003 onwards
1.AA.2.F-Other (please specify),,Gaseous Fuels,CO_2,,(Gg)	ES	2006	15540	16577	-1037	-6	AD	Revision of energy balance
1.AA.2.F-Other (please specify),,Gaseous Fuels,CO_2,,(Gg)	GB	2006	33912	32744	1168	4	M	Reallocation of gas use to coke in the lime industry following updated information from industry
1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	DE	2006	11715	16635	-4920	-30	AD	Revision of activity data from 2003 onwards
1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	GB	2006	19699	21949	-2250	-10	M AD	Revision to the reported geopraphical coverage.Overall, fuel from this category did not change but the coverage of emissions reported has Revision to the methodology to reflect the significant reduction in the use of lubricants due to the Waste Incineration Directive Revision to activity data for fuel oil presented in UK National Statistics (DUKES)
1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	CZ	2006	1196	2372	-1177	-50	M	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector
1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	PT	2006	4609	3581	1029	29	AD All	Update of activity data for several industries. Introduction of biodiesel.
1.AA.2.F-Other (please specify),,Liquid Fuels,CO_2,,(Gg)	FR	2006	14820	13040	1779	14	EF, All	une révision des consommations des GIC; la mise à jour du bilan énergétique national produit par l'Observatoire de l'énergie; non decompte des brais de cimenterie du bilan energie un transfert d'une partie des consommations des chaudières <50MW dans les engins mobiles de l'industrie et du BTP.
1.AA.2.F-Other (please specify),,Other Fuels,CO_2,,(Gg)	DE	2006	6617	3856	2760	72	AD	Revision of activity data from 2003 onwards
1.AA.2.F-Other (please specify),,Solid Fuels,CO_2,,(Gg)	DE	2006	16258	17816	-1558	-9	AD	Revision of activity data from 2003 onwards
1.AA.2.F-Other (please specify),,Solid Fuels,CO_2,,(Gg)	CZ	2006	7009	3099	3910	126	M	For all 1A2: As mentioned in the sheet "Sector specific findings 2009", there are some allocation problems within 1A2 sector

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
Source category	**MS**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
1.AA.3.A-Civil Aviation,,Jet Kerosene,CO_2,,(Gg)	DE	2006	2238	5290	-3051	-58	AD	Recalculations are due to a) separate reporting of Aviation Gasoline and b) a changed split factor used for separating national and international aviation.
1.AA.3.B-Road Transportation,,Diesel Oil,N_2O,,(Gg)	IT	2006	3	7	-1432	-64	M	The whole time series has been revised due to the application of the updated version of COPERT model (COPERT 4)
1.AA.3.B-Road Transportation,,Gasoline,CO_2,,(Gg)	DE	2006	66894	68536	-1642	-2	AD	Changes are due to recalculations because of the newly reported use of bio-ethanol which is reported under biomass.
1.AA.3.B-Road Transportation,,Gasoline,N_2O,,(Gg)	GB	2006	624	3751	-3127	-83	EF	Change to N_2O factors, revised from COPERT4 and Emissions Inventory Guidebook
1.AA.3.B-Road Transportation,,Gasoline,N_2O,,(Gg)	IT	2006	2	5	-1051	-65	M	The whole time series has been revised due to the application of the updated version of COPERT model (COPERT 4)
1.AA.4.A-Commercial/Institutional,,Gaseous Fuels,CO_2,,(Gg)	DE	2006	24350	25925	-1575	-6	AD	new available data
1.AA.4.A-Commercial/Institutional,,Gaseous Fuels,CO_2,,(Gg)	NL	2006	11480	10309	1171	11	All	For 2006 an erroneous allocation of gaseous fuels and corresponding emissions was removed from 1.AA.4.C Agriculture/Forestry/Fisheries to 1.AA.4.A Commercial/Institutional.
1.AA.4.B-Residential,,Gaseous Fuels,CO_2,,(Gg)	DE	2006	53750	56951	-3202	-6	AD	new available data
1.AA.4.B-Residential,,Solid Fuels,CO_2,,(Gg)	CZ	2006	3464	1735	1729	100	M AD	In the 2008 submissions activity data were used from the preliminary energy balance. These data were in the 2009 submission substituted by the activity data fro the final energy balance Activity data revised from the final Energy balance, explanation given in NIR
1.AA.4.C-Agriculture/Forestry/Fisheries,,Gaseous Fuels,CO_2,,(Gg)	NL	2006	6299	7469	-1171	-16	All	For 2006 an erroneous allocation of gaseous fuels and corresponding emissions was removed from 1.AA.4.C Agriculture/Forestry/Fisheries to 1.AA.4.A Commercial/Institutional.
2.C.1-Iron and Steel Production,,,CO_2,,(Gg)	PL	2006	8367	4096	4271	104	M	For 2005-2006 CO_2 emission values were verified for 2.C.1 sub-categories as follows: Iron Ore Sintering,. Blast Furnaces Process, Basic Oxygen Furnace Steel and Electric Furnace Steel. For the sub-categories listed above, CO_2 emission values were taken from verified reports. For the reason, that these emissions include also emissions from fuel consumption in the mentioned processes, this fuel consumption was subtracted from 1.A.2.a)
2.E.1-By-product ,,Actual HFCs,,(Gg CO_2 equivalent)	GR	2006	NA,NO	2290	-2290	-100	M	The one plant existing in Greece has closed in 2006.
2.F.1-Refrigeration and Air Conditioning Equipment,,,Actual HFCs,,(Gg CO_2 equivalent)	GR	2006	596	2357	-1761	-75	M	As requested by the ERT the National Association of Refrigerating and Cooling Technicians and main refrigerant importers have been contacted. In the meeting held on the21rst of November 2008 the main assumptions have been investigated and re-estimated so as to depict the reality. All the time series have been recalculated according to the latest expert opinion.

			Latest year	Previous year	Deviation		Recalculation explanation (actual submission)	
Source category	**MS**	**Year**	**Gg**	**Gg**	**Gg CO_2 Equ.**	**%**	**Type**	**Explanantion**
4.A-Enteric Fermentation,,Dairy Cattle,CH_4,,(Gg)	DE	2006	372	480	-2272	-23	M EF AD	Estimation of a new MCF. Use of a different mean emission factor Population data has been updated.
4.A-Enteric Fermentation,,Dairy Cattle,CH_4,,(Gg)	FR	2006	455	405	1053	12	EF	Les facteurs d'émission de la fermentation entérique ont été revus et appliqués à toute la série temporelle des émissions.
4.A-Enteric Fermentation,,Non-Dairy Cattle,CH_4,,(Gg)	FR	2006	763	811	-1014	-6	EF	Les facteurs d'émission de la fermentation entérique ont été revus et appliqués à toute la série temporelle des émissions.
4.B-Manure Management,,,N_2O,Solid storage and dry lot,(Gg)	DE	2006	3	9	-1656	-63	EF	Change of emission factor, according to IPCC 2006.
4.D.1.1-Synthetic Fertilizers,,,N_2O,,(Gg)	DE	2006	28	33	-1655	-16	EF	Changed emission factors (in IPCC 2006) for direct emissions from synthetic fertilizers.
4.D.1.2-Animal Manure Applied to Soils,,,N_2O,,(Gg)	DE	2006	14	20	-2001	-32	EF	New emission factor according to 2006 IPCC guidelines.
4.D.1.4-Crop Residue,,,N_2O,,(Gg)	DE	2006	9	5	1135	74	AD AD	Emissions from crop residues have been estimated dependent on harvest. Transcription error has been corrected. It is considerred that parts of the straw has been used as litter in animal husbandry.
4.D.3.2-Nitrogen Leaching and Run-off,,,N_2O,,(Gg)	DE	2006	11	32	-6692	-67	EF	A lower emission factor has been used.
6.A.1-Managed Waste Disposal on Land,,,CH_4,,(Gg)	FR	2006	219	330	-2328	-34	AD	Le carbone organique dégradable (COD) a été revu sur la base de résultats de campagnes de mesure ADEME sur la composition des déchets mis en décharge.
6.A.1-Managed Waste Disposal on Land,,,CH_4,,(Gg)	ES	2006	408	346	1316	18	AD	This recalculation is motivated by the revision of the waste disposed of in landfills. The new activity rates come from new data obtained from individual questionnaires administered to the large landfills.
6.B.2.1-Domestic and Commercial (w/o human sewage),,Wastewater,CH_4,,(Gg)	RO	2006	0	60	-1252	-99	EF AD	new data have been provided regarding to the aerobic and anaerobic treatment new data have been provided regarding to the population connected to sewerage and the fraction of DOC removed as Sludge
7 OTHER:(CO_2)	GB	2006	NA	-3026	3026	-100	M	Change to geographical coverage used.

10.2 Implications for emission levels

Table 10.5 provides the differences in total EU-15 GHG emissions between the latest submission and the previous submission in absolute and relative terms. The table shows that due to recalculations, total EU-15 1990 GHG emissions excluding LULUCF have decreased in the latest submission compared to the previous submission by 10992 Gg (-0.3 %). EU-15 GHG emissions for 2006 decreased by 35166 Gg (- 0.8 %) due to recalculations.

In the EU-27, 1990 GHG emissions excluding LULUCF have decreased by 13318 Gg (-0.2 %). For 2006, they decreased by 36577 Gg (-0.7 %) (Table 10.6).

Table 10.5 Overview of recalculations of EU-15 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total CO_2 equivalent emissions including LULUCF (absolute)	35.642	6.962	37.390	5.166	3.188	-17.425	18.960	4.215	10.603	-4.463	-6.490	-56.593	30.392
Total CO_2 equivalent emissions including LULUCF (percent)	0,9%	0,2%	1,0%	0,1%	0,1%	-0,5%	0,5%	0,1%	0,3%	-0,1%	-0,2%	-1,5%	0,8%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	-10.922	-4.827	-5.427	-5.773	-5.077	-7.841	-10.024	-10.278	-12.078	-27.115	-35.782	-44.709	-35.166
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0,26%	-0,1%	-0,1%	-0,1%	-0,1%	-0,2%	-0,2%	-0,2%	-0,3%	-0,6%	-0,8%	-1,1%	-0,8%

Table 10.6 Overview of recalculations of EU-27 total GHG emissions (difference between latest submission and previous submission in Gg CO_2 equivalents)

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Total CO_2 equivalent emissions including LULUCF (absolute)	53.490	10.054	36.032	7.567	2.288	-17.621	11.237	-2.662	8.511	-13.396	-11.178	-58.694	19.983
Total CO_2 equivalent emissions including LULUCF (percent)	1,0%	0,2%	0,7%	0,2%	0,0%	-0,4%	0,2%	-0,1%	0,2%	-0,3%	-0,2%	-1,2%	0,4%
Total CO_2 equivalent emissions excluding LULUCF (absolute)	-13.318	-7.071	-7.144	-7.203	-6.644	-8.161	-11.104	-11.483	-13.835	-29.262	-37.545	-43.495	-36.577
Total CO_2 equivalent emissions excluding LULUCF (percent)	-0,2%	-0,1%	-0,1%	-0,1%	-0,1%	-0,2%	-0,2%	-0,2%	-0,3%	-0,6%	-0,7%	-0,8%	-0,7%

Table 10.7 provides an overview of recalculations for the EU-15 key source categories for 1990 and 2006 (see Section 1.5 for information on identification of EU-15 key sources). The table shows that the largest recalculations in absolute terms were made in the key source N_2O from 4D: 'Agricultural Soils' for both 1990 and 2006.

Table 10.8 and Table 10.9 give an overview of absolute and percentage changes of Member States' emissions due to recalculations for 1990 and 2006. Large recalculations in absolute terms were made in Germany, Italy, Greece, the UK and Romania. Recalculations in relative terms of more than 3 % occurred in Germany, Greece, Cyprus and Malta.

Table 10.7 Recalculations for the EU-15 key source categories 1990 and 2006 (difference between latest submission and previous submission in Gg of CO_2 equivalents and in percentage)

Greenhouse Gas Source Categories	Gas	Recalculations 1990		Recalculations 2006	
		(Gg CO_2 equivalents)	(%)	(Gg CO_2 equivalents)	(%)
1A1 Energy Industries	CO_2	54	0,0%	1907	0,2%
1A1 Energy Industries	N_2O	32	0,3%	-2	0,0%
1A2 Manufacturing Industries	CO_2	840	0,1%	-7686	-1,4%
1A3 Transport	CO_2	1084	0,2%	-7668	-0,9%
1A3 Transport	CH_4	204	4,9%	-164	-9,6%
1A3 Transport	N_2O	-528	-7,9%	-6982	-37,5%
1A4 Other Sectors	CO_2	-1109	-0,2%	-6288	-1,0%
1A4 Other Sectors	CH_4	-56	-0,5%	346	5,4%
1A5 Other	CO_2	78	0,4%	-149	-2,0%
1B1 Solid Fuels	CH_4	-5	0,0%	0	0,0%
1B2 Oil and Natural Gas	CH_4	484	1,6%	251	1,1%
2A Mineral Products	CO_2	-247	-0,2%	-763	-0,6%
2B Chemical Industry	CO_2	88	0,3%	-267	-0,9%
2B Chemical Industry	N_2O	390	0,4%	-198	-0,5%
2C Metal Production	CO_2	-201	-0,3%	515	0,7%
2C Metal Production	PFC	0	0,0%	5	0,3%
2C Metal Production	SF_6	0	0,0%	2	0,1%
2E Production of Halocarbons and SF6	HFC	0	0,0%	-2158	-45,6%
2F Consumption of Halocarbons and SF6	HFC	11	1,9%	6	0,0%
2E Production of Halocarbons and SF6	PFC	0	0,0%	130	2,4%
2F Consumption of Halocarbons and SF6	SF_6	0	0,0%	130	2,4%
4A Enteric Fermentation	CH_4	-2124	-1,6%	-1445	-1,2%
4B Manure Management	CH_4	621	1,4%	385	0,9%
4B Manure Management	N_2O	-806	-3,2%	-411	-1,8%
4D Agricultural Soils	N_2O	-12570	-5,6%	-10166	-5,3%
6A Solid Waste Disposal on Land	CH_4	-3368	-2,3%	-662	-0,8%
6B Waste-water Handling	CH_4	19	0,1%	336	3,4%
6B Waste incineration		-21	-0,5%	42	1,6%

Note: Many of these source categories are more aggregated than the EU-15 key source categories identified in Section 1.5.

Table 10.8 Contribution of Member States to EU-27 and EU-15 recalculations of total GHG emissions without LULUCF for 1990–2006 (difference between latest submission and previous submission Gg of CO_2 equivalents)

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	-135	-118	-114	-126	-115	-92	-58	-196	-135	-188	112	-428	428
Belgium	-1.281	-744	-780	-744	-468	-387	-411	-314	-487	-517	-498	-427	-358
Denmark	47	19	23	30	-136	9	-175	-49	-10	-54	-99	-77	571
Finland	-84	-109	-128	-179	-193	-212	-232	-237	-225	-295	-305	-331	-356
France	-647	866	198	976	1.314	993	1.247	800	605	197	-181	-1.268	426
Germany	-12.480	-10.113	-10.014	-9.801	-9.849	-10.734	-11.330	-11.227	-10.875	-23.004	-30.363	-36.108	-24.789
Greece	960	-308	-557	-706	-412	-883	-1.105	-1.354	-1.625	-2.198	-2.371	-2.000	-5.023
Ireland	-142	-165	-158	-138	-102	-81	-78	-85	-74	-71	-97	-87	-80
Italy	-580	-771	-804	-946	-1.300	-1.379	-2.765	-3.034	-3.445	-3.678	-4.225	-4.260	-4.940
Luxembourg	-69	55	29	48	-38	-253	-214	-196	33	109	-117	100	-18
Netherlands	346	679	687	825	626	761	797	613	624	413	314	428	1.032
Portugal	160	79	56	94	100	138	-3	526	679	779	1.228	1.798	1.506
Spain	447	388	663	465	859	946	787	656	444	120	-21	263	-270
Sweden	-109	-110	-115	-137	-151	-131	-126	-160	-359	-490	42	300	1.122
UK	2.645	5.524	5.585	4.567	4.787	3.463	3.641	3.981	2.775	1.763	798	-2.615	-4.419
EU-15	**-10.922**	**-4.827**	**-5.427**	**-5.773**	**-5.077**	**-7.841**	**-10.024**	**-10.278**	**-12.078**	**-27.115**	**-35.782**	**-44.709**	**-35.166**
Bulgaria	956	552	422	494	-89	435	431	440	446	384	334	143	-18
Cyprus	-563	-347	-285	-170	-21	627	618	642	162	-199	-306	5	-40
Czech Republic	468	286	291	298	279	276	277	306	347	420	447	500	903
Estonia	343	61	117	142	34	65	133	293	170	178	303	324	304
Hungary	976	518	495	422	490	538	428	360	816	655	460	184	240
Latvia	223	78	60	72	76	70	82	79	72	69	112	83	50
Lithuania	-295	-136	-85	-106	-111	128	-154	-93	-39	-133	-113	-118	-347
Malta	-157	-187	-46	-123	-96	-130	-114	-148	-155	-173	-242	-270	-281
Poland	742	428	658	906	965	897	501	328	-121	61	657	3.013	606
Romania	-4.659	-3.329	-3.126	-3.088	-2.926	-3.008	-3.194	-3.247	-3.349	-3.365	-3.360	-2.600	-2.840
Slovakia	-423	-196	-168	-224	-110	-176	-75	-112	-126	-14	-14	42	35
Slovenia	-7	27	-50	-53	-58	-40	-11	-54	20	-29	-41	-90	-21
EU-27	**-13.318**	**-7.071**	**-7.144**	**-7.203**	**-6.644**	**-8.161**	**-11.104**	**-11.483**	**-13.835**	**-29.262**	**-37.545**	**-43.495**	**-36.577**

Table 10.9 Contribution of Member States to EU-27 and EU-15 recalculations of total GHG emissions without LULUCF for 1990–2006 (difference between latest submission and previous submission in percentage)

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Austria	-0,2	-0,1	-0,1	-0,2	-0,1	-0,1	-0,1	-0,2	-0,2	-0,2	0,1	-0,5	0,5
Belgium	-0,9	-0,5	-0,5	-0,5	-0,3	-0,3	-0,3	-0,2	-0,3	-0,4	-0,3	-0,3	-0,3
Denmark	0,1	0,0	0,0	0,0	-0,2	0,0	-0,3	-0,1	0,0	-0,1	-0,1	-0,1	0,8
Finland	-0,1	-0,2	-0,2	-0,2	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,4	-0,5	-0,4
France	-0,1	0,2	0,0	0,2	0,2	0,2	0,2	0,1	0,1	0,0	0,0	-0,2	0,1
Germany	-1,0	-0,9	-0,9	-0,9	-0,9	-1,1	-1,1	-1,1	-1,1	-2,2	-3,0	-3,6	-2,5
Greece	0,9	-0,3	-0,5	-0,6	-0,3	-0,7	-0,9	-1,0	-1,3	-1,6	-1,8	-1,5	-3,8
Ireland	-0,3	-0,3	-0,3	-0,2	-0,2	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1
Italy	-0,1	-0,1	-0,2	-0,2	-0,2	-0,3	-0,5	-0,5	-0,6	-0,6	-0,7	-0,7	-0,9
Luxembourg	-0,5	0,5	0,3	0,5	-0,4	-2,6	-2,1	-1,9	0,3	0,9	-0,9	0,8	-0,1
Netherlands	0,2	0,3	0,3	0,4	0,3	0,4	0,4	0,3	0,3	0,2	0,1	0,2	0,5
Portugal	0,3	0,1	0,1	0,1	0,1	0,2	0,0	0,6	0,8	0,9	1,4	2,1	1,8
Spain	0,2	0,1	0,2	0,1	0,3	0,3	0,2	0,2	0,1	0,0	0,0	0,1	-0,1
Sweden	-0,2	-0,1	-0,1	-0,2	-0,2	-0,2	-0,2	-0,2	-0,5	-0,7	0,1	0,4	1,7
UK	0,3	0,8	0,8	0,6	0,7	0,5	0,5	0,6	0,4	0,3	0,1	-0,4	-0,7
EU-15	**-0,3**	**-0,1**	**-0,1**	**-0,1**	**-0,1**	**-0,2**	**-0,2**	**-0,2**	**-0,3**	**-0,6**	**-0,8**	**-1,1**	**-0,8**
Bulgaria	0,8	0,6	0,5	0,6	-0,1	0,6	0,6	0,6	0,7	0,5	0,5	0,2	0,0
Cyprus	-9,3	-4,8	-3,8	-2,2	-0,3	7,5	7,1	7,4	1,8	-2,1	-3,1	0,0	-0,4
Czech Republic	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,3	0,3	0,3	0,6
Estonia	0,8	0,3	0,5	0,7	0,2	0,4	0,7	1,6	0,9	0,9	1,5	1,7	1,6
Hungary	1,0	0,7	0,6	0,5	0,6	0,7	0,6	0,5	1,1	0,8	0,6	0,2	0,3
Latvia	0,8	0,6	0,5	0,6	0,7	0,7	0,8	0,7	0,7	0,6	1,0	0,7	0,4
Lithuania	-0,6	-0,6	-0,4	-0,5	-0,5	0,6	-0,8	-0,5	-0,2	-0,6	-0,5	-0,5	-1,5
Malta	-7,2	-6,9	-1,8	-4,5	-3,5	-4,6	-4,2	-5,2	-5,4	-5,7	-7,8	-8,5	-8,8
Poland	0,2	0,1	0,1	0,2	0,2	0,2	0,1	0,1	0,0	0,0	0,2	0,8	0,2
Romania	-1,9	-1,8	-1,6	-1,8	-1,9	-2,2	-2,3	-2,3	-2,2	-2,1	-2,1	-1,7	-1,8
Slovakia	-0,6	-0,4	-0,3	-0,4	-0,2	-0,4	-0,2	-0,2	-0,3	0,0	0,0	0,1	0,1
Slovenia	0,0	0,1	-0,3	-0,3	-0,3	-0,2	-0,1	-0,3	0,1	-0,1	-0,2	-0,4	-0,1
EU-27	**-0,2**	**-0,1**	**-0,1**	**-0,1**	**-0,1**	**-0,2**	**-0,2**	**-0,2**	**-0,3**	**-0,6**	**-0,7**	**-0,8**	**-0,7**

10.3 Implications for emission trends, including time series consistency

Figure 10.1 shows that due to the fact that both the 1990 and 2006 emissions have decreased, the emission trend in the EU-15 has changed noticably for 2003-2006 mainly due to the revision of energy balance data in Germany. In the previous submission the trend of GHG excluding LULUCF between 1990 and 2006 was – 2.2 %. In the latest submission this trend has decreased to – 2.8 %.

In the EU-27, the trend of GHG excluding LULUCF between 1990 and 2006 changed from – 7.7 % in the previous submission to – 8.1 % in the latest submission (Figure 10.2).

Figure 10.1 Comparison of EU-15 GHG emission trends 1990–2006 (excl. LUCF) of the latest and the previous submission

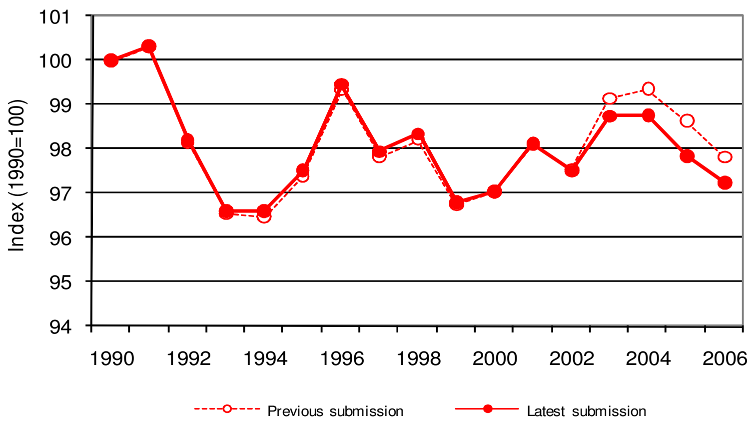
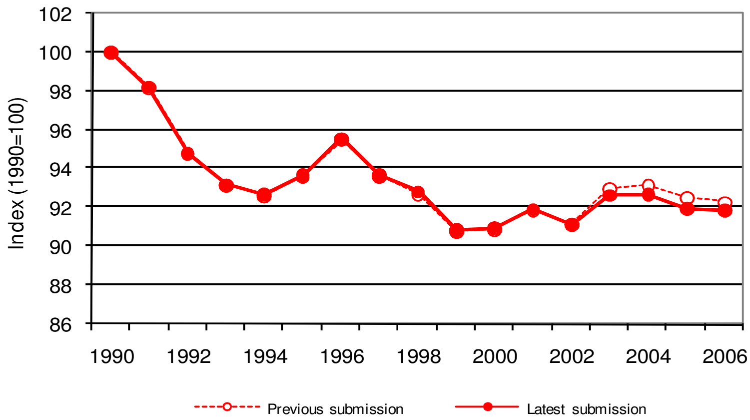


Figure 10.2 Comparison of EU-27 GHG emission trends 1990–2005 (excl. LUCF) of the latest and the previous submission



10.4 Recalculations, including in response to the review process, and planned improvements to the inventory

10.4.1 EC response to UNFCCC review

The following improvements were made in 2009:

- **Inventory system:** By 15 April all Member States provided GHG inventories. No gap filling was needed.
- **QA/QC:** extended quality checks in agriculture and LULUCF; in agriculture internal consistency checks on background data were made e.g. on nitrogen excretion. The EC internal review 2008 focused on completeness and allocation issues in Industrial Processes and on N_2O from road transport.
- **Uncertainty analysis:** LULUCF is inlcuded in the uncertainty analysis; a Tier 2 category analysis was performed.
- **Transparency:** CRF table Summary 2 is provided for the base year for EU-15; more trend explanations and explanations of outliers have been added in the NIR sector chapters; more information was provided on the allocation of emissions of Member States.
- **CRF/Reference approach:** the matching of apparent consumption (excluding feedstocks and non-energy use of fuels was improved; fraction od carbon stored was revised.
- **NIR/ LULUCF:** More extended information based on the recommendations from the review are included in the LULUCF chapter.
- **NIR/Industrial processes:** More trend explantions and information on outliers have been added; more detailed information is provided for carbide production, 2B5 and for 2E3; some Member

States revised allocation of emissions.

Additional improvements are mentioned in the sector chapters.

10.4.2 Member States' responses to UNFCCC review

Since the improvement of the EC inventory depends on Member States' efforts regarding completeness of estimation and improvement of methods and parameters used, Tables 10.10 and 10.11 provide an overview of Member States' responses to the UNFCCC review ([32]). The table shows that a considerable amount of improvements were made compared since the previous submissions of Member States. In addition to the response to the UNFCCC review, a large number of additional improvements were implemented by Member States. However, an aggregation of all improvements conducted in all Member States would be too much information and too detailed to be included in this report.

Table 10.10 Improvements made by EU-15 Member States in response to the UNFCCC review

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
Austria	The 2008 NIR identifies several areas for improvement across all sectors. The NIR states that an improvement plan has been established, and is updated in January each year. The overall goal is to produce emission inventories which are fully consistent with the UNFCCC reporting guidelines and the Revised 1996 IPCC Guidelines. The improvements include: (a) A new study to review and harmonize the CRF data with data from the International Energy Agency (IEA) on consumption of jet kerosene for international aviation; (b) Plans to investigate availability of data for implementing a higher tier method for the key category fugitive emissions from fuels for natural gas, in response to previous ERT recommendations; (c) Plans to derive country-specific EFs for all types of energy from waste and apply revised EFs back to 1990 if applicable; (d) Plans to determine the fossil carbon content of diesel fuel by analysis of the mixed biofuels and fossil diesel; (e) A proposed study to update information on animal waste management systems (AWMS) distribution, because it has probably changed over the time period. Austria will incorporate these new data in future inventory submissions; (f) Reassessment of forest soils, uncertainty and cropland biomass; (g) Plans for a further study to update the amount of CH_4 recovery from 2002 onwards for solid waste disposal to land. The ERT identifies the following cross-cutting issues for improvement: (a) Descriptions of QA/QC procedures for all categories in the NIR; (b) A complete uncertainty analysis including the LULUCF sector. (para 17, 18) FCCC/ARR/2008/AUT	• LULUCF sector was included in the key categories reported in the NIR 2007. • Uncertainty analysis for all categories except LULUCF is presented in the NIR 2008. • A more detailed description of category specific QA/QC activities is included in the NIR 2008 in the sectors Energy, Industrial Processes, and partly in LULUCF.
Belgium	The 2008 NIR identifies areas for improvement following recommendations from the previous expert review and inventory improvements identified by the Party. Belgium indicated that it is working to improve: (a) The harmonization of methods and EFs across the regions (energy, industrial processes, agriculture); (b) The recalculation of railway and navigation emissions; (c) The reporting of non-methane volatile organic compound emissions from solvent and other product use; (d) The reporting of non-CO_2 emissions from outdoor manure storage (including determining uncertainty). The ERT identifies the following cross-cutting issues for improvement:	• During this 2009 submission Belgium took into account as much as possible the recommendations as formulated in the 'Report of the individual review of the greenhouse gas inventory of Belgium submitted in 2007 and 2008 (January 2009)'. • In the energy sector recalculations and correction of emission factors took place to improve harmonization between the 3 regions. • Also in the agricultural sector emission factors and emission estimates have been revised, partly using Tier2 methodology, in order to harmonize the methodology between the regions. • The recalculations for the years 1990 to 2005 are mainly performed as a result of the in-country review of the

([32]) Issues related to the NIR are not included in this table as already addressed in Table 1.11.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	(a) The improvement of the completeness of the inventory with regard to its coverage of emissions by sources and removals by sinks, CRF tables and the use of notation keys within these tables; (b) The further improvement of documentation in the NIR in order to improve the transparency and understanding of the national inventory (which is compiled from three regional inventories) with respect to methods, EFs and other region- or country-specific data, recalculations, and inventory improvement. The further improvement of documentation in the NIR in order to ensure the data and information contained within it is consistent with the data and information contained in the CRF; (c) The improvement of the transparency of the inventory with regard to the reporting in the CRF on explanations on the use of the notation keys .NE. and included elsewhere (.IE.), recalculations, and methods and EFs used; (d) The improvement of the transparency of the estimates of uncertainty with respect to the documentation in the NIR of the underlying assumptions used for these estimates; (e) The establishment of a centralized archiving system; (f) The further development of harmonized methods and EFs between regions with a specific focus on higher-tier EFs (as opposed to using IPCC defaults); (g) The full implementation of the QA/QC plan; (h) The further consideration of QA and verification activities, and the incorporation of these activities into the QA/QC plan; (i) The development of an inventory improvement plan that takes into account, inter alia, output from key category and uncertainty analysis in order to prioritize improvements in the regional and national inventories. (para 26, 27) FCCC/ARR/2008/BEL	initial report of Belgium and of the 2006 greenhouse gas inventory submission of Belgium. • Belgium did submit a full QA/QC plan of the Belgian national system for the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol on the 20th of October 2008 to the UNFCCC-experts as a demand of the UNFCCC-centralized review carried out from the 1st to the 6th of September 2008. In the final Annual Review Report of UNFCCC (Report of the individual review of greenhouse gas inventories of Belgium submitted in 2007 and 2008) the ERT concluded that the QA/QC plan has been prepared and implemented in accordance with the IPCC good practice guidance. • Brussels Region: The general methodology of the inventory has been described in a quality handbook for the Brussels region. The handbook has been developed next to the recommendations of the 2007 in-country review of the UNFCCC-secretariat. So the available handbook is a first version (April 2008), improvements still have to be performed. • As a result of the centralized review of the Belgian greenhouse gas inventory in September 2008, the ERT of UNFCCC recommended in their annual report review (ARR) 'Report of the individual review of the greenhouse gas inventories of Belgium submitted in 2007 and 2008' of January 2009 that Belgium includes the LULUCF in its uncertainty analysis and encourages Belgium not to include the Kyoto base year for F-gases in the 1990 analysis. • As a result of the in-country review in June 2007, the 3 regions did perform a harmonization of the emission factors used to calculate the emissions of CH_4 and N_2O in the sector of manufacturing industry and construction (category 1A2). Before this 2008 submission, emission factors of CITEPA (Flemish region), IPCC 1996 and EMEP/CORINAIR (Walloon region) and from a specific study (Brussels region) were used in Belgium. • In Wallonia, the emission factor for enteric fermentation for goats, horses and sheep has been revised in order to harmonize the methodology between the regions. The new EF are IPCC default values, the same factors as in Flanders. • As a result of the centralized review in September 2008, Wallonia and Flanders revised the estimates for CH_4-emissions from manure management for cattle (dairy and non-dairy) using the Tier2 methodology as described in the Revised 1996 IPCC Guidelines. This methodology is harmonized between the two regions. This recalculation results in a decrease of the emissions for the entire time series and a reduction of 24489 ton CH_4 or 514 kton CO_2 in the base year.
Denmark	The 2008 NIR identifies several areas for improvement. Generally, Denmark is striving to continue improving the documentation of EFs and the implementation of QA/QC, and developing category-specific QA/QC plans (e.g. for stationary combustion and agriculture). In future annual submissions, Denmark plans to introduce more country-specific uncertainty estimates, where possible, and the Party plans to further incorporate data from the EU ETS. The Party intends to make major category-specific improvements in the agriculture sector (where data currently contained in spreadsheets will be incorporated into a database to support data management) and in the LULUCF sector (where data from the new National Forestry Inventory will be incorporated). The ERT identifies the following cross-cutting issues for improvement: (a) The strengthening of the national system to ensure adherence to decision 15/CMP.1 with respect to having a single national entity responsible for the national inventory of the Party (in this case Denmark, including Greenland); (b) The incorporation of emissions from Greenland into the	• The review on the submissions 2007 and 2008 has not been finalized and no country specific review report is available. So the most recent finalized review was the in-country review which took place in April 2007 on the 2006 submission for the inventory years 1990-2004. • The suggestions and views of the expert review team on the 2006 submission in their final report dated 7 November 2007 has been studied and implemented as far as possible. • As regards the review on the 2007 and 2008 submissions some improvement were implemented due to the communication with the review team in the autumn 2008 and due to the review draft report available to us 14 January 2009. However, implementation of recommendation and suggestions of the reviewers in the main findings etc. was not possible in the time left to this submission and the start of the implementation awaits the final review report. • In the energy sector the documentation for the use of EU ETS data has been improved, as well as the documentation for QA/QC of plant specific emission

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	respective category discussions in the NIR and under the respective cross-cutting issues and procedures (e.g. key category analysis, uncertainty, QA/QC and recalculations); (c) The incorporation of emissions data from the EU ETS in a manner that ensures that the data conform with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance, and that ensures completeness, accuracy and time-series consistency for each category; (d) The provision of tier 2 uncertainty estimates in order to identify where improvements to the inventory should be focused; (e) The undertaking of a tier 2 key category analysis. (para 25, 26) FCCC/ARR/2008/DNK	factors. (In connection with EU ETS data).
Finland	In its 2008 submission Finland includes the inventory improvement plan which summarizes the sectoral improvement needs for future inventories. The ERT noted that the inventory improvement plan is discussed in the advisory board set up by Statistics Finland before the beginning of the inventory compilation. In response to the ERT questions during the review week regarding the emissions reported as .NE., Finland expressed its intention to include a rough estimate of CH_4 emissions from enteric fermentation, and of CH_4 and N_2O emissions from field burning of agricultural residues, in its next submission. Finland also stated that it will provide more accurate time series for CO_2 emissions from cement production. The ERT commends Finland for this intention. The ERT identifies the following cross-cutting issues for improvement: (a) The improvement of transparency by including separate chapters in the NIR for each source/sink category or for a group of related categories (especially for all key categories), ensuring a minimum level of documentation on methods, EFs and AD, and providing (additional) explanations of peculiar emission and/or IEF trends for key categories at category level (e.g. N_2O from road transport, CO_2 from grassland remaining grassland); (b) The further strengthening of the QA/QC procedures, in particular in the agriculture sector, in order, for example, to ensure consistent reporting of nitrogen amounts under N_2O emissions from manure management and under agricultural soils; (c) The checking of the N_2O EF for gasoline from road transportation and the inclusion of a separate chapter in the NIR on this key category; (d) The elaboration of the further reporting under Article 3, paragraphs 3 and 4, of the Kyoto Protocol and the reporting of these issues in the 2010 annual submission. (para 19, 20) FCCC/ARR/2008/FIN	• Some recommendations of the expert review team (ERT), like those relating to the QA/QC system, have been grouped into one comment. • The quality management system forms an integral part of the national system and the annual inventory process. The description of the system and its implementation in 2008-2009 is updated. • The descriptions in the NIR have been updated and improved and separate sections for key categories have been added. • Finland has revised its uncertainty estimation as a whole. • b) Finland will endeavour to improve QA/QC procedures in agriculture. • c) The emission factors will be checked and updated as appropriate for the next submission. • d) This reporting will improved when the reporting starts in 2010. Finland has not provided voluntary reporting on the issue in 2009.
France	The 2008 NIR identifies several areas for improvement, including: (a) The undertaking of research to reduce uncertainty in the estimation of emissions from key categories; (b) The further development and application of uncertainty assessment by estimating uncertainty ranges. The information that results from this assessment should be used to improve the inventory further; (c) The inclusion of all categories that are not currently covered or are not sufficiently addressed (e.g. non-energy use of fossil fuels); (d) The further improvement of QA/QC procedures in the quality management system, especially consultations with external experts regarding certain areas of the inventory. The ERT identifies the following cross-cutting issues for improvement: (a) The improvement of transparency by: (i) Providing a more comprehensive NIR that includes the relevant information on the emission of direct GHGs, which is currently contained in the OMINEA report; (ii) Including in the NIR the rationale for the selection of country-specific EFs and other parameters; (b) The improvement of completeness by including emission	• A more comprehensive NIR was provided as extracts of the OMINEA report for the concerned GHG emissions have been included into the NIR. • Independent review via exchanges and bi- and multilateral actions with foreign bodies and experts has been undertaken. In July 2008 in-depth review was conducted between French and British experts for the agriculture sector.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	estimates for categories that have not yet been estimated; (c) The improvement of QA by introducing an independent review of the inventory before it is submitted (para 19-21). FCCC/ARR/2008/FRA	
Germany	The 2008 NIR identifies several areas for improvement. The NIR states that the German inventory is currently being subjected to an intensive internal review in which the conformity of the applied methods to the IPCC good practice guidance is being systematically reviewed, and methodological changes are being implemented. Improvements are reported in several categories of the energy, industrial processes and waste sectors. The NIR reports that in the agriculture sector a new methodology based on recognized international scientific literature is being developed but is not yet ready to be implemented in the inventory. The ERT identifies the following cross-cutting issues for improvement: (a) Germany should continue its efforts to complete and strengthen the well developed national system, for example: fully implementing the QA/QC plan; securing the timely completion of the energy balance; achieving agreement between the Federal Statistical Office and the Federal Agricultural Research Institute (FAL) regarding confidentiality issues and availability of agricultural statistics; eliminating data problems relating to railway transport; reaching agreement with the European Organization for the Safety of Air Navigation (EUROCONTROL) on data exchange; and developing an integrated concept for land-use monitoring in the LULUCF sector. During the review, Germany informed the ERT that this issue has been improved since the 2008 submission. The ERT recommends that Germany report on the progress it is making in its next annual submission; (b) Germany is encouraged to continue working to improve the completeness of the uncertainty analyses by providing uncertainty estimates for all categories. The calculation of trend uncertainty according to the IPCC good practice guidance and the IPCC good practice guidance on LULUCF should be included in the NIR; (c) Germany must ensure that the national system functions in such a way that consideration of a general change to the latest IPCC methodologies for agriculture is resolved in a timely manner and is not a reason for suspending the use of existing methods, or for not reporting the latest year estimates in a manner consistent with previous years. In the next submission, the Party should provide a transparent description of the new method and include a separate chapter in the NIR which compares the two methods. Germany should further improve the existing methodologies for calculating emissions from the agriculture sector, particularly for N_2O from agricultural soils; (d) Germany should give high priority to improving transparency in the LULUCF sector. The LULUCF sector has not been updated since the 2006 submission and no improvement plan has been mentioned; (e) Germany should provide estimates of emissions and removals for the categories reported as 'NE', if methods are available, with a view to avoiding problems and possible underestimation during the commitment period. (para 20, 21) FCCC/ARR/2008/DEU	• Germany continued its effort to complete and strengthen the national system. After restructuring of the research institutes under the auspices of the BMELV, Johann Heinrich von Thünen-Institut was commissioned to implement reporting of Art. 3.3 and 3.4 KP. • Progress in the further completion of the National System was achieved by conclusion of an agreement with FAL (vTI) and DESTATIS on the availability of agricultural statistics. • The schedule for the delivery of data derived from the national energy balance was adjusted to the requirements of the national GHG inventory. • The areas of agriculture and LULUCF were comprehensively revised and extensively recalculated. Below-ground biomass was included in the estimates of emissions/removals from LULUCF and relevant calculation methods have been improved. The current inventory considers all land use categories and provides information on definitions of the newly reported categories. • In the 2009 inventory several categories, pools and gases (consideration of all land use categories) were completed and improved. • Germany started to provide estimates for categories reported as NE. E.g. 1.A.3.b - Due to the improvement of data availability emissions from the use of bioethanol could be estimated for the first time and included in the GHG inventory. The categories reported as NE are considered to be negligible. Nevertheless the continuous process of inventory improvement will continue to periodically re-evaluate this assumption.
Greece	The 2008 NIR identifies several areas for improvement in response to issues raised in the previous expert review, and through Greece's own activities relating to inventory improvement. These improvements include: (a) Recalculations pursuant to IPCC good practice guidance and time-series consistency; (b) Obtain improved data in support of estimating emissions from road transportation; (c) Investigate the carbon content of fuels in the navigation subsector; (d) Investigate a higher tier method for aviation and navigation; (e) Resolve gaps in AD time series and fluctuations in trends for a number of industrial processes categories (e.g. cement production); (f) Explore the collection of data on feedstocks and non-energy	• The methodologies applied for the estimation of GHG emissions are discussed and the activity data and emission factors used are presented. The recommendations made by the Expert Review Team (ERT) during the in-country review of the GHG inventories submitted in 2007 and 2008, held from 8 to 13 of September 2008, have been taken into account as described in the present report. • The recalculations made are driven by the results of Greece's QA/QC system and the various review processes (mainly the in-country review from 8 to 13 September 2008), while prioritization is based on the key source analysis and the availability of resources. • Energy & Industry: As a consequence of adjustments applied by the ERT that performed the audit of the initial report of Greece during 23-28 April 2007,

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	use of fuels in ammonia production (2B1); (g) Calculate CH_4 emissions from iron and steel production; (h) Explore the opportunity to obtain data from consumption of F-gases (e.g. aerosols); (i) Explore the availability of data for carriage of a tier 1 (potential emissions) method to estimate F-gas emissions; (j) Update AD and investigate the application of a tier 2 method to estimate CH_4 emissions from enteric fermentation; (k) Collaborate with other research institutions to characterize animal waste management systems (AWMS); (l) Reduce the uncertainty of emission estimates from solid waste disposal sites by obtaining improved data on municipal solid waste disposed and its composition, and amount of biogas emitted. MINENV are to establish a database that will contain much of the above information; (m) Improve the completeness of CRF tables; (n) Further develop its QA/QC plan and the quality management handbook. The ERT identified the following cross-cutting issues for improvement by the Party: (a) Enhance knowledge and understanding within the national system on the preparation and reporting of emissions by sources and removals by sinks of activities under Article 3, paragraph 3, and activities elected under Article 3, paragraph 4, of the Kyoto Protocol; (b) Improve QA/QC procedures to ensure consistency between the NIR and the CRF, and develop tier 2 category-specific QC procedures for all key categories and for those categories in which significant methodological and/or data changes have occurred; (c) Improve the completeness of the national inventory to ensure that emissions by sources and removals by sinks are included in the national inventory, and, if they are not, that sufficient explanation is provided in the NIR (in the annex on completeness); (d) Complete all CRF tables with required data, notation keys and information (e.g. key category analysis and documentation boxes) and explanations (e.g. recalculations and completeness); (e) Enhance the transparency of the inventory by providing more detailed information in the NIR on choice of methodology (particularly country-specific and higher tier methods), assumptions underpinning choice of methodology and uncertainty assessment, references to these methodologies, data sources, rationale for recalculations, and information in the CRF documentation boxes, where applicable; (f) Improve the time-series consistency (energy and industrial processes); (g) Coordinate the uncertainty assessment with the main data providers; (h) Improve the reporting on key category analysis in the NIR and in the CRF; (i) Provide documentation in the NIR on actions undertaken to address recommendations from previous expert reviews; (j) Develop an inventory improvement plan that establishes a process to manage the improvement of the national inventory by addressing recommendations from previous expert reviews and using output of key category analysis, uncertainty analysis, and QA/QC procedures, as a basis to prioritize improvement in the national inventory; (k) Streamline the preparation and reporting of LULUCF under the Convention and under the Kyoto Protocol within a single institution to minimize duplication of efforts and ensure consistency and accuracy of reported data and information. (para 44, 45) FCCC/ARR/2008/GRC	conservativeness factors have been applied for the estimation of N_2O emissions of 1990 from liquid and solid fuels combustion and CO_2 emissions of 1990 from solid fuel combustion. Following the recommendation of ERT which performed the in-country review from 8-13 September 2008, the above mentioned emissions were recalculated so that the base year to be consistent with other years of the inventory time series (conservativeness factor was removed). • Following the recommendation of ERT which performed an in-country review from 8-13 September 2008, the following emissions were recalculated for time-series consistency purposes (the T2 with IPCC default EFs methodology applied for the years 2005-2007 was also applied for the rest years): a) CH_4 emissions for the years 1990-2004 from liquid and solid fuels combustion, b) CH_4 and N_2O emissions for the years 1997-2004 from gaseous fuel combustion.
Ireland	The 2008 NIR identifies several areas for improvement. Ireland indicated that it is working on: (a) Further consolidation of the national system; (b) Further application of formal QA/QC procedures that have been put into operation as an integral part of the national system; (c) An extension of peer review and expert review of the inventory data; (d) An outline of the annual requirements of a continuous improvement programme for the	• Every attempt is made to participate in the UNFCCC review process and to facilitate the work of the UNFCCC secretariat, especially insofar as it impacts on the quality and transparency of the Irish estimates of emissions. The in-country review of Ireland's 2006 submission (UNFCCC, 2007) was an important development in this regard. The majority of the recommendations in the 2007 review report were implemented in the 2008 submission. Further recommendations from the 2008 centralized review of Ireland's inventory have also been taken on

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	inventory. The ERT identifies the following cross-cutting issues for improvement: (a) Provision of more detailed descriptions of the approaches and underlying assumptions used for the uncertainty estimates; (b) Improved descriptions of methodologies that differ from those provided/recommended by the IPCC; (c) Provision of more detailed explanations of emission trends and changes in trends in all sectors; (d) Provision of technical references to country-specific EFs and AD. (para 16.17) FCCC/ARR/2008/IRL	board where feasible in the 2009 submission. • In particular, improved explanations and clarifications have been included in the 2009 NIR relating to a number of ongoing issues in Ireland's inventory, such as fluctuating implied emission factors in categories 1.A.1 and 1.A.2, time-series consistency related to process CO_2 emissions from cement production and the methodology for CH_4 emissions from solid waste disposal sites. It may be stated therefore that the inventory material being submitted in 2009 broadly meets the principles of transparency, completeness, consistency, comparability and accuracy laid down in the UNFCCC reporting guidelines.
Italy	The 2008 NIR identifies several areas for improvement and specifies the following actions: (a) Organize a basic independent review of the inventory before it is submitted; (b) Collect and assess supplementary information related to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol; (c) Improve the reporting of the energy sector by improving the allocation of fuel used by domestic and international aviation and marine sectors; (d) Create a single database for QA/QC purposes, including data collected under the European Union (EU) directive on large combustion plants (directive 2001/80/EC), the European Pollutant Emission Register (EPER), and the EU emissions trading scheme; (e) Elaborate on the best available technologies used in agriculture practices; (f) Improve the availability of information on waste composition and other waste parameters following the entering into force of the EU directive on the landfill of waste (99/31/EC); (g) Compare local inventories with the national inventory. The ERT identifies several cross-cutting issues for improvement and specifies the following actions: (a) Describe sector-specific QA/QC procedures in more detail and in separate paragraphs for the energy sector; (b) Improve the explanations of trends of emissions and/or IEFs at the category level (in energy, industrial processes); (c) Provide additional information on country-specific methods, EFs, and parameters used to calculate emissions (in energy, agriculture, waste). (para 22, 23) FCCC/ARR/2008/ITA	• Following the recommendations of the review processes different improvements have been carried out. • The main improvements regarded the update of the method for estimating emissions from transportation. Specifically, the new version of the programme to estimate emissions from road transport was applied to revise all the time series, an update of the method for estimating the fuel split for national and international aviation was carried out and a new study was finalized for the maritime sector. • The assumptions and rationale underlying the uncertainty analysis in the Italian inventory have been extensively detailed. Exhaustive results of uncertainty and key category analysis for the base year have been reported. • Verification and QA/QC procedures were explained more in detail for the energy sector, especially for those sectors mostly affected by recalculations and a further improvement is planned for the next submission. • An independent review of the complete inventory is still under consideration but sectoral emissions have been actually presented different institutions, local agencies and industrial sectors and methodologies shared, leading in some cases to a revision of the estimates before submission. • The description of country specific methods and the rationale behind the choice of emission factors, activity data and other related parameters should have improved the transparency of the present NIR
Luxem-bourg	The 2008 NIR identifies several areas for further improvement. These planned improvements cover all sectors and several cross-cutting issues. The quality manual for the compilation of the inventory, which was presented during the in-country review visit, lists further improvements. The ERT acknowledges this work and recommends that Luxembourg prioritize these improvements by taking into account the points listed in paragraph 24 above when setting priorities. The ERT identifies the following cross-cutting issues for improvement: (a) The expansion of the national system by securing resources for further needs, such as including the LULUCF data in the inventory and internalizing the QA/QC system in the single national entity; (b) The establishment of an official approval process that takes place before the GHG inventory is submitted to the UNFCCC secretariat; (c) The reorganization of the QA/QC system; (d) The reassessment of the methodologies used in inventory estimation, based on the obligations derived from the key category analysis; (e) The improvement of the key category analysis (a detailed description in the NIR, the inclusion of the LULUCF sector, and the use of a tier 2 approach, if possible); (f) The prioritization of inventory improvements; (g) The improvement of the completeness and consistency of	• NIR 2009 not yet available.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	the inventory. (para 30, 31) FCCC/ARR/2008/LUX	
Netherlands	The 2008 NIR identified several areas for improvement. In response to issues raised in the previous expert review, the Netherlands indicated that it is working to improve its inventory. Areas of improvement include: (a) The re-evaluation of the completeness of the inventory; (b) The re-assessment of the basic data on deforestation; (c) The improvement of the transparency of the inventory by including in the NIR more detailed information from the national monitoring protocols and background reports; (d) Further centralization of the archiving system. The ERT identifies the following cross-cutting issues for improvement: (a) The improvement of the consistency of information reported in the NIR when compared to the detail of information provided in the national monitoring protocols, ensuring that this information is up-to-date, thus allowing the ERT to reproduce the inventory; (b) Further improvement of the transparency of the inventory with a specific focus on the reporting of confidential emissions, AD, EFs and methodology; (c) The improvement of the completeness of the inventory; (d) The consistent reporting of emissions from deforestation in the CRF tables; (e) Further improvement of the description of category-specific QA/QC activities in the NIR to cover all key categories; (f) The expansion of QC procedures to identify inconsistencies in reporting; (g) The improvement of the reporting of the key category analysis in the NIR, by clearly differentiating the output of the analysis with and without LULUCF; (h) Further centralization of the archiving system. (para 22, 23) FCCC/ARR/2008/NLD	• The NIR 2007 and NIR 2008 were reviewed in the fall of 2008 and the report was published on 5th February 2009. The review report holds seven key recommendations and several sector specific recommendations and cross cutting issues. • To improve the consistency of information the documentation in the NIR and the protocols is being improved (rather than referring only to background reports). A first set of protocols is being updated; the full set is planned to be ready before the NIR 2010. • The protocols for transport were targeted for this update among others to increase the transparency. • The improved documentation of the export and import of manure and how this is treated in the calculations is under preparation, but this document could not be finalized in time for the 2009 submission and so not be incorporated in the protocols 2009. • The completeness of the inventory is a topic that already got attention for a long period, but the completeness is related to the allocation of resources and the relative importance of a source. This submission holds for the first time information on litter (as part of the Dead Organic Matter) in the LULUCF sector. To improve the transparency Annex 5 (Assessment of completeness) now holds information on actions undertaken to estimate AD and EFs and explanations why those did not result in reported data. • Information is also being further improved on sector-specific QC; the results are also expected in the NIR 2010. • For the key category analysis Annex 1 of the NIR holds now two tables (in stead of one) and so a clear differentiation of the key category analysis is presented. • For the LULUCF sector this year's submission holds major improvements. A new land use matrix is generated while the allocation of different land use categories is improved and made more consistent between 1990 and 2004. Among other forest land now holds only two subcategories and open water is reported no longer under other land (but under wetlands). Also deforestation got special attention and the emission factor for re- and afforestation was changed. • The time period was too short to take into account most of the sector specific recommendations for this submission and will be handled in the preparation of the 2010 submission.
Portugal	Review Report (Centralized Review 2008) not yet available.	
Spain	The 2008 NIR identifies several areas for improvement. Spain indicated that it plans to use tier 2 methods for its key category analysis and to some extent for the uncertainty analysis (for the agriculture sector). Spain also indicated that it plans to include the LULUCF sector in its key category analysis in its next inventory submission. In addition, Spain plans to include information on verified emission data from the EU ETS as part of the plant-level QA/QC procedures for the industrial processes sector. Furthermore, Spain plans to continue improving carbon accounting in the LULUCF sector in order to: allocate pasture land to a land-use category that is more appropriate than the category other lands under which it is currently reported; estimate changes in carbon stocks in living biomass for cropland remaining cropland and estimate carbon in soil deposits and dead organic matter; and collect the data and information required for reporting activities under Article 3, paragraph 3, of the Kyoto Protocol (afforestation, reforestation and deforestation) and Article 3, paragraph 4, of the Kyoto Protocol (forest management and cropland management). The ERT identifies the following cross-cutting issues for improvement: (a) The completeness of the inventory should be improved by estimating emissions for categories currently reported as "NE"	• Planned improvements still include the identification of key categories in the LULUCF sector according tier 2 methods and their inclusion in the key category analysis. • An agreement for the collaboration between the departments of the Ministry of the Environment and the Ministry of the Industry, Tourism and Trade on the one hand and the self-governed communities on the other has been concretized with the aim to install a central administration of information on verified emission data per installation.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	for which IPCC methods are available; (b) The transparency of the information regarding the national system should be improved by including, for example, overview tables and information provided to the ERT during the centralized review, such as the completed tier 1 QC tables, in the annex to its next inventory submission, as well as a list of key categories for which tier 2 QA/QC procedures have been applied; (c) Uncertainties of estimates should be reduced by implementing the detailed national QA/QC plan in order to address the challenges posed by the complexity of the national system. This could be achieved by continuing to strengthen the national working group on harmonization of inventory data, particularly for the energy and industrial processes sectors, in order, for example, to address the large inter-annual variations of EFs in several categories in these sectors; (d) The QA/QC activities should be further improved by using more independent experts, who are not directly involved in compiling the inventory, for peer review activities as part of Spain's QA procedures; (e) Summaries of additional information provided in response to comments made by the ERT during the centralized review should be provided in the next annual inventory submission; for instance, explanations for the inter-annual fluctuations in implied emission factors (IEFs) in several categories and descriptions of emission trends and QA/QC checks for relevant sectors, such as the industrial processes sector; (f) The consistency between information provided in the CRF tables and the NIR should be improved by providing adequate explanations in the documentation boxes to the CRF tables. (para 25-27) FCCC/ARR/2008/ESP	
Sweden	All sector descriptions in the NIR include the item .coming improvements. Extensive further inventory improvements are outlined under this heading in the LULUCF sector but there is none for other sectors. Sweden intends to further develop the methods to quantify carbon stock changes in all biomass pools and will undertake future recalculations as the number of sample plots continues to increase. The ERT identifies the following cross-cutting issues for improvement: (a) Provide information on any changes in the national system and any changes in the national registry as distinct items in the NIR; (b) Sweden may wish to consider further use of EU ETS emissions data in the national inventory, especially for categories that are completely covered by the EU ETS, and the incorporation of formal mechanisms within the national system to secure efficient and systematic use of this data source; (c) Investigate the availability of methods and data for those categories for which the notation key .not estimated. (.NE.) appears in the CRF tables, and make further efforts to include relevant estimates to avoid potential underestimation of national emissions in future years; (d) The land classification system used by the Party is subjective and the ERT encourages Sweden to revise its methodology for land representation to include a hierarchical order among land uses; (e) It is critical that Sweden resolve the data transfer errors associated with the CRF regarding the LULUCF sector and test thoroughly its CRF reporting and QA/QC procedures before its next submission. (para 15, 16) FCCC/ARR/2008/SWE	• In April 2007, Sweden was visited by an expert review team and several comments and recommendations from the team lead to revisions of the inventory data in submission 2008. Since the inventory time cycle in Sweden is planned for a national independent review of the inventory, this inventory for submission 2009 is already compiled in mid-november 2008. The preliminary result of the centralized review in 2008, taking place in October, can thus only be taken into account as minor recalculations and changes in response to the review process. • In this submission (2009) no general improvements were made in response to the review process. • Since the last submission, recalculations of GHG emissions for several years have been carried out throughout the inventory. The recalculations are due to comments in the ongoing progress to make the inventory be fully in line with the IPCC Good Practice Guidance and implement recommendations from the review teams. The recalculations include new methods, emission factors, thermal values and activity data. Some recalculations are due to discovered errors in earlier inventories during the work with the present inventory.
United Kingdom	The 2008 NIR identifies several general areas for improvement, including improvements required internally and those recommended in previous reviews. The United Kingdom has indicated planned improvements to most of the categories detailed in the NIR and also regarding the legal and procedural frameworks of the national system. The ERT identifies the following cross-cutting issues for improvement: (a) Information on the QA procedures and the external review of the inventory should be more detailed in the NIR; (b) The general trend analysis for the overall GHG emissions	• In response to the review Chapter 2 has been extended and a general trend analysis has been included. • To improve consistency between NIR and CRFs we have asked sector experts to review their sections in the NIR and to review the consistency of the NIR with the CRF. It has been tried to improve the consistency between the NIR and the CRF.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	should be presented in detail in the relevant chapter of the NIR; (c) The consistency between the NIR and the CRF should be further improved.(para 19, 20) FCCC/ARR/2008/GBR	

Table 10.11 Improvements made by new Member States in response to the UNFCCC review

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
Bulgaria	The 2008 NIR identifies several areas for improvement. Among the more important areas, Bulgaria indicated that it intends to improve its QA/QC system, the completeness of the inventory by estimating and documenting emissions/removals from the LULUCF sector, and the transparency of the estimates in the NIR, and that it also plans to elaborate an improvement programme, to be updated every year. The ERT identified some cross-cutting issues for improvement and recommends that Bulgaria should: (a) Strictly follow the IPCC good practice guidance when performing the key category analysis, check results, correct errors and report results consistently in both the NIR and CRF tables, in particular including the LULUCF categories in the results presented in the CRF tables, in accordance with the UNFCCC reporting guidelines; (b) Improve the transparency of the information in the NIR on implemented QA/QC activities, and ensure participation in QA activities of more experts not directly involved in inventory preparation; (c) Strictly follow the IPCC good practice guidance when selecting methods, EFs and AD, and provide clear and detailed information and explanation of the rationale behind the selection of methods, EFs and AD, particularly for key categories and those identified by the ERT; (d) Estimate emissions from the categories currently not estimated and for which IPCC methods are available, in particular actual emissions of F-gases for all relevant categories and for the complete time series, and emissions/removals for some missing LULUCF categories; (e) Improve the transparency of uncertainty analyses by providing more details on country specific values. Include the LULUCF sector in the uncertainty analysis and use it to prioritize further improvements to the inventory; (f) Improve the language of the NIR to prevent misinterpretation of the information provided. (para 31, 32) FCCC/ARR/2008/BGR.	• Source specific recalculations have been made in response to the review process. • Several emission estimates have been revised, now using the IPCC default emission factor and efforts have been made to ensure correct reporting of data in the CRF tables. • Net CO_2 emissions/removals from LULUCF have been included in the inventory and the CRF tables.
Cyprus	No Review Report (Centralized Review 2008) available.	
Czech Republic	The 2008 NIR identifies several areas for improvement in the sector chapters, including: (a) Reallocating, from the energy to the waste sector, the CO_2 emissions from petrochemical materials used in the production of plastics that end up in combustion plants; (b) Continuing to perform studies on the potential for refining the calculation of N_2O emissions from mobile combustion on the basis of emission measurement results; (c) Implementing a more detailed air transport monitoring system with respect to domestic flights; (d) Conducting a study to determine the ratio between methane produced and brown coal obtained by surface mining, in order to identify an appropriate EF that would correspond to the country-specific conditions; (e) Implementing an uncertainty assessment for all subsectors within the industrial processes sector; (f) Moving to a higher tier methodology (tier 2) when estimating GHG emissions from 2.C.1 (iron and steel production); (g) Preparing an inventory of fluorinated gases in products (currently only emissions from bulk import and export are	• In September 2008, the Czech national GHG inventory was subjected to re-examination of the centralized review type. The Czech national inventory team learned of the contents of the draft of the relevant review report (ARR) relatively late (in January 2009) and was thus not able to fully take into account the comments and recommendations of the ERT in this submission. Nonetheless, in feasible cases, the comments were taken into account in this years submission (e.g. lime production – the entire data series from 1990 was recalculated); in more complicated cases, the comments and recommendations will be taken into account in the 2009 submission. • Taking into account recommendations of the previous reviews QA, QC procedures described in the latest NIR should be improved. Therefore the inventory team focused its attention on making QA, QC outputs more detailed and more specific. For instance, QA procedure in the Energy sector will be performed by experts from the Czech Statistical Office. • As a result of the "in-country" UNFCCC review 2007, the

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	reported) and collect data on the lifetime of refrigeration and air-conditioning equipment, together with information on the disposal and destruction of equipment containing fluorinated gases; (h) Implementing the new methodologies available in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories when estimating GHG emissions from the agriculture sector; (i) Consolidating current emissions/removals estimates for the LULUCF sector, paying specific attention to the verification of AD, EFs and other parameters, and addressing the assessment of uncertainties in accordance with the requirements of the IPCC good practice guidance for LULUCF. (para 20, 21) FCCC/ARR/2008/CZE	Czech Republic was ask by the ERT to perform extra instant revisions to prevent possible adjustments: • Use of country specific emission factors for CO_2 for coal instead of the default values to be in line with the IPCC Good Practice Guidance, • Use of the IPCC default emission factors for CH_4 and N_2O for stationary fuel combustion instead of the former national values because of lack of transparency • Application of Tier 2 approach (FOD) instead of Tier 1 for CH_4 emissions from landfills to prevent possible overestimation of the base year • The initial revisions and other recommendations of ERT were taken into account in the previous (2008) submission and the relevant values were inserted in the CRF for the respective time interval (for the initial revisions mentioned above, all the data have been inserted for the period 1990). To be more specific, important new recalculations were performed in the sectors.
Estonia	The 2008 NIR identifies several areas for improvement. For example, Estonia indicated that it is working on: (a) Improving the development of the QA/QC system through the project "Improving the quality of Estonia's national greenhouse gas inventory"; (b) Including country-specific EFs for fugitive CH_4 emissions from oil shale; (c) Investigating CH_4 and N_2O emissions from animal manure, for which uncertainties are high; (d) Improving the waste classification following the waste groups indicated in the IPCC good practice guidance. The ERT identifies the following cross-cutting issues for improvement: (a) Providing a more detailed description of the approaches and underlying assumptions used for the uncertainty estimates in the next annual submission; (b) Providing more precise descriptions of methodologies that differ from those provided/recommended by the IPCC; (c) Documenting the relevant responsibilities of cooperating institutions and experts and their contributions to QA/QC activities in the next NIR submission; (d) Developing a national GHG inventory improvement plan which will address the issues identified in this report. (para 18, 19) FCCC/ARR/2008/EST	• Methodological improvements in accordance with the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories", "Revised 2000 IPCC Guidelines for National Greenhouse Gas Inventories" and the "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories," and according to the recommendations by the Expert Review Teams, have been implemented in the present inventory as far as possible and will be further implemented in the next submissions.
Hungary	The 2008 NIR identified several areas for improvement: (a) The revision of the LULUCF sector will be continued, and all preparatory measures will be taken to enable Hungary to be in a position in 2010 to report the elected forest management activity in accordance with the requirements of the Kyoto Protocol; (b) A new project will be initiated to increase the consistency between different emission databases, especially the GHG inventory, the emissions trading scheme (ETS) data and the European pollutant release and transfer registers data. In addition, the development of a common central database is planned; (c) A new government regulation is in preparation, which will facilitate data collection for different emission inventory purposes and will thus be in line with the European Union efforts to streamline climate change and air pollution reporting. The ERT identifies the following areas as needing improvement: (a) Provision of quantified uncertainty estimates for the LULUCF sector and the inclusion of this sector in quantifying the uncertainty for the overall inventory; (b) Further transparency in the LULUCF sector (especially for the new method to estimate land-use areas) and the industrial processes sector; (c) Provision of information on the QA/QC implementation and management system on the basis of the QA/QC plan; (d) Completion in a timely manner of any improvements that are still under way. For example, for the LULUCF sector, the priority should be to finalize the integration of forest land into the national system, preferably by the 2009 submission.	• The recommendations of the latest centralized review by the expert review team of the UNFCCC will be taken into consideration as much as possible. • Based on the outcome of all reviews and own experience, a development plan were made in order to further improve the system. • Agriculture: In accordance with the recommendation of the Centralized Review 2008 IPCC Tier 2 method was applied in the following categories: 4A Enteric Fermentation Dairy Cattle, 4A Enteric Fermentation Non-Dairy Cattle, 4B Manure Management (CH_4) by all livestock categories, except Rabbits. • LULUCF: Following recommendations of the 2008 centralized review the method used for estimation of aggregate emission/removal of all managed land have been delineated in Annex 3. The stratification of Cropland and Grassland by climate zone, soil type and land-use practices are detailed in Chapter 7.3 and Chapter 7.4. • Following the recommendation of the 2008 centralized review the revision of the estimation 5.B.Cropland remaining Cropland/Carbon stock change/ living biomass for the whole time series was done. The recalculation has been carried out in accordance with the GPG for LULUCF (IPCC, 2003) Tier 1 methodology, by the HCSO's statistics and estimated activity data, partially.

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	(para 20, 21) FCCC/ARR/2008/HUN	
Latvia	The 2008 NIR identifies several areas for improvement, including: (a) The development and implementation of QA procedures; (b) The enforcement of forthcoming legislation that it is hoped will develop QA/QC procedures for all institutions involved in inventory development; (c) The use of tier 2 methods for key categories; (d) The incorporation of plant-specific data from the EU ETS (e.g. cement production and iron and steel production); (e) The improvement in methods for the LULUCF sector, including the use of a higher-tier method and additional documentation on the identification of land-use areas. The ERT identifies the following cross-cutting issues for improvement and recommends that Latvia: (a) Conduct a quantitative uncertainty analysis for the remaining land-use categories, and transparently document the sources of uncertainty in the emissions estimates and the references for the AD and EF uncertainty values selected; (b) Transparently document in the NIR the methods and EFs used and the emission trends; (c) Ensure that the NIR sufficiently describes the national system, including the roles, responsibilities and minimum capacities of all collaborating entities, as well as the availability of formal agreements for coordination between the different bodies that collaborate on inventory preparation; (d) Fully develop and implement the QA/QC plan, in particular QA procedures; (e) Implement proper agreements in the energy sector to ensure a sustainable system for calculating energy sector emissions and ensuring the QA/QC of the data reported. (para 26,27) FCCC/ARR/2008/LVA	• Changes in the inventory have been made amongst other according to recommendations by ERT during the Centralized review (2008). • Corrections of activity data by CSB; • Using of new methodology for 2007 for LULUCF and ENERGY; • Changes of emission factors for ENERGY and INDUSTRIAL PROCESSES; • Using of COPERT IV for 2004 - 2007 for Road transport • Provide detailed description of the national system • Improvement of methods and documentation in the LULUCF sector.
Lithuania	The 2008 NIR does not identify any areas for improvement, including any planned improvements at the category level. The ERT identifies the following cross-cutting issues for improvement: (a) The implementation of the updated QA/QC plan in accordance with the IPCC good practice guidance and the provision of evidence and information on this in the NIR of the Party's next annual submission; (b) The establishment and implementation of a plan for inventory improvement and the provision of relevant information in the next annual submission in both the general section of the NIR and at the sectoral level in the NIR; (c) The provision of a comprehensive section in the NIR regarding the national system, including sufficient information on the legal, institutional and procedural frameworks, and the full cycle of the inventory preparation; (d) The preparation of a key category analysis in accordance with the IPCC good practice guidance and the IPCC good practice guidance for LULUCF by including the trend assessment and the LULUCF sector in the key category analysis; (e) The improvement of the transparency of the inventory by using the structure of the NIR outlined in the UNFCCC reporting guidelines and the inclusion of additional detailed information and references; (f) The provision of information and documentation in the NIR regarding the assumptions and expert judgement used in the uncertainty analysis; (g) The improvement of consistency in the inventory between the CRF and NIR; (h) The provision of detailed information on recalculations and improvements. (para 20,21) FCCC/ARR/2008/LTU	• More transparent National Inventory report (NIR) was prepared providing more precise descriptions of the methodologies, activity data and emission factors. Activity data for large number of emission sources were checked and reviewed. QA/QC plan was updated and implemented.
Malta	No Review Report (Centralized Review 2008) available.	
Poland	The 2008 NIR identifies several areas for improvement: (a) Use verification reports from installations covered by the EU ETS for the 2005–2007 period for emission estimates for relevant categories in the energy and industrial processes sectors; (b) Verify and update EFs in industrial processes categories that are not included in the EU ETS, such as N_2O emissions	• Following the recommendations of the Expert Review Team reviewing Polish inventory in 2008 recalculations in some agriculture subcategories were made. • Following the recommendations of the Expert Review Team reviewing Polish inventory in 2007 some further improvements are scheduled in the agriculture sector. • According to recommendations of the Experts Review

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	from nitric acid production, and estimate CO_2 emissions from limestone and dolomite use; (c) Carry out recalculations to address time-series inconsistency owing to changes in the age characterization of non-dairy cattle livestock since 1998 and the disaggregation of the subcategories for non-dairy cattle to enable the application of tier 2 methodology for estimating CH_4 emissions for this category; (d) Carry out a five-year cycle (2005–2009) national forest accounting study to identify and subsequently monitor the forest status, as well as the rate and trend of the carbon stock change taking place in forests, in order to provide data on Polish forests for the estimation of emissions and removals for the LULUCF sector, including activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol; (e) Develop country-specific inventory methods in accordance with the IPCC good practice guidance and in line with the improvement plans for key categories for which tier 1 methodology is used. These categories include N_2O emissions from nitric acid production, CO_2 emissions from land converted to forest land, CO_2 emissions from cropland remaining cropland and CH_4 emissions from solid waste disposal on land (using country-specific EFs and replacing the default values currently employed); (f) Address the time-series consistency in the use of data from the Food and Agriculture Organization of the United Nations (FAO) for the estimation of N_2O emissions from human waste for the period 2004–2006. The ERT identifies the following cross-cutting issues for improvement: (a) Finalize the legal arrangements currently under consideration to fully meet the requirements for national systems as required by decision 19/CMP.1, ensuring the implementation of the timeline submitted to the ERT; (b) Estimate actual and potential emissions of HFCs, PFCs and SF6 for all the relevant categories and years and use appropriate notation keys for categories identified as insignificant or irrelevant in order to improve transparency, make efforts to estimate emissions for currently missing categories for which the Revised 1996 IPCC Guidelines and the IPCC good practice guidance provide methodologies, and provide clear and consistent information on the remaining categories not estimated in the CRF tables and the NIR; (c) Include in the NIR a detailed overview of the assumptions made for the estimation of country-specific EFs and the handling of AD from data providers; (d) Address the time-series consistency of the 1988–2006 period in accordance with the IPCC good practice guidance; (e) Improve the transparency of the NIR and provide more precise descriptions of the methodologies and choice of EFs used in recalculations, as well as of the steps followed to ensure time-series consistency in all recalculations. In addition, provide explanations for recalculations in the relevant CRF tables; (f) Include all the required chapters and specified annexes in the NIR in accordance with the outline provided in the UNFCCC reporting guidelines; (g) Document sectoral QA/QC and verification procedures as part of the implementation of the inventory QA/QC plan under the national system and apply further QA/QC checks related to time-series consistency, AD and EFs; (h) Include adequate explanations in the NIR for the methodologies and underlying assumptions as well as the expert judgement used in the uncertainty analysis, including a discussion of the quality of AD and EFs, as well as the rationale for choosing uncertainty values. Furthermore, use more country-specific information and uncertainty values for the uncertainty analysis; (i) Make efforts to obtain geographical information on land use for the inventories of the LULUCF sector with a view to meeting future reporting requirements, in particular those related to Article 3, paragraphs 3 and 4, of the Kyoto Protocol. (para 31, 32) FCCC/ARR/2008/POL	Team all calculations within the GHG inventory for LULUCF for period 1990 -2004 were prepared using IPCC 2003 „Good Practice Guidance for Land Use, Land Use Change and Forestry". Previous GHG inventory for LULUCF for period 1988-2004 were prepared using [IPCC 1997]. • The uncertainty assessment of GHG Inventory for 2007 was made on the basis of calculations and experts opinions made in previous years (during compiling inventories for years 1988-2005) and recommendations of the UNFCCC expert review team in 2005 and 2008. The calculations were extended to cover simplified approach for LULUCF sector and industrial gases.
Romania	The NIR identifies several areas for improvement, some in	• In response to the review process, recalculations were

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	response to issues raised during the previous expert review and other as a result of Romania's own activities. These improvements include: (a) The provision of more detailed data to support development of methodologies in line with the IPCC good practice guidance; (b) The development of procedural arrangements for independent review of its inventory; (c) The enhancement of QC procedures for key categories; (d) The extension of QA/QC activities to cover QC procedures of main data providers. The ERT identifies the following cross-cutting issues for improvement by the Party: (a) The improvement of the accuracy of the inventory by developing higher tier methods for key categories; (b) The allocation of sufficient resources for improving the inventory, giving priority to improving emission estimates of key categories and the completeness of the inventory; (c) The implementation of all recommendations from the previous review. (para 25, 26) FCCC/ARR/2008/ROU	carried out as follows: • Recalculation of the entire time series of soda ash production and use as the data source was changed. The data used in the last submission (provided by the National Institute for Statistics) have been replaced with the data provided directly from economic operators which use soda ash in their activity (the consumption data has been provided by pulp and paper producers, chemicals producers, flue gas desulphurization, water treatment, soap and detergents producers) (2.A.4.2); • Recalculation of the entire time series of the carbide production, as the CO_2 EF for carbide production used to determine the CO_2 emissions in the last submissions has been replaced with the other default CO_2 EF considering the 1996 IPCC Guidelines (2.B.4.2); • Recalculation of the entire time series of ferroalloys production as the CO_2 default EFs for ferroalloys production (EF of silicon manganese production) used to estimate the CO_2 emissions in the last submissions have been replaced with the other CO_2 default EFs considering the AD (ferroalloys production) and EF in a disaggregate manner, by type of products (2.C.2); • Changing the EF specific to dairy cattle in order to account better the milk productivity (4A)
Slovakia	Slovakia has outlined in chapter 9 of the NIR the improvements that it has undertaken in completing its 2008 submission. However, there is little indication in the NIR of improvements or changes being planned for the coming years. The Party also provided information during the review that outlines improvements undertaken and planned in all sectors of the GHG inventory. However, the date of implementation of these is not clear and it is difficult to identify from this outline precisely which improvements are already reflected in the 2007 and 2008 submissions. The ERT identified the following cross-cutting issues for improvement, many of which reiterate recommendations from previous reviews: (a) Mandatory provisions and functions of the national system need to be strengthened for more efficient and effective implementation on a long-term basis. Clarification is needed on how the completion of the consultants' questionnaires is guaranteed and what the procedure is for updating the NEIS database in a timely manner. Slovakia may wish to seek alternatives to the system of annual contracts with an October deadline that underpin major parts of the inventory compilation. The Party needs to show what controls are in place to secure timely and complete annual returns under these contracts and what arrangements are in place to ensure that the various consultants obtain the data they require to fulfil their respective contractual obligations with SHMI; (b) A QA/QC plan that defines specific quality management responsibilities, tasks and procedures across the many institutions, consultants and individuals involved in the Slovak national system must be developed and completed. The Party should implement the overall QA/QC management system rigorously and describe its operation in future submissions; (c) The NIR should give full details of the QA/QC procedures to be applied by contributing institutions and consultants in the preparation of their respective estimates for SHMI. The single national entity should ensure that all contributors are aware of the requirements necessary to ensure an adequate level of transparency. Institutions and consultants should also be aware of the necessary content and format of the partial reports that they should return to SHMI for use in compiling the NIR; (d) Further improvement of the NIR with respect to methodological descriptions and the inclusion of summary supporting tabular information on key AD and EFs; (e) Development of procedures to use EU ETS data in the annual GHG inventory; (f) Updating of uncertainty analyses, using appropriate input values of AD uncertainty for all categories and gases;	• Significant changes are expected according the revisions of the NEIS database (new fuel's catalogue) and trying to keep consistency with European Trade System (ETS). • According to the recommendations of the ERT in previous review processes changes have been made in the transport, agricultural and waste sector. • According to the recommendations of the ERT in the previous review process, the blended biomass in liquid fuels was considered and the emission data were recalculated. The information were obtained from Slovnaft Ltd. Bratislava, exclusive distributors of fuels in the Slovak Republic.(Transport) • According to the recommendations of the ERT from 2007 in-country review of the Slovak Republic, all emissions from inland shipping category are included in category 1.C1 memo items – international bunkers, because of international character of shipping transportation on Danube River. Other inland shipping transportation in the Slovak Republic is negligible and only for tourist purposes. (Transport)

Member State	Improvements as recommended by the review team	Improvements in response to UNFCCC review as indicated in the NIR 2009
	(g) Inclusion of the rationale and explanations for all recalculations and indication of the link to recommendations from reviews or from Slovakia's listed improvements in the categories concerned; (h) Provision of information on any changes in the national system and in the national registry as distinct items in the NIR; (i) Investigation of the availability of methods and data for those categories which are currently reported as .NE. and inclusion of relevant estimates to avoid potential underestimation of national emissions in future years. (para 18,29) FCCC/ARR/2008/SVK	
Slovenia	The 2008 NIR identifies areas for improvement. Slovenia indicated that it is working on: (a) Finalizing the work on the national database to enable automatic reporting; (b) Providing more detailed information on all data sources used; (c) Improving the documentation of quality control at all stages of inventory preparation; (d) Updating the QA/QC manual and implementing sectoral QC procedures; (e) Documenting QA/QC procedures at all stages of inventory preparation; (f) Implementing a documented process for approving the GHG inventory; (g) Including more descriptions of fluctuations in the trend of emissions data in the NIR; (h) Performing an independent peer review of the energy sector in 2008 and the waste sector in 2009; (i) Estimating CH_4 emissions from closed coal mines; (j) Obtaining chemical analyses of natural gas distributed in Slovenia in order to calculate country-specific CO_2 EFs from combustion of natural gas; (k) Improving estimates of HFC emissions from refrigeration and mobile air-conditioning; (l) Estimating the amount of clinical waste incinerated. The ERT identifies the following cross-cutting issues for improvement: (a) Implementation of the documented process for approving the national GHG inventory, and documentation of this in the NIR; (b) Moving to a tier 2 key category analysis; (c) Inclusion in the next NIR of more detailed methodological descriptions (particularly for the LULUCF sector) and rationales for the selection of EFs; (d) Inclusion of a more detailed description of the approaches and underlying assumptions used for the uncertainty analysis and use of the analysis to prioritize improvements in the GHG inventory; (e) Inclusion of a summary of the QA/QC plan; (f) Inclusion of sector- and/or category-specific information on QA/QC. (para 17, 18) FCCC/ARR/2008/SVN	• Although no UNFCCC review process has been performed in the previous year some changes to GHG emissions estimates for the period 1986-2005 have been performed and also some improvements from list of recommendations from previous reviews have been done for this submission. The most important improvements are: • Data for CLRTAP reporting and for UNFCCC reporting have been harmonised; • CRF Tables 7 (key categories) have been filled in for the base year and for 2006 and 2007; • Archiving process has been improved; • QA/QC manager has been set up

10.4.3 Improvements planned at EC level

The following activities are planned at EC level with a view to improving the EC GHG inventory:

- Further implement the recommendations from the past reviews;
- Continue sector-specific QA/QC activities within the EC internal review;
- Further develop the EC QA/QC activities on the basis of the experience in 2008/2009;
- Improve the uncertainty analysis and prepare a Tier 2 key category analysis including LULUCF.

PART II: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

11 Information on accounting of Kyoto units

11.1 Background information

The standard electronic format (SEF) for providing information on ERUs, CERs, tCERs, lCERs, AAUs and RMUs for the year 2008 for the Community registry is submitted together with this report (Annex 13). The data in the Community registry reflect only the transactions to and from the Community registry, but not the sum of all Member States's transactions. Member States' separately submit information on Kyoto units in SEF tables to the UNFCCC.

11.2 Summary of information reported in the SEF tables for the Community Registry

The standard electronic format tables for the Community are included in the submission for the first time. The SEF reporting software has been used for this purpose. The tables include information on the AAU, ERU, CER, t-CER, l-CER and RMU in the Community registry at 31.12.2008 as well as information on tranfers of the units in 2008 to and from other Parties of the Kyoto Protocol. Neither AAUs, nor ERUs or RMUs have been issued in the Community Registry in 2008.

The assigned amount for the EC, calculated pursuant to Article 3 paragraphs 7 and 8 as described in the EC's initial report, exceeds the sum of Member States' assigned amounts by 19,357,531 tonnes CO_2-equivalent. This arithmetical difference is due to the fact that the joint agreement under Article 4 of the Kyoto Protocol was formulated in percentage contributions based on base-year data available in 1998. As the Member States have revised their base-year emissions, the adopted percentage contributions under the burden sharing agreement no longer exactly match EC's 92 % commitment. As each assigned amount unit (AAU) can only be issued into a national registry once, the assigned amount of each Member State should be issued into its respective national registry after being recorded in the compilation and accounting database. The remaining assigned amount for the EC, amounting to 19,357,531 tonnes CO_2-equivalent (which is the arithmetical difference between the Community's assigned amount and the sum of the Member States' assigned amounts), will be issued in the registry of the EC. This amount has not yet been issued in the Community registry in 2008.

The additions and subtractions of AAUs in the Community registry for 2008 exactly balance and no units were held in the Community registry at the end of 2008. The total quantities of AAUs acquired and transferred during the reporting period are provided in SEF table 2b and 2c.

11.3 Summary of information reported in the SEF tables of Member States

SEF tables for the Community registry, EU-15 and EU-25 are provided in Annex 13. The SEF tables for EU-15 include aggregated information for EU-15 and EU-25 Member States. Note that the EU-15 SEF tables also include transactions between the Community registry and the new EU Member States and non-EU Member States. Table 11.1 provides an overview of transactions included in Table 2(b) in the Community registry, EU-15 SEF tables and EU-25 SEF tables.

Table 11.1Transactions included in Table 2(b) in the Community registry, EU-15 SEF tables and EU-25 SEF tables

Table 2(b)		Community registry SEF tables	EU-15 SEF tables	EU-25 SEF tables
From	**To**			
Community registry	EU-15 MS	Yes		
Community registry	new MS	Yes	Yes	
Community registry	Non-EU MS	Yes	Yes	Yes
EU-15 MS	Community registry	Yes		
EU-15 MS	new MS		Yes	
EU-15 MS	Non-EU MS		Yes	Yes
new MS	Community registry	Yes	Yes	
new MS	EU-15 MS			Yes
new MS	Non-EU MS			Yes

The European Commission, Member States and the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) completed the live connection between the CITL, the UNFCCC International Transaction Log (ITL) and Member State registries on 16 October 2008. The CITL tracks all activities in Member States registries in the same way as the ITL at international level.

For the 2009 submission Member States' SEF submissions were checked against information contained in the CITL. The comparison of Member States' SEF tables with CITL information was fully consistent for all Member States except for Finland and Hungary. These inconsistencies were due to the fact that the CITL does not take into account transactions performed before 16 October 2008. The attached SEF tables for EU-25 include the correct information taking into account all transactions performed in 2008.

11.4 Discrepancies and notifications

With respect to the respective paragraphs of decision 15/CMP.1 the following information is provided for the Community registry:

- Paragraph 12: No discrepances identified by the transaction log.
- Paragraph 13: No notifications directed to the Partry to replace ICERs in accordance with Pararaph 49 of the annex to decision 5/CMP.1.
- Paragraph 14: No notifications directed to the Partry to replace ICERs in accordance with para 50 of the annex to decision 5/CMP.1.
- Paragraph 15: No issue of non-replacement.
- Paragraph 16: No KP Units that are not valid.
- Paragraph 17: No actions were necessary to correct any problem causing a discrepancy.

11.5 Publicly accessible information

The information based on the requirements in the annex to decision 13/CMP is publicly available on the European Commission website: http://ec.europa.eu/environment/climat/home_en.htm

11.6 Calculation of commitment period reserve (CPR)

The EC commitment period reserve is 17,659,243,358 tonnes CO_2eq. as indicated as revised estimate in the report of the review of the initial report of the European Community (FCCC/IRR/2007/EC). The commitment period reserve for the EC is calculated as 90 per cent of its assigned amount pursuant to article 3, paragraphs 7 and 8 of the Kyoto Protocol and therefore remains unchanged during the first commitment period.

11.7 KP-LULUCF accounting

Mandatory reporting of reporting tables on activities under Articles 3.3 and 3.4 only start in 2010 including an accounting table on KP LULUCF information. For the 2009 submission, Austria, the Czech Republic and Francereporting tables under the Kyoto Protocol on a voluntary basis. However, the reporting of three Member States is not sufficient to compile Member States submissions to a voluntary EC submission on KP LULUCF activities.

12 Information on changes in national system

No changes were made to the EC national system.

13 Information on changes in national registry

The European Commission, Member States and the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) completed the live connection between the CITL, the UNFCCC International Transaction Log (ITL) and Member State registries on 16 October 2008. The CITL re-started processing transactions as planned on Thursday 16 October 2008, at 8:00 AM (CEST). The registry has been operational since the connection.

The connection was established after testing was successfully completed. As part of the testing the European Commission, Member States and the UNFCCC Secretariat have carried out two rehearsals to test technical procedures in 2008. The first test-run, which took place from 15 to 30 May, involved five Member States. The second rehearsal, from 18 July to 4 August involved all Member States, as well as non-EU registries in Russia, Japan and New Zealand. These tests have been successfully completed by 6 Auguts 2008.

A description of the EC registry was provided in the EC initial report. This description was updated in 2008 and the revised description was provided as Annex 13 to the NIR 2008.

Referring to paragraph 22 of the annex to Decision 15/CMP.1, the following changes have occurred in the Community Registry since the last report:

The name and contact information of the registry administrator designated by the Party to maintain the national registry:

The registry administrator changes from Istvan Bart to Ronald Velghe.

No further changes of the EC national registry occurred compared to the description provided in the 2008 submission of the NIR.

References

Agency for the Protection of the Environment and for Technical Services (APAT) 2006: *Report on the determination of Italy's assigned amount under Article 7, paragraph 4, of the Kyoto Protocol. Draft report to the European Commission.* 11 April 2006, Rome.

Agency for the Protection of the Environment and for Technical Services (APAT) 2008: *Italian Greenhouse Gas Inventory 1990-2006. National Inventory Report 2008.* Rome.
(IT NIR 2008)

Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 2009, *Inventaire des émissions de gaz à effet de serre en France au titre de la convention cadre des Nations Unies sur le changement climatique (CCNUCC)*, Mars 2009. Paris.
(FR NIR 2009)

Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 2007, *Organisation et Méthodes des Inventaires Nationaux des Emissions Atmosphériques en France (OMINEA).* 4th edition. January 2007. Paris.

Centre Interprofesionnel Technique d'Etudes de la Pollution Atmosphérique (CITEPA) 2008.*Oraganisation et Méthodes des Inventaires Nationaux des Emissiones Atmosphériques en France (OMINEA).* 5th edition. February 2008. Paris.
(FR NIR 2008 (French)

Czech Hydrometeorological Institute (CHMI) 2009: *National greenhouse gas inventory of the Czech Republic, NIR. Reported Inventory 2007.* March 2009, Prague.
(CZ NIR 2009)

Environment Service 2008. *National Greenhouse Gas Inventory Report of the Czech Republic (reported Inventory 2006).* March 2008. Prague.
(CZ NIR 2008)

Environmental Agency of the Republic of Slovenia 2009. *SLOVENIA'S NATIONAL INVENTORY REPORT 2007.* January 2009, Ljubljana.
(SI NIR 2009)

Environmental Agency of the Republic of Slovenia 2008. *Slovenia´s National Inventory Report 2008.* March 2008. Ljubljana.
(SI NIR 2008)

Environmental Protection Agency (EPA, Ireland) 2007. *Ireland - National Inventory Report 2009. Greenhouse Gas Emissions 1990-2007 reported to the UNFCCC.* March 2009, Wexford, Ireland.
(IE NIR 2009)

Environmental Protection Agency 2008. *Greenhouse Gas emissions 1990-2006 reported to the United Nations Framework Convention on Climate Change.* March 2008. Wexford.
(IE NIR 2008)

European Commission (EC) 2000, *Guidelines under Council Decision 1999/296/EC for a monitoring mechanism of Community CO_2 and other greenhouse gas emissions. Part I: Guidelines for Member States and EC annual inventories*, 1 September 2000. Brussels

European Commission (EC) 2001, *Community under the UN Framework Convention on Climate Change*, Commission staff working paper, SEC(2001)2053. 20. December 2001. Brussels.

European Environment Agency (EEA) 2006a, *Annual European Community greenhouse gas inventory 1990–2004 and inventory report 2006. Submission to the UNFCCC Secretariat*, Technical report No 6/2006. Copenhagen.
(EC IR 2006)

European Environment Agency (EEA) 2006b, *Greenhouse gas emission trends and projections in Europe 2006*, EEA report No. 9/2006. Copenhagen.

European Environment Agency (EEA) 2006c, *The European Community's initial report under the Kyoto Protocol. Report to facilitate the calculation of the assigned amount of the European Community pursuant to Article 3, paragraphs 7 and 8 of the Kyoto Protocol.* Submission to the UNFCCC Secretariat. EEA Technical report No 10/2006. Copenhagen.

European Topic Centre on Air and Climate Change (ETC/ACC) 2007. *Analysis of European greenhouse gas inventories in the aviation sector*, ETC/ACC Technical Paper 2007/6, December 2007

Federal Public Service Health, Food Chain Safety and Environment, DG Environment - Climate Change Section, 2006b. *Belgium's National Inventory Systemfor the estimation of anthropogenic greenhouse gas emissions by sources and removals by sinks under Article 5, paragraph 1, of the Kyoto Protocol*, Brussels, January 2006.

Flemish Environment Agency (VMM), 2009. *Belgium's greenhouse gas inventory (1990–2007). National inventory report, submitted under the UNFCCC United Nations Framework Convention and the Kyoto Protocol*, March-April 2009, Brussels.
(BE NIR 2009)

Flemish Environment Agency (VMM), 2008. *Belgium´s Greenhouse Gas Inventory. (1990-2006) National Inventory Report submitted under the United Nations Framework Convention on Climate Change.* March 2008. Belgium.
(BE NIR 2008)

Hungarian Meteorological Service, Greenhouse Gas Inventory Division 2009. *National Inventory Report for 1985-2007.* March 2009, Hungary.
(HU NIR 2009)

Institute for Environmental Protection and Research (ISPRA) 2009: *Italian Greenhouse Gas Inventory 1990-2007. National Inventory Report 2009:* April 2009. Rome.
(IT NIR 2009)

Institute of Environmental Protection, 2009. *Poland's National Inventory Report 2007.* Submission under the Article 3.1 of Decision 280/2004/EC and the UNFCCC and its Kyoto Protocol. March 2009, Warsaw.
(PL NIR 2009)

Institute of Environmental Protection, 2008. *Poland's National Inventory Report 2006.* Submission under the United Nations Framework Convention on Climate Change. April 2008, Warsaw.
(PL NIR 2008)

Intergovernmental Panel on Climate Change (IPCC), 1997. *Revised 1996 IPCC guidelines for national greenhouse gas inventories*. Geneva.

Intergovernmental Panel on Climate Change (IPCC), 2000. *Good practice guidance and uncertainty management in national greenhouse gas inventories*. Geneva.

Intergovernmental Panel on Climate Change (IPCC), 2003. *Good Practice Guidance for Land Use, Land-Use Change and Forestry.* Geneva.

Laitat, E.; Karjalainen, T.; Loustau, D. and Lindner, M. (2000), 'Introduction: towards an integrated scientific approach for carbon accounting in forestry', *Biotechnol. Agron. Soc. Environ.* 4:241–51.

Latvian Environment, Geology and Meteorology Agency (LEGMA), 2009. *Latvia's National Inventory Report 1990-2007 – submitted to the European Commission under the Decision No.280/2004/EC,* March 2009, Riga.
(LV NIR 2009)

Ministry of the Agriculture, Department of Forest Resources, 2008. Latvia's National Inventory Report for 1990-2006 – submitted under the United Nations Convention on Climate Change. March 2008. Riga.
(LV NIR 2008)

Ministerio de Medio Ambiente y Medio Rural y Marino 2009. *Inventario de emisiones de gases de efecto invernadero de España años 1990-2007.* Comunicación a la Comisión de la Unión Europea. Marso de 2009
(ES NIR 2009 (Spanish))

Ministerio de Medio Ambiente 2008. *Inventario de emisiones de gases de efecto invernadero de España años 1990-2006.* Comunicación a la Comisión de la Unión Europea. March 2008. (ES NIR 2008 (Spanish))

Ministry of Agriculture, Natural Resources and Environment, 2009. *National Inventory Report 2007. 2009 Submission. Under Article 3(1) of Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol*: April 2009. Cyprus.
(CY NIR 2009)

Ministry of Agriculture, Natural Resources and Environment Service, 2008. *National Inventory Report 2006. 2008 Submission. Under Article 3(1) of Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto*: March 2008. Cyprus.
(CY NIR 2008)

Ministry of Environment and Water, Executive Environment Agency, 2009. *National Inventory Report 2009 for Bulgarian Greenhouse Gas Emission, Submission under the UNFCCC and the Kyoto Protocol.* March 2009. Sofia.
(BG NIR 2009)

Ministry of Environment and Water, Executive Environment Agency, 2008. *National Inventory Report 2008 for Bulgarian Greenhouse Gas Emissions,* March 2008. Sofia.
(BG NIR 2008)

Ministry for the Environment, Physical Planning and Public Works 2009. *Annual Inventory Submission to the european community under decision 280/2004/ec for greenhouse and other gases for the years 1990-2007.* March 2009. Athens.

Ministry for the Environment, Physical Planning and Public Works 2009. *Greece - Climate Change Emissions Inventory - Annual inventory* submission to the European community under decision 280/2004/ec for greenhouse and other gases for the years 1990-2007. March 2009. Athens.
(GR NIR 2009)
Ministry for the Environment, Physical Planning and Public Works 2008. *Greece - Climate Change Emissions Inventory- Annual inventory submission under the convention and the Kyoto protocol for greenhouse and other gases for the years 1990-2006.* April 2008. Athens.
(GR NIR 2008)

Ministry of Environment (Estonia)-Ambient Air and Radiation Safety Bureau, 2009. *Greenhouse Gas Emissions in Estonia1990–2007 National Inventory Report to the unfccc secretariat.* March 2009, Tallinn.
(EE NIR 2009)

Ministry of the Environment, 2008. *National Inventory Report Estonia 2008, Greenhouse Gas Emsissions in Estonia 1990-2006, National Inventory Report to the UNFCCC secretariat.* March 2008. Tallin.
(EE NIR 2008)

Ministry of Environment (Lithuania), 2009. *National Greenhouse Gas Emission Inventory Report 2007 of the Republic of Lithuania. Reported Inventory 1990-2007.* March 2009, Vilnius.
(LT NIR 2009)

National Environmental Protection Agency 2009, *Romania's Greenhouse Gas Inventory 1989-2007 - National Inventory Report*, March 2009, Romania.
(RO NIR 2009)

National Environmental Protection Agency (NEPA) 2008, *Romania's Greenhouse Gas Inventory 1989-2006 – National Inventory Report*, March 2008, Bucharest
(RO NIR 2008)

Ministry of the Environment of the Czech Republic, 2007. *Reporting under Article 3.1 of the Decision No 280/2004/EC Reporting under under Article 3.1 Decision 280/2004/EC.* January 2007, Prague.

Ministry of the Environment of the Slovak Republic and Slovak Hydrometeorological Institute, 2009. *Slovak Republic – National Inventory Report 2009, Greenhouse Gas Rmission Inventory 1990–2007 submission under the UNFCCC and voluntary submission under the Kyoto Protocol.* March 2009, Bratislava.
(SK NIR 2009)

National Environmental Agency, 2008. Portuguese National Inventory Report on Greenhouse Gases, 1990-2006 Submitted under the United Nations Framework Convention on Climate Change. January 2008. Amadora.
(PT NIR 2008)

National Environmental Research Institute (NERI) 2009, *Denmark's national inventory report 2009*, *Emission Inventories 1990-2007*. March 2009, Copenhagen.
(DK NIR 2009)

National Environmental Research Institute, University of Aarhus, 2008. *Denmark's National Inventory Report 2008, Emission Inventories 1990-2006 - submitted to the European Commission.* March 2008. Denmark.
(DK NIR 2008)

National Greenhouse Gas Emission Inventory Report 2008 of the Repbublic of Lithuania (reported Inventory 1990-2007), Annual report under the UN Framework Convention on Climate Change. December 2008. Vilnius.
(LI NIR 2009)

National Greenhouse Gas Emission Inventory Report 2007 of the Repbublic of Lithuania (reported Inventory 1990-2006), Annual report under the UN Framework Convention on Climate Change. December 2007. Vilnius.
(LI NIR 2008)

National Emissions Inventory System Team Malta Environment and Planning Authority, 2009.

National Greenhouse Gas Emissions Inventory Report for Malta 1990 – 2007. Annual Report for submission under the United Nations Framework Convention on Climate Change and decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. March 2009. Malta.
(MT NIR 2009)

National Emissions Inventory System Team Malta Environment and Planning Authority, 2008. *National Greenhouse Gas Emissions Inventory Report for Malta 1990 – 2006. Annual Report for submission under the United Nations Framework Convention on Climate Change and decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol.* March 2008. Malta.
(MT NIR 2008)

Department of Energy and Climate Change, 2009. *UK Greenhouse Gas Inventory 1990 to 2007: Annual Report for submission under the Framework Convention on Climate Change*, April 2009, Didict Oxfordshire, UK
(GB NIR 2009)

Department for Environment, Food and Rural Affairs. AEA Technology, 2008. *UK Greenhouse Gas Inventory 1990 to 2006: Annual Report for submission under the Framework Convention on Climate Change.* March 2008. Didcot Oxfordshire.
(GB NIR 2008)

Netherlands Environmental Assessment Agency (MNP) 2009. *Greenhouse Gas Emissions in the Netherlands 1990-2007. National Inventory Report 2009.* MNP report 500080 0012. March 2009, Bilthoven, The Netherlands, 2009.
(NL NIR 2009)

Netherlands Environmental Assessment Agency (MNP), 2008.*Greenhouse Gas Emissions in the Netherlands 1990-2006, National Inventory Report 2008,* March 2008. Bilthoven.
(NL NIR 2008)

Portuguese Environmental Agency (Departamento de Alterações Climáticas, Ar e Ruído) 2009, *Portuguese National Inventory Report on Greenhous Gases, 1990-2007 Submitted under the United Nations Framework Convention on Climate Change and the Kyoto Protocol*. Amadora, March 2009.
(PT NIR 2009)

Slovak Hydrometeorological Institute*, 2008. National Inventory Report, Greenhouse Gas Emission Inventory in the SR 1990-2006. March 2008*. Bratislava.
(SK NIR 2008)

Statistics Finland, 2009. Greenhouse Gas Emissions in Finland 1990-2007 National Inventory Report to the European Union, March 2009, Helsinki.
(FI NIR 2009)

Statistics Finland , 2008. *Greenhouse Gas Emissions in Finland 1990-2006, National Inventory Report to the European Union.* March 2008. Finland.
(FI NIR 2008)

Swedish Environmental Protection Agency (EPA), 2009. *national Inventory Report 2009submitted under the UNFCCC and the Kyoto Protocol.* March 2009, Stockholm.
(SE NIR 2009)

Swedish Environmental Protection Agency, 2007. *Sweden's National Inventory Report 2008, Submitted under the United Nations Framework Convention on Climate Change.* 2007. Stockholm.
(SE NIR 2008)

Umweltbundesamt (Austria), 2009. *Austria´s National Inventory Report 2009. Submission under the United Nations Framework Convention on Climate Change.* March 2009, Vienna.
(AT NIR 2009)

Umweltbundesamt, 2008. *Austria´s National Inventory Report 2008, Draft, Submission under the EC Monitoring Mechanism.* March 2008. Vienna.
(AT NIR 2008)

Umweltbundesamt (Germany), 2006b. AAU Bericht - Bericht zur Festlegung der zugewiesenen Mengen Umweltbundesamt. März 2006. Dessau.

Umweltbundesamt, 2009. *Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen, 2009, Nationaler Inventarbericht zum Deutschen Treibhausgasinventar 1990 – 2007.* January 2009. Dessau.
(DE NIR 2009 (German))

Umweltbundesamt, 2008. *Berichterstattung unter der Klimarahmenkonvention der Vereinten Nationen, 2008, Nationaler Inventarbericht zum Deutschen Treibhausgasinventar 1990 – 2006.* March 2008. Dessau.
(DE NIR 2008 (German))

Units and abbreviations

t	1 tonne (metric) = 1 megagram (Mg) = 10^6 g
Mg	1 megagram = 10^6 g = 1 tonne (t)
Gg	1 gigagram = 10^9 g = 1 kilotonne (kt)
Tg	1 teragram = 10^{12} g = 1 megatonne (Mt)
TJ	1 terajoule

AWMS	animal waste management systems
BEF	biomass expansion factor
BKB	lignite briquettes
C	confidential
CCC	Climate Change Committee (established under Council Decision No 280/2004/EC)
CH_4	methane
CO_2	carbon dioxide
COP	conference of the parties
CRF	common reporting format
CV	calorific value
EC	European Community
EEA	European Environment Agency
EF	emission factor
Eionet	European environmental information and observation network
ETC/ACC	European Topic Centre on Air and Climate Change
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
GHG	greenhouse gas
GPG	good practice guidance and uncertainty management in national greenhouse gas inventories (IPCC, 2000)
GWP	global warming potential
HFCs	hydrofluorocarbons
JRC	Joint Research Centre
F-gases	fluorinated gases (HFCs, PFCs, SF_6)
IE	included elsewhere
IPCC	Intergovernmental Panel on Climate Change
KP	Kyoto Protocol
LULUCF	land-use, land-use change and forestry
N	nitrogen
NH_3	ammonia
N_2O	nitrous oxide
NA	not applicable
NE	not estimated
NFI	national forest inventory
NIR	national inventory report

NO	not occurring
PFCs	perfluorocarbons
QA/QC	quality assurance/quality control
QM	quality management
QMS	quality management system
RIVM	National Institute of Public Health and the Environment (The Netherlands)
SF_6	sulphur hexafluoride
SNE	Single National Entity
UNFCCC	United Nations Framework Convention on Climate Change

Abbreviations in the source category tables in Chapters 3 to 9

Methods applied	**EF: methods applied for determining the emission factor**	**AD: methods applied for determining the activity data**	**Estimate: assessment of completeness**	**Quality: assessment of the uncertainty of the estimates**
C — Corinair	C — Corinair	AS — associations, business organizations	All — full	H — high
CS — country-specific	CS — country-specific	IS — international statistics	F — full	M — medium
COPERT X — Copert Model X = version	D — default	NS — national statistics	Full — full	L — low
D — default	M — model	PS — plant specific data	IE — included elsewhere	
M — model	MB — mass balance	Q — specific questionnaires, surveys	NE — not estimated	
NA — not applicable	PS — plant-specific	RS — regional statistics	NO — not occurring	
RA — reference approach			P — partial	
T1 — IPCC Tier 1			Part — partial	
T1a — IPCC Tier 1a				
T1b — IPCC Tier 1b				
T1c — IPCC Tier 1c				
T2 — IPCC Tier 2				
T3 — IPCC Tier 3				