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accompanying the

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Strategy for an internalisation of external costs

and the

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures

Impact assessment on the internalisation of external costs

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COMMISSION STAFF WORKING DOCUMENT

Impact assessment on the internalisation of external costs accompanying the proposal for a directive amending Directive 1999/62/EC on the charge of heavy goods vehicles for the use of certain infrastructures (COM(2008)aaa) and a Communication on the internalisation of external costs (COM(2008)bbb) {SEC(2008) ccc} {SEC(2008) ddd}

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Executive summary

When amending Directive 1999/62/EC on charging heavy goods vehicles (HGV) for the use of infrastructure in May 2006, the European Parliament and the Council stated[1] that: "*No later than 10 June 2008, the Commission shall present, after examining all options including environment, noise, congestion and health-related costs, a generally applicable, transparent and comprehensible model for the assessment of all external costs to serve as the basis for future calculations of infrastructure charges*". The amending Directive adds that: "*This model shall be accompanied by an impact analysis of the internalisation of external costs for all modes of transport and a strategy for a stepwise implementation of the model for all modes of transport. The report and the model shall be accompanied, if appropriate, by proposals to the European Parliament and the Council for further revision of this Directive*".

The present impact assessment focuses on the internalisation of external costs of noise, air pollution, climate change, congestion and accidents from heavy goods vehicles and other transport means through pricing instruments such as charges, taxes or tradable permits. It analyses the options for internalising external costs in HGV tolls in order to revise Directive 1999/62/EC and the options for internalising external costs in other modes of transport such as railways, aviation, maritime and inland waterways.

The problem definition highlights the following elements:

- the diversity of tax and charge systems across Member States and across modes of transport which generally fails to give the right price signals to users.

- implementing an internalisation strategy in road transport may lead to issues such as traffic detour, lack of public and impact on the internal market that might mitigate the effectiveness of instruments. Therefore, traffic diversion, public acceptability, the use of

[1] Article 11 of Directive 1999/62/Ec as amended by Directive 2006/38/EC.

new technologies and enforcement aspects should be considered in the analysis of impact and the comparison of options.

- if nothing is done, Member States have limited scope for internalisation since the current Directive on infrastructure charging in road transport does not allow to do so for heavy goods vehicles (HGV) and the current Directive on infrastructure charging in railways allows mark-ups for external costs under certain conditions. The revision of Directive on infrastructure charging in road transport should be a first step in the strategy of internalisation of external costs.

A set of policy options has been analysed, also with the help of modelling tools. An option analyses the impact of charging external costs in road freight transport. This policy option would lead to a revision of Directive 1999/62/EC. Three variants have been analysed: charging for air pollution and noise costs, charging for air pollution, noise and CO2, charging for air pollution, noise and congestion. Another policy option envisages charging air pollution, noise and CO2 in all modes of transport.

The results of the analysis of impact show that mobility is practically maintained as the reduction of traffic in road freight transport is almost completely compensated by an increase in other modes. The impact on GDP and efficiency varies across policy options and can be negative. However, the results of the models cannot capture some benefits such as the improvements in health and human well-being derived from the reduction of environmental emissions and the improvement of safety. The reduction of external costs would benefit to citizens and contribute to improving welfare.

The comparison of selected quantitative and qualitative criteria allows identifying preferred options. Policy option 2C – charging for air pollution, noise and congestion in road freight transport – allows maintaining sustainable mobility while limiting negative economic and social impact. Policy option 3B – charging for air pollution, noise, CO2 in all modes – gives also evidence of the best combination of these effects. Sensitivity analysis and implementation issues also suggest practical steps to initiate a stepwise strategy of internalisation.

1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Preliminary Remarks on the scope of the Impact Assessment

1.1.1. The request of the EU legislator

When amending Directive 1999/62/EC on charging heavy goods vehicles (HGV) for the use of infrastructure in May 2006, the European Parliament and the Council stated[2] that: "*No later than 10 June 2008, the Commission shall present, after examining all options including environment, noise, congestion and health-related costs, a generally applicable, transparent and comprehensible model for the assessment of all external costs to serve as the basis for future calculations of infrastructure charges*". The amending Directive adds that: "*This model shall be accompanied by an impact analysis of the internalisation of external costs for all modes of transport and a strategy for a stepwise implementation of the model for all modes of transport. The report and the model shall be accompanied, if appropriate, by proposals to the European Parliament and the Council for further revision of this Directive*".

The current impact assessment focuses on the internalisation of external costs from heavy goods vehicles and other transport means through pricing instruments such as charges, taxes or tradable permits. It is part of the Commissions work programme (TREN/2008/073 and TREN/2008/023) and of the Green Transport Package.

The objective of the internalisation of external costs is to provide a clear and correct price signal to the transport users so as to influence their behaviour. It should lead to an improvement in transport efficiency as transport users will base their decisions upon the price mechanism in accordance with the principle that the user and polluter pays for the costs they generate. Furthermore, setting the pricing which includes social costs should provide incentives that are consistent with greater sustainability of transport activities.

1.1.2. Scope of the impact assessment

The request from the EU legislator requires looking at the internalisation of external costs in the charges levied on heavy goods vehicles, but also mentions the need to analyse these issues in other modes. The scope of this impact assessment is limited to pricing based internalisation measures. Internalisation of external costs should lead to a reduction of external costs. However, in presence of rigid demand resulting from, or combined with different other market failures (producing lack of alternatives, low incentive to buy clean vehicles…), other tools such as regulation, infrastructure policy or research support can be used in complementary and mutually reinforcing ways (see box 2).

1.1.2.1. Internalisation of external costs in all modes of transport

For reasons of fairness and efficiency, the request of the European legislator explicitly referred to the need to carry out an analysis not only for road transport but also in other modes of transport.

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[2] Article 11 of Directive 1999/62/Ec as amended by Directive 2006/38/EC.

Internalisation is already foreseen in some cases. The EU legislation addresses charging issues in railways in Directive 2001/14/EC. According to this Directive, infrastructure managers are obliged to charge all trains for access to infrastructure to recover the costs of operating the train service. They have the possibility to charge for external costs (article 7). According to the Directive, "*charging of environmental costs which results in an increase in the overall revenue accruing to the infrastructure manager shall however be allowed only if such charging is applied at a comparable level to competing modes of transport*" (article 7).

The situation is different in other modes of transport. Internalisation of external costs within the TENs is not allowed in the current Eurovignette if it leads to extra-revenues (see below 1.1.2.2). However, Member States are free to apply tolls or user charges on roads other than those on the trans-European network, including for the internalisation of external costs. Member States are also equally free to apply charging schemes to passenger cars. The Commission considers that, for reasons of subsidiarity, the decision whether to internalise or not is best left in these cases to the Member States. Still, the existing Eurovignette and railways legislation opens new avenues for reflection and possible action in other modes of transport.

In air transport, the Commission has recently proposed to include air transport in ETS, which contributes to internalising the cost of greenhouse gas emissions. In waterborne transport, the EU legislation does not propose at the moment any measures on internalisation. Navigation in the river Rhine which covers the main part of inland waterway transport is subject to the revised Mannheim convention which exempts navigation from pricing issues. As regards maritime, the Community has identified many challenges to strengthen the competitiveness of European ports, but has left pricing issues to national initiatives.

This impact assessment will analyse the impact of internalisation of external costs not only for HGV, but also in other modes of transport such as railways, aviation, maritime, inland waterways and cars.

1.1.2.2. Charging for external costs in Directive 1999/62/EC

In some cases, HGV compete with railways. Therefore, allowing internalisation in the framework of the existing directive on infrastructure charging would give further opportunities to internalise external costs in the railways sector and other modes.

Directive 1999/62/EC allows but does not oblige Member States to charge road freight vehicles over 3.5 tons on the roads belonging to the trans-European network. Tolls can not exceed the recovery of infrastructure costs. The infrastructure costs are defined as being the costs of constructing, operating and maintaining the infrastructure network concerned and may include a profit margin based on market conditions. Tolls can vary no more than 50% at constant revenue.

The amending Directive 2006/38/EC allows a toll mark-up of up to 25% in mountainous areas on an exceptional basis if earmarked to finance the construction of priority European projects in the same corridor. It also allows a higher variation of tolls of up to 100%, without fixing a minimum, according to the EURO class of vehicles, the time of day, type of day or season to tackle congestion. However, the variation is allowed only if

it does not generate additional tolling revenues. Moreover, the Directive does not address the variations of tolls between roads crossing areas exposed to different level of external costs (in-built areas and rural areas).

The current Directive therefore does not allow levying charges specifically designed to reflect external costs, nor does it provide a framework for fully varying existing tolls, i.e. beyond 100%. Hence the request of the legislator to propose a methodology to assess external costs and to analyse whether it may serve as the basis for calculating an external cost element in tolls levied on HGVs.

This impact assessment will analyse the options to internalise external costs in HGV tolls in order to revise Directive 1999/62/EC. The revision of Directive 1999/62/EC is a step to allow internalisation in a mode which competes with railways in some networks by giving incentives to internalise.

1.1.2.3. Internalisation of external costs in urban transport

Although many external costs of road transport are related to the use of vehicles in cities, the current exercise does not deal with this issue. The high diversity of mobility patterns between different cities, both for freight and passenger transport, makes analysis at an EU level much more difficult than that of long distance transport, which is also at the heart of the Common Transport Policy. In addition, other instruments such as parking policies, public transport or promotion of walking and cycling are specific to urban policies and would need a full separate analysis. Analysis in urban transport will be provided when it comes to congestion. However, the impact assessment will not provide a pricing strategy in cities as it is considered that in this field policy decisions are better taken at a level that is closer to the citizens and their particular circumstances. The forthcoming Action Plan on urban mobility will cover both passenger and freight transport. It will address internalisation in urban areas while respecting the subsidiarity principle. Improving the quality of policy making in this field through the harmonisation of rules and standards and the interoperability of technologies could contribute to creating a common framework in this field. In addition, the exchange of experiences and knowledge can play a role. .

1.1.2.4. The treatment of infrastructure costs

In most cases, the EU legislation allows Member States to recover infrastructure maintenance, operation and construction costs through charges for the use of infrastructure, provided that a number of general principles like non discrimination and transparency are respected. This possibility is used to some extent by Member States. Tolls are levied on only 3% of the total trunk and motorways network.

The request of the EU legislator does not question the flexibility left to Member States on infrastructure pricing and concerns only external costs.

However, in order to assess the impact of charging external costs, existing charges levied to recover infrastructure costs in road transport will be taken into account in the analysis of impact of policy options (see part 4 and 5 below). In the modelling exercise, the approach leaves all existing charges for infrastructure as they are and puts internalisation charges on top of them.

Box 1: Infrastructure Costs

Variable infrastructure costs

Infrastructure use costs correspond to the variable part of infrastructure costs. Although it is often difficult to distinguish the variable cost from the fixed costs, it is generally considered that variable infrastructure costs cover maintenance and operating costs (expenditures for road maintenance, expenditure for dredging a canal or a harbour). These costs vary with traffic volumes, vehicles weight per axle and weather conditions.

However, only a part of these variable costs can be considered as external cost insofar as they are imposed by some users on other users. Damage costs by vehicles could be considered as external costs.

Infrastructure construction costs

Traditionally, construction costs have been borne by public authorities or by operators linked to public authorities. In most cases, it is still true nowadays although some infrastructures are increasingly provided by the private sector (subject to public-private partnership contracts) in some Member States and some modes (motorways, airports…).

The impact assessment assumes that the recovery of construction cost is independent of the internalisation of external costs. This "separation" assumption is quite realistic for most external costs (air pollution, noise, accidents) as cost recovery payments are weakly related to the costs drivers of these externalities (e.g. vehicle characteristics, population density, etc). However, as to congestion, charging for it provides under certain conditions (i.e. absence of economies or diseconomies of scale, absence of indivisibilities) an optimal expansion pathway for the infrastructure. Conversely, cost recovery pricing may integrate in the price a congestion differentiated signal reflecting the need to provide for additional capacities. If infrastructure is correctly dimensioned and planned through cost-benefit appraisal, cost recovery pricing (e.g. based on two-part tariffs) may not be conceptually too different from long term marginal cost pricing of congestion in which new vehicles are asked to pay not only for the actual congestion they produce in the short run but also for the long term expansion of the infrastructure they bring nearer. Both systems may mesh and complement each other over the life of a project.

In conclusion, the assumption of separation between efficient infrastructure use and efficient infrastructure provision, including cost recovery is needed to allow the theoretical analysis of internalisation to proceed. When it comes to implementing instruments, it should be acknowledged that there are many linkages between both as for example, the differentiation of cost recovery charges according to EURO class in Directive 2006/38/EC.

1.2. External Expertise

This impact assessment relies on different works carried out over the past years – EU research projects and the IMPACT study.

1.2.1. Research project under the Research Framework Programme

For many years, the Commission has financed research programmes in the field of transport pricing[3].

GRACE[4] – Generalisation of Research on Accounts and Cost Estimation – is a research project funded by the EC sixth Framework programme. This project aims to support policy makers to develop sustainable transport systems by facilitating the implementation of pricing and taxation schemes that reflect the costs of infrastructure use. Among the areas of research, it proposes methods of evaluation of external costs. GRACE project has been reviewed in the Handbook on the assessment of external costs.

An ongoing research project named REFIT[5] is aiming at providing a set of sustainability indicators for assessing the effect of various policies. This project is developing a "modelling tool-based" methodology that produces data on a set of identified indicators and that enables ex-ante evaluation of the Transport Policy measures considering the economic, environmental and social dimensions of sustainability. Some of these indicators are being used in the current analysis. In order to be consistent with the whole exercise, REFIT has applied its methodology to some policy options of the current impact assessment and used the scenarios defined in the IMPACT study.

Finally, DIFFERENT[6] is reviewing the state of play of differentiated charges in Member States and analyses user reaction from real-world cases. DIFFERENT has been used when assessing the existing charging situation in Member States.

1.2.2. External Study

The Commission has launched a study – IMPACT – aiming at reviewing the existing methods to estimate external costs in Europe[7] which has been published in January 2008. On top of the handbook, two other studies have been made available: one on the study of infrastructure costs and charging in road transport, another one on the analysis of impact of pricing scenarios (using transport models run by the Commission and ASTRA model[8]).

1.2.3. Inter-service group

An Inter-service group has been created and comprised transport units of DG TREN (maritime and inland waterways, railways, road, air transport, and logistics), ENV, ENTR, EMPL, ECFIN, TAXUD, SG, and JRC. The interservice group met 5 times

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3 Efficient pricing in transport - overview of European Commissions transport research programme. Catharina Sikow-Magny. Chapter 15. Acceptability of transport Pricing Strategies. 2003, ed by J. Schade and B. Schlag, Elsevier.

4 http://www.grace-eu.org/project.htm

5 http://refit.bouw.tno.nl/index.htm

6 http://www.different-project.eu/

7 *Internalisation Measures and Policies for all external Costs of Transport (IMPACT). Handbook on estimation of external costs in the transport sector*. CE Delft. 2007.

8 "Report on internalisation Strategies". Ongoing work. CE Delft. IWW Institut für Wirtschaftspolitik und Wirtschaftsforschung, Universität Karlsruhe, Germany) is modelling ASTRA.

between October 2007 and March 2008. The modelling of transport was carried out by JRC (TRANSTOOLS) and ENV (TREMOVE, service contract with the University of Thessaloniki) as an input to the IMPACT study.

1.3. Consultation of stakeholders

1.3.1. Consultation on the Handbook

On 15 March 2007, the Commission held a workshop with stakeholders to test the main assumptions and orientations undertaken in the IMPACT study[9]. The aim of the workshop was twofold. The first objective was to make use of the broad expertise of the invitees on the issues presented with a view to incorporating their comments into the project deliverables of the IMPACT study. The second objective was to gain support for the results of the project, which was deemed crucial for any further step towards policy development on the internalisation of external costs. The issues discussed included the following: which external costs need to be considered; should a pragmatic marginal cost oriented approach with averaged figures for typical traffic situations form the basis for the estimation of concrete values; are there well established methods to estimate and value these external costs; are there limits to the use of universal methods and to the level of accuracy available in practice.

On 22 November 2007, the Commission organised a technical meeting with experts nominated in different Member States. The objective of the meeting was to have a diverse panel of scientific and technical experts nominated by the Member States to peer-review the final draft handbook and give their comments on how the document could be improved before it is published.

There was a general agreement on the external cost categories selected, on their definitions, on the suitability of the methodology used and the completeness of the data presented. It was generally acknowledged that the handbook provides a comprehensive review of the existing state-of-the art research on the subject and as such creates important added value. There were several specific suggestions made for improvements and it was also pointed out by several participants that the "How to use the handbook" section would benefit from further elaboration as the situation of potential users of the handbook will depend a great deal on the availability of input and output data for their particular countries. The authors have incorporated the comments into the final version of the Handbook.

1.3.2. Consultation on the impact assessment

A broad Internet consultation has been launched end October 2007 and stopped on 31 December 2007. The objective of the consultation was to get a feedback on the general principle of internalisation and on the various policy options developed in a consultation paper[10].

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9 Summary and minutes can be found at: http://www.ce.nl/redirect/Workshop_IECT_index.htm

10 "Preparation of an Impact Assessment on the Internalisation of External Costs". Consultation Document. Available at http://ec.europa.eu/transport/white_paper/consultations/index_en.htm.

The Commission received 469 replies and 17 position papers. Annex 1 gives details on the results of the consultation. The majority of respondents agreed with the principle of internalising external costs generated by transport. In general, participants expect internalisation to improve efficiency, fairness in society and a reduction of nuisances. However, some concerns were expressed on a possible increase in costs which would affect overall competitiveness of EU economies. In addition, stakeholders were asked to provide feedback on the choice of economic instruments to tackle external costs.

On 31 January 2008, a high level conference was organised in order to present the main findings of these consultations[11].

This feedback has enriched the analysis and has been taken into account when defining policy options on the internalisation of external costs.

1.4. Consultation of the Impact Assessment Board

1.4.1. Preliminary comments

An early cooperation has been organised with the Impact Assessment Board (IAB) in order to get quality support. The IAB had the opportunity to comment on the draft outline of the current impact assessment and on the draft handbook. The two sets of comments were received on 20 September and 30 October 2007.

The main comments have been on the need to take into account infrastructure costs, to define a level of internalisation for each mode of transport; and to analyse the effects of internalisation on social inclusion.

Many of the comments of the IAB have been taken into account, in particular the level of internalisation and the social aspects. As regards infrastructure costs, the inclusion of these costs is part of the analysis. But, the impact assessment does not deal with cost recovery principle and its implementation (see box 1).

1.4.2. Opinion of the Impact Assessment Board

The impact assessment was discussed with the Impact Assessment Board on 2 April 2008. The IAB published its opinion on 7 April 2008.

The opinion of the Board listed the following recommendations for improvements:

- strengthening the economic reasoning underlying the internalisation of externalities.

- stressing the limitations of the quantitative models and complementing with a reinforced qualitative analysis.

- improving the identification and description of policy options

- strengthening the analysis of earmarking

[11] See the position papers and the presentations at http://ec.europa.eu/transport/costs/conference/index_en.htm.

- improving the comparison of options.

Following these recommendations, the impact assessment has been revised along these lines.

- The economic reasoning has been reinforced across the document and a box (box 2) on theoretical aspects has been added. This box develops further the theoretical principles exposed in the consultation paper on the internalisation of external costs. More specifically, it explains how external costs represent a market failure that would require and justify public authority's intervention.

- The limitations of the models have been highlighted in box 6 (section 5). In particular, models should be seen as providing indications on likely effects rather than quantifications of impacts, as they are not able to capture all the effects. Moreover, the aggregation at EU level limits the analysis of local effects and underestimates the positive aspects. A qualitative analysis complements the quantitative analysis in section 5. Results from transport economic literature and research projects are provided and help analyse the overall impact of internalisation.

- The process of selection of policy options is explained step by step. In addition, the reasons why policy option 4 has been discarded are explained.

- The analysis of earmarking has been expanded in section 5 and section 6. Pro and cons arguments are provided and policy choices are explained and justified.

- Finally, the comparison of options has been reinforced and supplemented by a qualitative assessment.

In order to help the reader, a glossary of technical terms has been added in annex 15.

On 30 April 2008, the IAB published its second opinion and recommended to (1) further streamline and clarify section 4 on policy options, (2) to provide some quantitative results when comparing policy option 3A and 3B and (3) to explain why using electronic tolling should be the implementation mechanism.

Following these recommendations, the following amendments have been made:

- Section 4 has been restructured in order to clarify the presentation of the selection of policy options. A table (table 4.1) summarising each policy options has been added;

- A table (table 6.2) on the comparison of policy option 3A and 3B has been included in section 6. It provides some quantitative results from the modelling exercise.

- The issue of electronic tolling had already been mentioned in section 2.3.4. It has been further developed in section 2.3.4 and section 6 in order to justify why this mechanism is preferred.

2. PROBLEM DEFINITION: WHY INTERNALISATION OF EXTERNAL COSTS?

While transport choices are influenced by transport prices, the gap between prices and underlying costs may lead to an inefficient situation (see box 2). In a number of cases, part of the costs generated by transport users is not fully borne by them but is paid for by other transport users or by society. As a consequence, the "user pays" and "polluter pays" principle fails to be applied in transport activities.

This section will try to assess to which extent external costs are not internalised.

Box 2: Internalisation of external costs: Theory and Practice

Who pays what? Private costs and External costs

For efficiency as well as for fairness purposes, the costs and nuisances related to transport activities should be borne by those who produce them. Regarding transport activities, it appears that quite often some of these costs are not borne by transport users and more importantly that there is no direct relation between the costs paid by users and the cost they impose on the society.

The costs of transport can be split into **private/internal costs** (those directly borne by the person engaged in transport activity) and **external costs** (i.e. those that are imposed on others but not supported by the user). The sum of private and external costs represents **social costs**. The boundary between internal and external costs is defined by the costs the person takes into account when deciding to use a transport service. This means that when engaging in a transport activity, a person will incur private costs linked to the use of a mode of transport (vehicle purchase, tolls or fuel use), but will not be aware of effects imposed on others such as pollution or congestion. His/her decision will not be based on the social costs of his/her activity.

In other words, the costs imposed on others– environmental damages, accidents, congestion - generated by transport activities are external costs, more generally referred to as **externalities**. Most of them have increased over the past years despite technological progress.

The table below draws the line between both categories of costs.

Table Box 2: Classification of the costs of Transport

Cost of categories	**Social costs**	
	Internal/Private costs: borne by transport user	**External costs: borne by other transport users or society**
Transport operating expenditure	Fuel and vehicle costs Tickets/fares	Costs paid by other users or by society
Infrastructure use costs	Costs covered by infrastructure charge Costs covered by tickets/fares	Costs partly uncovered
Accidents costs	Costs covered by insurance, own	Uncovered accident costs (e.g. pain

	accident costs	and suffering imposed on others), administrative and police costs
Noise costs	Own disbenefits	Costs borne by people exposed to noise (noise disturbance, health effects)
Air pollution costs	Own disbenefits (depending on individual situation)	Costs borne by people exposed to air pollution (health effects)
Climate change costs	Own disbenefits (including future generation, i.e. children)	Costs borne by society and by future generations
Congestion costs	Own time costs	Delays/time costs imposed on others

Source: Consultation Paper on Internalisation of External Costs (October 2007). Table adapted from Table 2.1. of the Green Paper "Towards fair and efficient pricing in transport. COM(95) 691 final.

Internalisation as a way to convey the right economic signal

If prices do not appropriately reflect social costs, they fail to convey the right economic signals, thus leading to situations where transport activities generate excessive costs as compared to an efficient situation. Consequently, each mode will not be used in an optimal way and the final equilibrium will not lead to maximum benefits to society. For example, health care due to damage from air pollution or noise will be paid by others, i.e. tax payers in this case. The transport activity being relatively under-priced in respect of its cost, too much of it will take place or more often too much transport activity with the wrong characteristics (technical, modal, timing).

Internalisation is a way to ensure that each transport user pays the social costs associated to his individual trip. It can be implemented through taxation and user charges. Trade permits can also play a role by allowing prices to reflect damages. By this way, transport users will have an incentive to reduce the nuisances/costs they generate.

Internalisation eliminates the market failure due to externalities and defines a new equilibrium in which individual behaviour is consistent with maximisation of social welfare. However, internalisation will only be effective insofar as transport choices are sensitive to price signals. In the presence of other market failures that make demand less responsive to internalisation charges (lack of alternatives, low incentive to buy clean vehicles, bounded rationality (myopic behaviour)…), internalisation should be complemented by other policies such as infrastructure policy, research policy, competition policy…… If these other market failures are removed, the internalisation of externalities would probably determine an equilibrium at which the level of external costs would be significantly lower and possibly better adjusted to politically expressed social preferences.

Which external costs?

Transport activities generate costs related to the need to build and maintain infrastructure and to the use of these infrastructures. The provision of infrastructure generates external costs on land use, nature (fragmentation of ecosystems) and on landscapes. The current impact assessment does not deal with these costs and focuses on costs related to the use of infrastructure. Among external costs of using infrastructure, economic and transport

literature agrees to identify congestion, accidents, air pollution, noise and climate change as the main ones.

Estimating external costs: providing a common framework

The characteristic of externalities is that they are not borne by the user. One of the reasons may stem from the fact that it is often difficult to identify precisely the physical impact as such. Assessment is also made difficult as there is often no market and no monetisation. For example, air pollution and noise affect health; time loss imposes adjustments and waste. But these costs are indirect and there is not market as such to monetise them. As a result, internalising these costs requires making estimates of them.

In January 2008, a Handbook on estimation of external costs in transport sector has been published. It reviews the recent methodologies of estimating external costs and identifies best practices. On this basis, the Commission intends to publish in June 2008 a common framework to assess external costs. It will provide a common methodology to estimate external costs of air pollution, noise and congestion. The Communication will also recommend default values in case such values would not be available in Member states. Finally, recommendations on the application of charging will be made on the basis of differentiation.

Principle of charging: social marginal cost pricing versus equity approach

The need to confront each individual transport decision-maker with the correct costs he imposes on others pleads for the use of a marginal social cost approach. The choices of individuals are made by equating marginal benefit to marginal cost. By ensuring that marginal cost to the user is equal to marginal cost to society, the overall equilibrium will reflect the condition for efficiency that marginal abatement costs are set equal to the marginal damage. Such an approach means that prices in transport should be equal to the short-run additional cost created by an additional user of the infrastructure. In theory, this approach should include price-relevant cost of use (infrastructure wear and tear, congestion, scarcity costs) and marginal external costs (environmental costs, external accidents costs). Marginal social cost pricing would then lead to allocative efficiency for the use of existing infrastructure, both statically and dynamically through the provision of the right level of incentives. Furthermore, as the user would pay for the additional cost he imposes on society, this would contribute to fairness across transport users and non users. However, this system would not guarantee that the infrastructure can be financed as the revenues it would produce can fall short of the needs or can exceed them.

Another approach based on full cost pricing is often perceived as a more appropriate, as it ensures that the user will pay for the whole cost of the infrastructure, which sometimes may be considered necessary by public authorities. This approach – also called equity approach – takes all costs into account, including infrastructure investment costs, and considers that prices should be equal to average costs in order to allow cost recovery*. It can be noted that average cost charging may prevent the access to the infrastructure of users whose marginal benefit would be larger than the marginal cost they actually cause, thus producing a sub-optimal allocation. Moreover it also assumes that the beneficiaries of the infrastructure are only the actual users of it, and not the people and firms who value the option of using it, which gives to the infrastructure a public good character.

Both approaches are presented in this impact assessment. However, when possible, the social marginal cost pricing should be favoured as it gives incentives to adopt less costly behaviour and gives transport users the freedom to respond in ways which are most efficient in their particular circumstances. In order to be effective, such a principle would require that transport users do not receive direct compensation that would reduce the incentives to change the behaviour and thus eliminate the effectiveness of internalisation.

Assessing the current level of internalisation

In real life, it might be difficult to assess the true level of internalisation. Modes of transport are already faced with charges, taxes and/or subsidies which are not linked to external costs, but contribute to influencing behaviours. The analysis of internalisation has to take these elements into account.

Depending on the approach – equity and efficiency, there are two ways of assessing the level of internalisation. The first one – equity – will tend to assess all costs and charges/taxes/subsidies while the second one – efficiency – will only take into account variable costs linked to the use of an additional vehicle.

Both approaches are proposed in this impact assessment as they provide a complementary assessment of the situation (see section 2.2).

* Average costs are not the only way to reach full cost recovery. Second best schemes such as dual tariffs or Ramsey-Boiteux pricing could be preferred.

2.1. The need to maintain the sustainability of transport activities

2.1.1. Transport growth

Transport services play a central role in modern society and economy. They account for 4.3% of EU25 value added and employ about 8.2 million persons in the EU25.

Over the past decades, transport has increased in line with economic growth. Freight transport thus grew by 2.8% per year over the period 1995-2005 while real GDP growth was by 2.3% per year over the same period; at the same time passenger transport grew by 1.9% per year. Freight transport demand has increased more strongly for modes offering greater flexibility, in particular road transport (see chart 0a and table 0a and 0b of annex 2).

2.1.2. Evolution of nuisances generated by transport

Although the benefits of transport services are widely acknowledged, transport activities generate nuisances/costs not only to other transport users, but also to society in general, including local population and future generations. More specifically, transport activities have an impact on time – private and professional (congestion), on life (accidents), on health (pollution, noise) and on climate change (greenhouse gas emissions) among other

things[12]. Over the past years, measures to reduce these nuisances – regulatory measures, awareness information campaign, research projects and financial support (TENs, Marco Polo) have been undertaken at EU and national level. Several economic instruments such as infrastructure charging, vehicle taxation, congestion charging, and fuel taxation have also been implemented with various degrees of intensity and coverage. As a result, some of these nuisances have displayed a significant decrease even though they still remain important.

Congestion in Europe

The density of traffic in Europe has increased over the past years, reflecting the creation of an internal market in the EU and consequently increased mobility of individuals, and growing dynamism of the exchange of goods. The growth of traffic has been sustained while the pace of expansion of infrastructure network was lower, which exerts pressure on its capacity use (see graph 1, annex 2).

The increase of density of traffic may lead to bottlenecks in corridors crossing densely populated areas or sensitive areas such as the Alps and the Pyrenees. But, congestion is mainly an urban problem (which is not reflected in the graph 1 in annex 2)[13].

Accidents in Europe

Road fatalities have displayed a net reduction (- 21.4% between 2000 and 2004 in EU25. See graph 2 in annex 2). However, in 2005, there were still 41 274 persons killed in EU25, among which 53.4% involved cars and taxis and 19.6% involved motorcycles and moped. In 2006, there were 42953 persons killed. In comparison, fatalities in other modes are much lower (65 in railways in 2006 and 1 casualty in the activities of EU27 air operators in 2006).

Air pollution generated by transport

Air pollution emissions from road transport have considerably decreased over the past years due to technology progress and regulation. However, air pollution from road transport still remains a challenge in dense and high traffic areas.

By contrast, in other modes of transport (except railways), the decrease has been much slower and emissions have even increased again for carbon monoxide (CO), sulphur dioxide (SO2) and non-methane volatile organic compounds (NMVOC). Graph 3 (a, b, c, d, e, and f) in annex 2 provides evidence of these contrasted evolutions.

In international maritime transport, the increase in NOx, SO2 and NMVOC has been high (respectively +37.6%, +44.2% and +41.0% between 1990 and 2005). Moreover, the

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12 Such as land use, energy supply security and infrastructure maintenance. This impact assessment deals with the following external costs: air pollution, noise, climate change, congestion and accidents. See section 4 on the selection process of policy options.

13 See COMPETE (2006), Annex 2, "Studies, harmonised approach and panorama of congestion in Europe and US". It gives estimates of congestion in cities using the travel time index (ratio between the actual average and the free flow travel speed). The travel time index in large cities of Europe compares journey times due to congestion between them: 1.34 for Paris Ile de France, 1.40 for Greater Copenhagen area, 1.84 for Greater London, 1.32 on average for other English cities

Thematic Strategy on air pollution[14] shows that emissions of SO2 and NOx from the maritime sector should surpass total emissions from land-based sources by 2020.

In air transport, the increase in NOx has been particularly important between 1990 and 2005 with an increase of 48.8% for domestic aviation and +85.5% for international aviation.

Greenhouse gas emissions generated by transport

Transport is a large contributor to greenhouse gases emissions, namely CO_2 (27.2% of the latter come from transport; of which 72.8% are from road transport). CO_2 emissions of transport have increased by 32% from 1990 to 2005 while CO_2 emissions in other sectors of the economy (industry, households) have decreased or stabilised. However, the evolution is not homogeneous across modes of transport. Rail has reduced emissions of CO2 over the past decade (1990-2005) due to a large extent to a reduction of the share of diesel trains. CO2 emissions growth from air transport and maritime (international bunkers) has been higher than CO2 emission growth from road transport (+49.1%, +51.6% against +27.5%).

Noise generated by transport

In 1999, the European Environment Agency estimated that 32% of total EU population was exposed to road noise level above 55 Ldn dB at the front of their house whereas 10% was exposed to rail noise level above 55 Ldn dB and another 10% was highly annoyed by aviation noise[15]. In 2008, the Commission reports that the number of people affected by aircraft noise, particularly at night, has increased since 2002 due to the general increase in the number of movements, and predicts that this number will continue to grow although the situation may differ between airports[16]. More generally, the mid term review of the Commissions White Paper on Transport emphasises that attention should be paid to noise pollution from road transport and other modes of transport.

2.1.3. These nuisances have a cost for other transport users and society

All these nuisances have a cost for others in terms of time loss (congestion), life threats (accidents), health (accidents, air pollution and noise) and climate change. Most of the time, these costs are external, meaning that they are not borne by those who generate them, but by other transport users (congestion, accidents) and society (environmental costs)[17].

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14 SEC (2005) 1133, p 30. Annex to the Communication on Thematic Strategy on Air Pollution and the Directive on "Ambient Air Quality and Cleaner Air for Europe".

15 "Traffic noise: exposure and annoyance". 1999. European Environment Agency. According to the Directive 2002/49/EC on the assessment and management of environmental noise, Member States should report to the Commission more recent data on exposure to transport noise. These data were not yet available when drafting this document.

16 Forthcoming COM(2008)66 final.

17 Accidents costs are already partially internalised by vehicle drivers. External accidents costs are those costs which are not covered by risk oriented insurance premiums. The level of external costs non internalised depends on the level of accidents, but also on the insurance system.

There have been many attempts to quantify external costs generated by transport and, depending on the methodology and the scope of analysis, the amount of total external costs varies. All these methods have been reviewed by a Handbook on external costs published in January 2008. This handbook reviews the different methodologies and identifies the best practices for each category of external cost. Several conclusions can be drawn from it.

First, there have been large efforts in the research field to propose and use methodologies of assessment of external costs. A wide set of methods are available to monetise these externalities. Although the estimation of external costs has to consider several uncertainties, there is a wide consensus on the methodological issues and on the bandwidths[18].

Second, congestion, accidents, air pollution and noise external costs vary across location. In all modes of transport, marginal external costs are higher in areas with higher population density, typically urban areas. Furthermore, the time of the day during which transport takes place leads to strong variations of external costs (differences between night and day and peak and off-peak periods). The costs of a lorry or a freight train may vary according to time and location (see graphs and tables from the Handbook in annex 3). By contrast, greenhouse gas emissions do not depend on location and time and are instead related to fuel consumption and the carbon content of fuel.

Third, the Handbook reviews studies that have assessed the magnitude of externalities. It is widely agreed that road transport accounts for more than 90% of total external costs[19] imposed by transport on society. Roughly 25% is generated by trucks. Such a situation is also explained by the high modal share of road transport. Road transport is by far the biggest mode of transport accounting for more than 70% of inland freight transport and more than 80% of total passenger transport in Europe. Despite its high modal share, the growth of road transport still continues, both in absolute and relative terms. However, these figures do not capture the recent evolutions of emissions in non road transport. As mentioned in section 2.1.2, emissions of non road transport have largely increased, especially in maritime and in air transport and will continue to do so. It could be assumed that the share of external costs of non road transport modes could be higher than the past estimates.

2.2. Are external costs already internalised?

Under some conditions, markets fail to ensure that all costs – private and external – are fully reflected in price formation. External costs are a manifestation of market failures related to the efficient allocation of resources when prices paid by economic actors fail to reflect the entire social costs and benefits of economic activities (see box 2).

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[18] See "Handbook on estimation of external costs in the transport sector" published in January 2008 at http://ec.europa.eu/transport/costs/handbook/index_en.htm

[19] 96% in the UNITE study (excluding maritime). 95% in the IMPACT study (based on TREMOVE) excluding maritime. However, it is important to note that these figures exclude maritime as the emissions of air pollution and CO2 of maritime have increased over the past years.

Given its environmental externalities, transport is already exposed to a number of regulatory measures. In addition, transport activities, including vehicle purchase, ownership and use, are subject to numerous taxes and charges, which may overall compensate, and in some cases maybe even over-compensate, for some of their social costs. It is therefore is necessary to take into account the existing situation to avoid double charging for the same external cost. The question, however, is to ascertain to what extent existing measures allow external costs to be internalised, in other words whether the price signals given by these existing charges, taxes or subsidies incite the development of new technologies, new ways of transportation or a change in consumer behaviour.

2.2.1. Existing taxes/charges and subsidies in transport: General Overview

Existing taxes/ charges and subsidies give an indication of what is being borne by transport. The primary objective of these economic instruments was either to finance infrastructure or to provide revenues to the general budget. Few of them aimed at reducing negative externalities generated by transport. The same can be said on subsidies which are not related to an objective of avoiding external costs or obtaining external benefits (e.g. for public service obligation or else). However, taxes/charges and subsidies (targeted or not) cannot be ignored as they influence the behaviour of transport users and may have an impact on external costs.

Environmental taxes and charges

Compared to 1980, environmental taxes have increased in nominal terms (more than quadrupled). The share of environmental taxes in GDP has also increased a lot. The main increase took place between 1990 and 1994 and was driven by the increase in energy taxes. Since the beginning of this decade, the share of environmental taxes in GDP has been stable. In 2005, environmental taxes represented approximately 2.6% of EU25 GDP, of which 1.9% were energy taxes (most of which are taxes levied on motor fuels) and 0.6% were transport (or vehicle) taxes (see graph 1 in annex 4)[20].

On the total revenues of environmental taxes, more than 90% are supported by transport in most EU countries (see graph 2 in annex 4)[21]. Most of these revenues come from petrol and diesel taxes and to a lesser extent vehicle tax (ownership and use of motor vehicles). Road transport bears the majority of these taxes as some modes of transport are exempted from fuel taxation (see below).

User charges are also applied in transport mainly to recover infrastructure costs, but it is more difficult to have a quantitative estimate of these charges (see below for the description in each mode of transport).

Subsidies

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[20] 2007 Edition of Tax Structures (Eurostat/TAXUD). http://ec.europa.eu/taxation_customs/taxation/gen_info/economic_analysis/tax_structures/index_en.htm

[21] This applies to 20 MS. For Lithuania and Malta, 18 and 30% of environmental revenues are paid from transport. These figures are even lower for Bulgaria and Romania.

Subsidies can have different objectives: economic (fostering regional development or creating jobs); social (grant access to different types of services) and environmental (reducing pollution or noise for example)[22]. Another objective is the compensation for high fixed costs of infrastructure if borne by the public budget, but the amount is much more difficult to assess. Overall EU state aids to transport have decreased over the past decade. The allocation of aids between modes of transport has changed: state aids to air transport have decreased while state aids to maritime have increased. State aids to railways are higher than in other modes of transport. Overall, according to the State Aid Scoreboard published by the European Commission, the share of state aid to transport accounts for less than 0.4% of EU25 GDP (excluding railways, see graph 3 of annex 4).

Tax exemptions for some transport modes can be considered as subsidies. Although they cannot be ignored because they contribute to distorting market signals, it is more difficult to assess the revenues loss from tax exemptions (e.g. international air and maritime transport). According to the EEA, fuel tax exemptions and VAT exemptions affecting the transportation sector could reach from 0.35 to 0.58% of GDP in 2005[23].

2.2.2. Existing charges and taxes by mode of transport: stylised facts

Each mode of transport has its own characteristics and needs, which leads to different external costs (see above). For the same reasons, the level of taxes, charges and subsidies vary across modes of transport, but may also vary across Member States, although common minimum levels of taxation apply to motor fuels across the EU (given the EU energy tax harmonisation). There might be a beginning of EU harmonisation in the field of vehicle taxation and charging, but it does not apply to all modes of transport.

2.2.2.1. Road Transport

Existing charges and taxes

Several instruments coexist in the EU, mainly fuel taxes, vehicle taxes and road usage charges (see annex 5 for a description of charges and taxation in road transport).

Fuel taxation is related to the EU directive on energy taxation which sets mandatory minimum values. As a result, fuel taxes are applied in all Member States. Excise fuels and vehicles taxes represent most of transport taxes (95%). Fuel tax (72% of total revenues paid by transport) and other taxes (such as circulation tax…) may partially serve to recover infrastructure costs or other general purpose.

Directive 1999/62/EC, article 2, sets EU minimum tax levels for vehicle (circulation taxes) to contribute to fiscal harmonisation and reduce distortions of competition in the road market. But in practice the range of annual rates across Member States is well above

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22 These aspects are not taken into account in DG COMP scoreboard. The EEA Technical report (n° 3/2007) provides estimates on infrastructure subsidies based on the UNITE report. According to these figures, in EU15, road transport would receive the majority of infrastructure subsidies (110 bn euros in 2005 out of a total of 156 bn euros). Rail would receive 37 bn euros.

23 Fuel tax exemptions have been estimated between 11 and 36 billions euros in 2005 (8-16 in air transport and 3-19 in waterborne transport). VAT exemptions amount to 29 billions euros in 2005, of which 18 billions come from air transport. EEA Technical Report, n°3/2007. "Size, Structure and Distribution of transport subsidies in Europe".

the EU minima and quite wide from € 515 to almost € 3000 (see graph 1 of annex 5). Vehicle taxes are in the order of few cents per vehicle kilometre and proportionally much smaller than tolls (usually above >15ct/vkms). They vary according to the weight per axle to reflect the damage to the infrastructure. By contrast, they do not vary according to the EURO class, nor do they reflect the real use of vehicle (travelled distance, time and location of use).

The system of road usage charges differs considerably across European countries. Tolls are levied on some 56 000 km of motorways and trunk roads (3% of the total network) through either toll barriers or electronic pricing. Few countries require a time based fee (vignette). Hitherto, variations of user charges according to EURO vehicle class to provide incentives for using cleaner vehicles or according to time to relieve congestion have hardly been applied.

Box 3: HGVs user charge in the EU

Some countries have no nationwide road usage charging systems at all (e.g. Finland, Estonia and Latvia) while other countries have no nationwide road charging systems and only toll on a few infrastructure sections (Ireland and UK). The map in annex 6 presents the diversity of charging systems in the EU.

Others (e.g. France, Italy, Spain, Portugal, and Greece) have a long tradition of having parts of their motorway network operated by concession motorways. Although the tolls are distance based, they are usually not expressed in a price per kilometre but in the form of a matrix listing motorway entry and exit points. These schemes cover all types of vehicles not only HGVs. Slovenia has a similar system in that most motorway roads are toll roads with tolls collected at toll stations.

Several countries have recently introduced integrated network-wide electronic road charging systems for HGVs. The first EU member states to introduce such systems were Austria and Germany on 1 January 2004 and 1 January 2005 respectively. The Czech Republic introduced its own system on 1 January 2007. Similar systems are envisaged in the Netherlands, France, Slovenia, Hungary and Slovakia. The charging systems are all distance based but differ in a number of characteristics from the technology used to the network covered.

Lastly, there are countries with time based fees (vignettes). Belgium, Denmark, Luxembourg, Netherlands and Sweden have been operating the so-called Eurovignette system since 1 January 1995. Germany had also participated until it stepped out to launch its own distance based electronic system. The principle of the Eurovignette system is that the certificates issued are mutually recognised in all participating countries. The system covers the motorway network and certain other roads and applies to HGVs only.

In addition to the Eurovignette countries many new Member states (Bulgaria, Hungary, Lithuania, Poland, Romania and Slovakia) have their own time based vignette systems covering both passenger cars and HGVs.

Internalisation tools available under the current Eurovignette Directive

While the existing Directive 1999/62/EC stipulates that tolls shall be based on the principle of the recovery of infrastructure costs only, it does theoretically allow Member States to vary the toll rates for purposes such as combating environmental damage or tackling congestion. However, toll variation is subject to a number of conditions, the most significant being that it must not be designed to generate additional tolling revenue and any unintended increase in revenue has to be counterbalanced through changes to the structure of the variation.

In practice, only a few Member States have implemented charging systems that actually differentiate the tolls for the recovery of infrastructure charges. Germany and the Czech Republic have electronic tolling systems that apply differentiated charges of HGVs based on the environmental performance of the vehicle (as indicated by the EURO classification of the engine) while in France there are examples of time based differentiation on the A1 motorway between Paris and Lille and on the A14 motorway between Orgeval and Paris. The experience from these schemes is positive. Germany has witnessed adjustments in the fleet composition with a visible trend towards cleaner vehicles and accelerated renewal of the fleet. In contrast, this effect has not been seen in neighbouring Austria where the tolling system on the motorways does not differentiate by emissions class. The time based differentiation on the French motorway sections has reduced the traffic flow during rush hour by up to 10%. Despite the encouraging results from these existing schemes there are a number of reasons why the current options for differentiation are not more widely used in the Member States:

- Toll operators face practical difficulties to adjust the differentiated charges to changes in traffic demand in a way which respects the condition that the total tolling revenue remains constant on a biennial basis;

- There is a clear lack of interest for Member States to introduce differentiated charges and increase the complexity and operating costs of the tolling system if no extra revenue is allowed to be generated. The effective removal of the constant revenue requirement would give the possibility of financial incentive to the beneficiaries of the tolling revenues to introduce the differentiated charges.

- There are genuine difficulties in controlling and enforcing a differentiated scheme (e.g. accurate identification of the EURO class of vehicle). This can be especially problematic in case of non resident hauliers. Often the only realistic enforcement method would be to carry out costly roadside checks.

The other internalisation tool available under the current Directive is the mark-up in mountainous areas. However, it is allowed only in exceptional cases and in mountainous corridors where priority projects of the trans-European network are located. In practice this limits the application of this instrument to the two corridors crossing the Alps.

2.2.2.2. Rail Transport

Directive 2001/14 obliges to charge for infrastructure variable costs and allows charging for environment or congestion (article 7 of the directive). In 10 Member states, infrastructure managers charge according to marginal costs pricing (AT, CZ, DK, FI, FR, NL, PT, SE, UK). Except NL and PT, they allow having mark-ups in order to recover full costs. In other Member States (BE, EE, DE, HU, IT, LT, PO, RO, SL), infrastructure

managers have adopted the principle of recover full costs minus state subsidies and set their charges according to this principle. Charges for congestion and scarcity, accidents and environment are undertaken in a minority of countries (see annex 5 table 2).

2.2.2.3. Air Transport

The EU Directive on energy taxation establishes the fuel tax exemption of international air transport for legal reasons (see annex 5 table 3). At the same time, the Directive, in its article 14(2) allows for taxation of aviation fuel on domestic flights and under certain conditions for intra-Community transport. In 2006, the Commission has proposed to include aviation in the fight against climate change. As a result, air transport would be subject to the Emission Trading Scheme from 2011.

Many airports are already applying differentiated charges for some external costs. The situation is not homogeneous, not only across countries, but also across airports.

2.2.2.4. Maritime Transport

The EU Directive on energy taxation establishes the fuel tax exemption of maritime transport (see annex 5 table 4). The same optional fuel taxation envisaged for aviation also applies to navigation within Community waters.

There is a great variety in port charging practices. Port charges can vary by type of infrastructure, by charge description and by port institutional arrangements. At the same time, ports tend to be subsidised in order to make the region more attractive and to induce value-added logistic and industrial activities.

2.2.2.5. Inland waterways transport

A large share of EU inland waterway transport is concentrated on relatively few watercourses. 70% of all inland waterway transport is carried on the river Rhine, Elbe, Oder, and Danube. On the river Rhine, charges are prohibited (under the Mannheim Convention). 20% are subject to sophisticated charges in LU, FR, DE (under the Mosel Convention), FI, UK and NL (see annex 5 table 5).

2.2.3. Level of internalisation by mode of transport

Having the full picture of external costs and existing levies and subsidies, the following step would be to analyse the level of internalisation in each mode of transport.

Assessing the level of internalisation requires comparing costs and payments in each mode of transport. When payments are not sufficient to cover costs, the mode of transport does not support all the costs it generates. Given the incomplete availability of data, this exercise is however quite difficult, in particular for other modes than road transport. There are two ways of assessing gap between costs and payments (see also box 2 for theoretical arguments).

The first approach – account or equity approach – takes into account the total social costs and total resources and analyses the gap between both. This approach helps assess cost recovery ratio and to which extent additional levies are needed; it neglects however the reasons for political choices that are made with respect to funding of infrastructure or

subsidisation of passenger transport and may lead to extended disputes on the level of implicit subsidies in one particular mode. Furthermore, the comparison of total costs and resources does not help assess whether transport users have the right incentives. This approach is however presented here as it is a practical way to report on the level of internalisation.

The second approach – based on efficiency consideration – would be to compare marginal social cost and price and the failure of price to cover this cost. Obviously, this approach would be the best way to assess whether transport users have the right incentives as it reflects the principle of social marginal cost pricing. However, such an approach is difficult to calculate as the variation of marginal costs with time and location is not easy to capture[24]. This is particularly true for noise and congestion costs where the relationship between these costs and traffic is not linear and average and marginal costs can be very divergent. Moreover, the comparison of marginal costs and marginal revenues is typically done by aggregating average variable costs, which will hide specific situations.

Both approaches have their own advantages and limitations. For this reasons, both are presented as they give useful indications on the level of internalisation and can be used in a complementary way.

The equity approach has been adopted by REFIT and the following indicators try to give evidence of the level of internalisation as far as data are available (see annex 7 for methodological explanations). The IMPACT study attempts to apply the efficiency approach by comparing marginal costs and marginal resources (see annex 8).

2.2.3.1. Equity or account approach

The equity (account) approach proposed by REFIT leads to an indicator – level of internalisation (Lol) designed to specify to which degree market distortions have been compensated by subsidies, taxes and charges.

The equity or account approach is based on cost recovery principle. As a consequence, the calculation of the index requires average costs in order to take into account all costs occurred in the mode of transport. All relevant components – including infrastructure charges – are included in the calculation of the indicator.

From this approach, it can be concluded that transport does not bear all the costs it generates because of subsidies and despite the existence of taxes/charges. However, the equity (account) approach does not allow drawing conclusions on the efficiency of the whole system. In other words, it is hard to know whether transport users have the right incentive and whether the tax/charge structure is related to cost drivers.

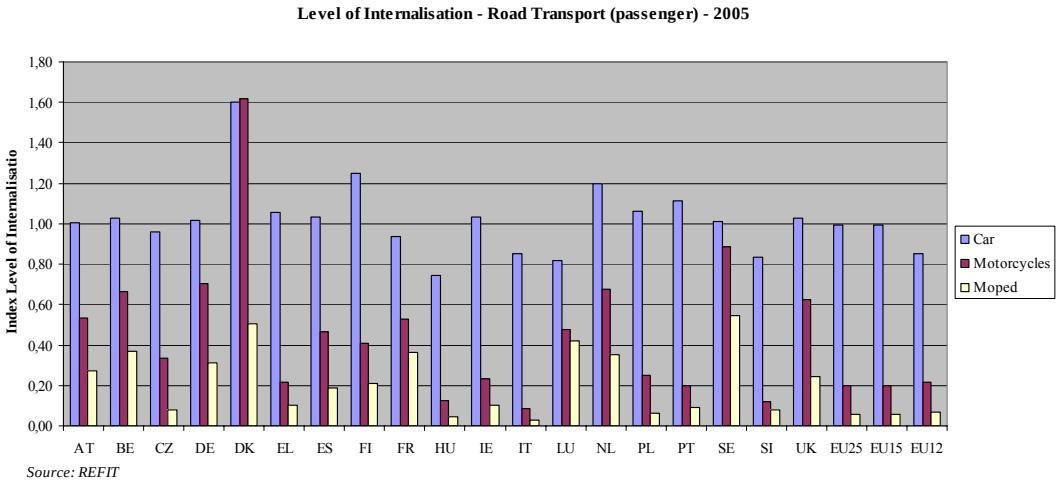
Road transport

A disaggregated perspective highlights the disparities of the situation between types of vehicles and country, in particular due to strong disparities in registration or annual

[24] See Nash C et al (2002), The environmental impact of transport subsidies, Paper presented at the OECD workshop on environmentally harmful subsidies, 7-8 November 2002, Paris.

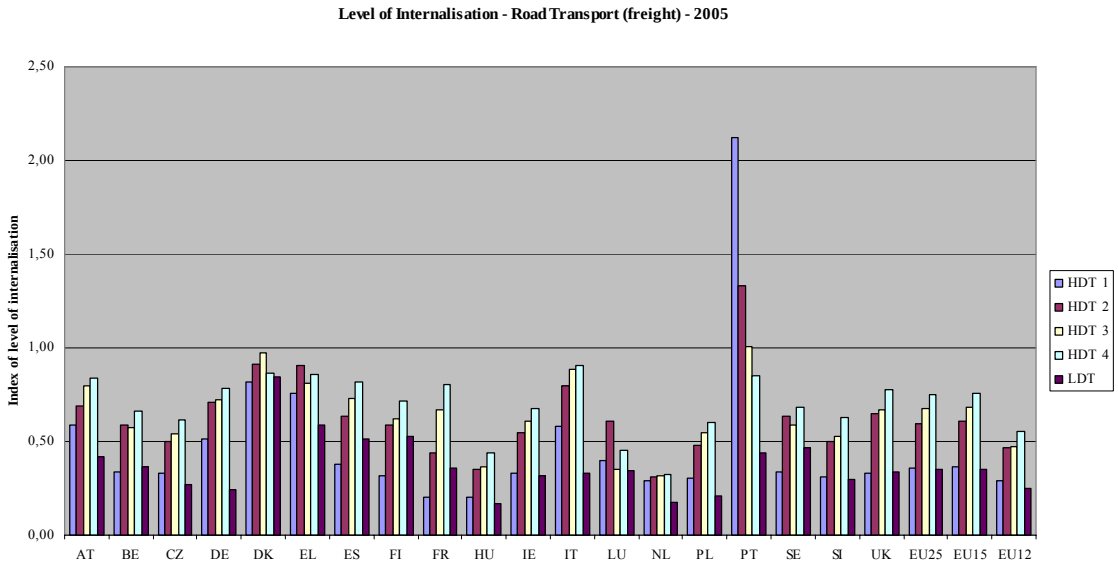
circulation taxes. HGVs are responsible for the largest part of the wear and tear of roads. However, infrastructure wear and tears are not properly reflected in circulation tax.. More specifically, passenger cars users are already largely paying for the costs of using their vehicle (including fixed infrastructure costs) which is not the case of other types of vehicles, notably trucks or motorcycles.

Graph 2.1: Level of internalisation in road transport (equity approach)



Source: REFIT

Graph 2.2: Level of internalisation in road freight transport (equity approach)



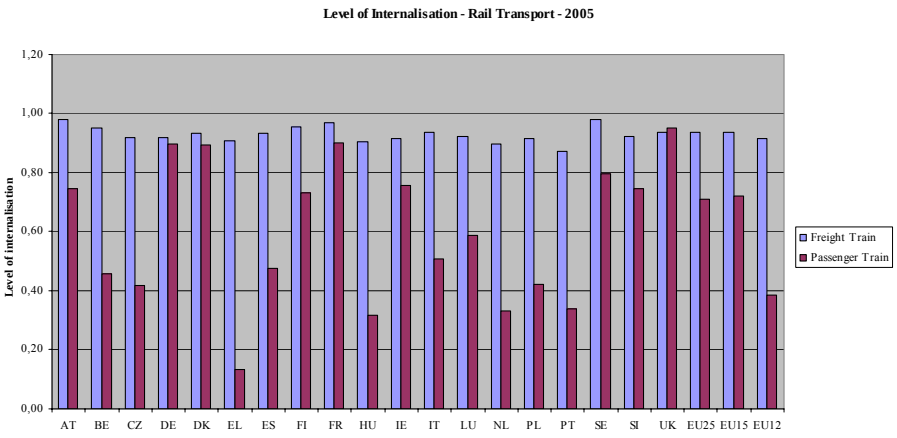
Source: REFIT
HDT1: heavy duty truck 3.5-7.5t; HDT2: heavy duty truck 7.5-16t, HDT3: heavy duty truck 16-32t, HDT4: heavy duty truck > 32t
LDT: Light duty truck

Other modes of transport

The level of internalisation in freight railways is higher than in passenger railways (probably due to subsidies in the field of public service obligation). In aviation and inland

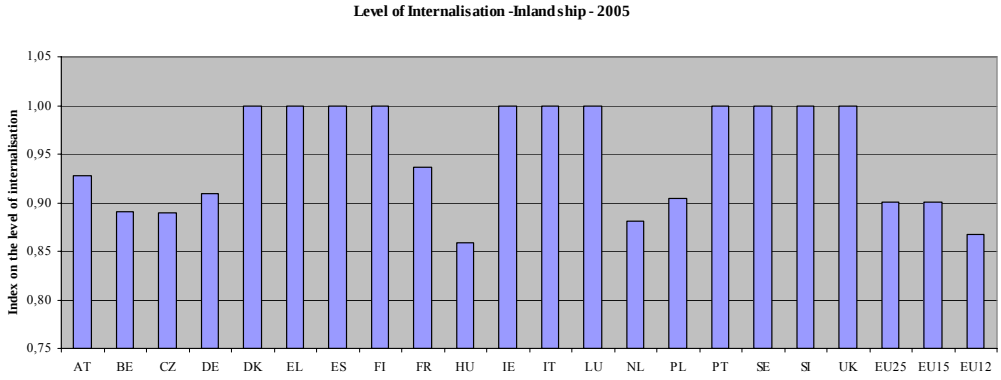
navigation, the availability of data is less exhaustive and therefore, these indexes should be considered as rough indications of the level of internalisation.

Graph 2.3: Level of internalisation in rail transport (equity approach)



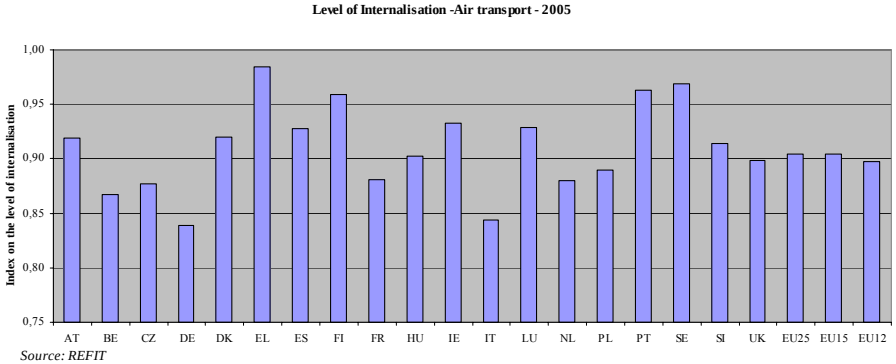
Source: REFIT

Graph 2.4: Level of internalisation in inland ship transport (equity approach)



Source: REFIT

Graph 2.5: Level of internalisation in air transport (equity approach)



Source: REFIT

2.2.3.2. Efficiency approach

The efficiency approach aims at establishing how variable user charges compare with variable external costs. Under this approach, only the variable component of costs is provided. The advantage of the efficiency approach is to assess whether the tax/charge structure provides the right incentive as it should be directly related to the cost drivers.

From an efficiency perspective, the results of the IMPACT study show that the level of internalisation is not achieved, i.e. marginal resources do not cover marginal costs. The analysis only covers road transport. Graph 1 in annex 8 shows the gap between marginal external costs and marginal user charges for truck 32 tons. In all Member states, charges and tolls are insufficient to cover external costs. In other words, when an additional truck travels, it will pay a certain amount of charges/tolls linked to the distance of trip, but in comparison, will generate additional external congestion, noise, air pollution and accident costs for which it will not pay entirely. Charges and tolls fail to provide this message when decision is made to travel.

In practice, calculations according to the efficiency approach lack data at a more disaggregated level and as a consequence fail to capture the local dimension of external costs. However, differentiated charges help take into account these variations across time and location. For example, table 2.1 displays the lower level of internalisation in in-built areas and in countries where no tolls are levied. Comparing Italy and Germany at aggregate level shows that both corridors have roughly the same level of internalisation. However, in Germany, total external costs show strong variations between built-up and non built-up areas while tolls do not show any difference in charging. This leads people from built-up areas to pay comparatively less for the nuisance they generate. By contrast, the Italian case shows that differentiation of charging between both areas (built-up and non built-up) induces a higher level of internalisation in built-up areas.

Table 2.1: Overview on costs per km (in Euro ct.)

	HGV EURO III	**Toll**	**Total external costs**	**Infrastructure costs**	**Total costs**	**Cost coverage**
		€ct/km	€ct/km	€ct/km	€ct/km	%
IT	Genova-Chiasso	16.0	11.5	18.1	29.6	54.7
	Built-up	39.4	25.3	18.1	43.4	90.7
	Non-built-up	12.5	9.5	18.1	27.6	45.2
DE	Basel-Venlo	12.0	12.7	7.4	20.1	59.7
	Built-up	12.0	28.1	7.4	35.5	33.8
	Non-built-up	12.0	12.3	7.4	19.7	60.9
NL	Venlo-Rotterdam port	1.2	10.6	10.3	20.9	5.7
UK	Felixstowe-Preston	2.6	8.5	17.1	25.6	10.1
	Average	**6.8**	**9.2**	**10.2**	**19.4**	**35.0**

* Source: IMPACT Study. All costs are calculated for a EURO III HGV. Total external costs include air pollution, noise and congestion costs. Infrastructure costs are average variable infrastructure costs and exclude construction costs.

2.2.4. What can be concluded from the existing situation?

Heterogeneity of internalisation across Member States and modes of transport

- Existing charges and taxes are far from homogeneous across Member States (except minimum fuel tax where there is a European framework). This situation might be justified as the level of infrastructure costs and external costs varies across regions, depending on the density of traffic and also on the density of population. However, this diversity does not reflect the various situations, but the extent to which countries tackle external costs. Such a variety may give rise to distortions of competition in road transport since the road transport market is open to competition at EU level and half of the international road haulage market is operated by non registered hauliers.

- Existing charges are not homogeneous within Member States. The variety of situation also exists within Member States. For example, a typical HGV from Hamburg to Bilbao pays a toll of around 15 ct/km to use the German primary roads and the concession motorways in France and Spain and pays a daily vignette of 8 € (2-6 ct/km) to cross the Benelux. However, when this truck crosses the Paris area it generates considerably higher external costs but pays no usage charge at all.

- Existing instruments are not homogeneous across vehicles and modes of transport. User charge, tax exemptions on fuel use, emissions trading scheme and fuel taxes lead to a variety of situation between modes of transport which might compete on certain segments or routes. In the road sector, the situation differs between categories of vehicles. Graphs 2.1 and 2.2 show that, from an account/equity approach, the level of internalisation is higher in private cars than in trucks.

The market signal given by existing charges and taxes could be improved

- Existing charges are user pays instruments which primarily aim at recovering infrastructure costs. Except minor variations according to vehicle types under revenue neutrality constraints as far as HGVs are concerned or environmental charges in Swedish harbour, current user charges rarely address external costs. Few Member States apply differentiated charges to take external costs into account, also because the Community legislation limits them in doing so. The efficiency approach shows that vehicles do not have the right incentive when travelling. Charges fail to reflect the additional social costs generated by one trip.

- Existing levies do not relate to the key cost drivers of external costs which make them quite inefficient because they are unable to capture the variations of time and location. However, they are already borne by transport users and may induce some changes in behaviour. Existing levies or subsidies should be considered when implementing internalisation of external costs in order to avoid double charging.

- By contrast, fuel taxes are directly related to fuel consumption, which is the cost driver of CO_2 emissions. This makes this instrument the most appropriate to internalise the cost of CO_2 emissions. Independently of other objectives that fuel taxes pursue, the minimum level of excise duties correspond to a shadow price of 159 euros per ton of CO_2 for petrol (see box 4).

Box 4: CO2 emissions and fuel tax

CO2 emission is related to fuel consumption. Therefore, increasing the price of fuel may induce a change of behaviour from consumers when they purchase a vehicle and to a smaller extent a change in the way they use it.

For many years, fuel taxes have increased in Europe, making them the first private expenditures of transport users (mainly road transport as some other modes are exempted). Taking into account the minimum excise duties as foreseen in the Directive 2003/96/EC on energy taxation and the CO2 content of fuel, the shadow price of CO2 could be estimated to 159 euros per ton for petrol and 115 euros per ton for diesel.

Despite this level of taxation, CO2 emissions are the only nuisances that have not been reduced over the past years in particular in air and road transport. This is however not surprising since traffic in these modes has risen more than CO2 and is very much linked to the economic growth and to the (limited) development and availability of alternative modes of transport which are less CO2 intensive and provide the same utility for transport user. The effectiveness of fuel taxes – and of internalisation measures in general – in curbing the growth of road emissions is doubtful to the extent that they have a low capacity to influence the demand of transport in the short run. This is not to say that this instrument has not been effective at all. Compared to the US where fuel taxation is much lower, European cars display higher performance in fuel efficiency (ICCP, 2007). Some recent studies highlight the increase in car dependency and therefore the very low elasticity of demand. Short run price elasticities (within 1 year) had been assessed to be around -0.25 (Goodwyn (2002)) but recent evidences found that these elasticities could drop to about -0.04 between 2000 and 2006. These studies refer to the US market. However, they could also confirm the low short term impact of fuel taxes on CO2 emissions. In a longer term, fuel consumption is more sensitive to prices. Long run elasticities (5 years) are estimated to be around -0.6 (Goodwyn, (2002).

Therefore, the use of other instruments such as regulation, standard settings or trade of emission permits cannot be ignored.

In conclusion, although there is some evidence that some degree of internalisation of external costs is already in place, transport users do not bear all these costs or they pay in ways not related to external costs. In most cases, government measures are fragmented and do not tackle explicitly these market failures. The problem is that the structure of existing levies does not give a price signal efficient enough to influence the mobility behaviour.

2.3. Why and how to implement the internalisation of external costs in the road freight transport sector?

The sections below will discuss about charging HGV and explore in more details few of the concrete implementation issues raised by charging external costs for trucks. These issues may impact the ways of these questions should be tackled in the review of the Directive.

2.3.1. Why charging HGV?

As mentioned above, road transport accounts for more than 90% of external costs[25]. Given the forecast for a continued steady growth of road freight transport (estimated at more than 50% between 2000 and 2020) these negative impacts are likely to increase.

The specific features of road freight transport make them more sensitive to prices. It has to be pointed out that taking into consideration all the existing taxes and charges the current average degree of internalisation is substantially lower for trucks than for cars (see 2.2.3.1). Compared to private motorists, commercial road haulage operators respond more efficiently to price signals due to their capacity to plan the route in advance and make rational decisions about how to optimise their operating costs. In this respect the incidence of occasional and unplanned use seems lower for HGV. In addition, more than one quarter of trucks regularly crosses internal borders in the EU which raises the issue of internal market (see below). In contrast, as studied in the GRACE project, drivers of passenger are less likely to adapt in the short term their behaviour to complex changes in prices as they do not perceive their vehicle operating costs accurately and usually underestimate trip distances to start with.

The initial conditions for internalisation seem to be in place for HGVs. Tolling systems are more widely implemented for heavy goods vehicles than for passenger cars and as a result the tolling technology used to charge trucks is more mature. Pursuant to the Directive 1999/62/EC a number of Member States have already introduced electronic tolling systems to recover from heavy goods vehicles the infrastructure costs related to the use of certain infrastructures. Data protection and privacy issues which may be a potential obstacle to implement road pricing for cars are also considered less severe for truck as demonstrated by the wide spread use of on-board computers and fleet management applications in the road haulage sector. As an example, Germany has already gained practical experience on the use of electronic devices to implement internalisation schemes.

Of course there would be additional benefits if other vehicles including passenger cars would also be charged, but the additional complexities and public acceptance issues may justify a stepwise approach starting with heavy goods vehicles. National strategies to develop road pricing based in a first step on electronic tolling systems for trucks make therefore sense from both an economic point of view, technology point of view and probably from a public acceptability point of view.

When defining a strategy at EU level, subsidiarity considerations need to be taken into account. National and local authorities are better placed to decide on ways of implementing road pricing for cars provided that general Treaty principles like non discrimination on the basis of the nationality are respected. Conversely for road freight transport, which includes an important and growing international transport segment playing an important role in the internal market, the questions appear to be mainly which actions can be relevant both to encourage an efficient pricing and to maintain a smooth functioning of the internal market. The review of the Directive 1999/62/EC should therefore seek to tackle these questions.

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[25] See footnote 19

2.3.2. The base and differentiation of variations of charges: limits posed by information and transaction cost

The difficulty of the identification of external costs in all times and places imposes a trade-off between the level of differentiation and the cost and feasibility of its implementation. In theory, an internalisation charge should be levied on the aspect(s) of transport decisions that drive the externality being addressed, and hence vary with the size of the eternality. In practice, however, externalities and their drivers cannot be perfectly determined or monitored, and charges cannot be set accurately and without transaction costs on the driver of the externality. These information and cost issues have informed the shape of existing internalisation charge schemes which only approximate (more or less precisely) the theoretically prescribed charges and charge levels.

A first important type of differentiation is per vehicle type. Current truck usage charges vary in general according to the weight per axle to better approximate infrastructure damages. The Directive adopted in 1999 introduced the possibility to vary tolls according to the environmental performance up to 50%, the amending Directive adopted in 2006 widened this possibility by allowing a higher variation of up to 100%. This possibility has been used in Germany and Czech Republic which introduced differentiated rates according to a simple Euro classification for using their network wide toll system. This possibility has however not been used in the Member States with tolls on individual sections or small network (usually concession tolls). Toll operators wishing to differentiate the rates according to vehicle types have to design a classification which reflects the various costs, infrastructure, air pollution and noise costs mainly and at the same time a classification which is enforceable, i-e which allows an automatic or easy vehicle identification by toll managers and by road enforcers. To be effective in sending price signals understood by the EU freight transport operators and indirectly the manufacturing industry, such classification should be kept simple and preferably harmonised at EU level.

Another type of differentiation is according to the type of roads and the areas which are crossed as external costs in in-built areas are significantly higher than in other areas due notably to the higher population exposed to traffic air pollution and noise. Most external costs estimates suggest a rather simple differentiation between agglomeration, urban roads, and other roads. The toll rates should therefore be set according to such classifications. As to congestion, the issue is more complex as it requires a differentiation according to time and theoretically a rather disaggregated approach to calculate the charge segment per segment. A simple time variation distinguishing peak, off-peak should be a minimum common requirement to justify a congestion charge.

Overall it should be remembered that variation of tolls are already allowed by the current Directive but at the condition that revenues remain constant to reflect only the infrastructure costs. Section 2.2.2.1 has already described the main reasons why variations are in general not applied. Such variation is relatively complex to manage for tolling operators and particularly when regular adjustments of the charge structure are required to keep the revenues constant. The additional revenues raised by charging external costs could give the possibility to reimburse toll or infrastructure operators for the additional costs incurred due to the increased complexity created by variation of rates. In addition, by promoting the use of interoperable electronic tolling systems, the control and enforcement issue would also be effectively addressed.

2.3.3. Setting the geographical scope: diversion of traffic and charging all roads or only motorways?

Tolling motorways may divert traffic to parallel roads with lower or no charge at all. This has a particularly negative impact when lorries use secondary roads which are usually less safe than tolled motorways and which may cross areas more sensitive to pollution and noise (e.g. small towns). Such traffic diversion is well known on roads parallel to concession motorways (e.g. between Zaragoza and Barcelona), on roads in Alsace bordering the German tolled network or on secondary roads in Austria. There, when implementing charging, there is a need to see whether the diversion effect does not mitigate the effect of the measure.

Additionally, unless charges are introduced simultaneously throughout the EU, there may be undesirable cross-border effects due to traffic diversion from one Member State to another as road users try to avoid the use of tolled infrastructure. Although the causal relation is hardly measurable, Austria uses to claim that the introduction of a high Swiss kilometre charge has generated traffic detours on its territory. At EU level the phasing-in of a truck kilometre charge would require coordination mechanisms between Member States to prevent traffic diversion with undesirable cross-border effects or to mitigate its effect.

2.3.4. Technology and interoperability: implementation costs

Levying user charge requires controlling the access to the network in order to avoid free riders. Unlike other modes of transport, it may entail relatively high implementation costs and local environmental nuisances (e.g. queues at manual toll barriers at each entry/exit, visual intrusion of tollbooths). Advanced electronic toll systems can reduce these costs while avoiding obstacles to the free flow of traffic. The system implemented in Germany for heavy goods vehicles costs 20-22% of the revenue levied with it (excluding enforcement) while in Austria, the costs/revenues ratio is around 10-12%[26]. The Netherlands have a target of 5% costs/revenues ratio for its future distance charging. The Swiss system has a lower ration of 6-8%. As it applies to the full network, it requires fewer facilities to control entry/exit points. The variety of electronic systems is also not fully interoperable in spite of Directive 2004/52/EC and users are currently obliged to subscribe to different systems and with different operators for an international transport. Implementing an EU wide external cost charging system would require ensuring a full interoperability to both reduce high transaction costs and gain higher acceptance by the road haulage industry. It should be noted that an important part of the toll operation costs are caused by the need to provide for adequate facilities for occasional users, whose vehicles may not be equipped with the required On Board Unit.

2.3.5. User orientation: acceptability and intelligibility of the system

The implementation of a pricing scheme needs to take account of the needs of the targeted transport users in order to warrant its effectiveness and fairness. Several research

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[26] Austria [Asfinag] has a DSRC-based toll for vehicle > 3,5 tonnes and toll stations or stickers for lighter vehicles. According to Autria,, costs/revenue ratios range between 10-12 %. Switzerland uses tacho/GPS/DSRC technologies and claims 6-8% costs/revenue ratio. All these figures include capital costs.

projects have analysed these aspects and have derived conclusions on the conditions to be successful. More particularly, it appears that a pricing strategy should be complementary to other measures such as extending the possibility of choice of consumers by offering alternatives of transport and using the revenues in a transparent way[27]. As a result, earmarking of revenues to transport may increase the public acceptability.

A fair and effective charge scheme should include the following elements:

- **Link prices and external cost**. The user should be able to understand the link between the charge and the (driver of the) externality. For instance, a congestion charge on road users at off-peak periods where there is no congestion will not be understood and accepted.

- **Transparency**. The derivation of the charges must be sufficiently transparent so that the user can be confident no over-charging takes place. A similar transparency requirement seems to apply to the size of the revenues and where they are used for. The user must also be able to see the charge's unit rate(s) and the amount actually paid as this would allow making better informed choices. This again points to the need for an adequate communication.

- **Intelligibility**. The scheme must not become overly complex. A much differentiated scheme is likely to approximate the marginal external costs more accurately but also risks to become unintelligible for many users and so hinder their effective response to the given price signal. Next to the implementation and operational costs, this suggests that the best internalisation scheme needs to have a simpler structure than suggested by theory. It also points to the need to assist the users to learn and adapt when internalisation schemes are being implemented.

- **Transport alternatives**. Both user acceptance and changes in transport decisions would be enhanced when there are transport alternatives, such as different routes to the destination or other transport modes. For examples, commuters may want to respond to congestion charges by going to work by metro instead of by car or taking a less congested route respectively.

It has also been argued that the revenues of the internalisation charges would help to making the transport alternatives available (the so-called "earmarking" of the revenues). This issue will be further discussed in section 5.7. Some earmarking of the revenues to the transport sector may be required to obtain political acceptability.

2.3.6. Preserving the EU internal market: non discrimination and transparency

International road freight traffic plays an important role in the internal market. This role will become even more significant as the forecast growth rate of international road freight transport is twice as high as that of domestic road freight transport. Between 2000 and 2020 international road freight traffic volume is forecast to double.

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[27] See C. Sikow-Magny, quoted in footnote 3. . Three Research Programmes deals with acceptability issues: AFFORD, PRILA and PATS.

The main thrust of the current Directive 1999/62/EC is in fact to ensure that the charges set by Member States to recover the infrastructure costs are non-discriminatory proportional and therefore transparent. The same principle should apply when giving Member States the possibility to cover external costs. More specifically, mandatory checks and controls at Community internal border should also be avoided.

External cost charging should not discriminate between local and international transit traffic as the damage caused by the individual vehicle in a particular location does not depend on its destination. The same applies to the issue of regular versus occasional users. Users should pay for the damage caused by each individual trip and there should not be any "frequent polluter discounts". Similarly the occasional users should not be subject to higher charges although toll operators considering the higher implementation costs created by this category of users (see 2.3.4) may be tempted to charge them more. Non discrimination principles may also lead to measures to discourage national or local charging policies which are limited and targeted exclusively at roads with international traffic.

External cost charging should also be proportional. There is however a risk that infrastructure monopolies set charges at a level higher than what is justified. The charge setting should therefore be done by organisations independent of those which collect and use the toll revenues. The conflict between local and general interest gives rise to the risk that some local or national authorities set excessive charges in those sections of infrastructure that bear heavy transit traffic with a view to extracting rents from users. Moreover the variability of external costs according to time and place gives rise to a rather complex pattern of information needs to calculate these costs. The lack of a common method to set the external cost charge may lead to a situation of asymmetric information between Member States and between infrastructure operators and users, in which possible abuses would be difficult to detect.

2.4. What happens if nothing is done?

Leaving the situation unchanged would mean that transport would continue to generate nuisances that would not be borne by transport users. However, this is not to say that nothing would be done as there are other instruments either in existence (e.g. vehicle taxes, Euro classes) or being discussed at the EU institutions (e.g. ETS for aviation, CO2 and cars rules) to fight external costs. Without internalisation, transport price would continue to give a wrong signal to users who would not have enough incentives to use cleaner vehicles and avoid congested routes at peak times.

2.4.1. Incentives to internalise external costs

As described above, the EU legislation does not allow charging for external costs in road freight transport and allows it in railways subject to certain conditions. Accordingly, the heterogeneity of charging across Member States and across modes of transport will be maintained and the use of price signals will be barely exploited.

2.4.2. External costs will continue to increase

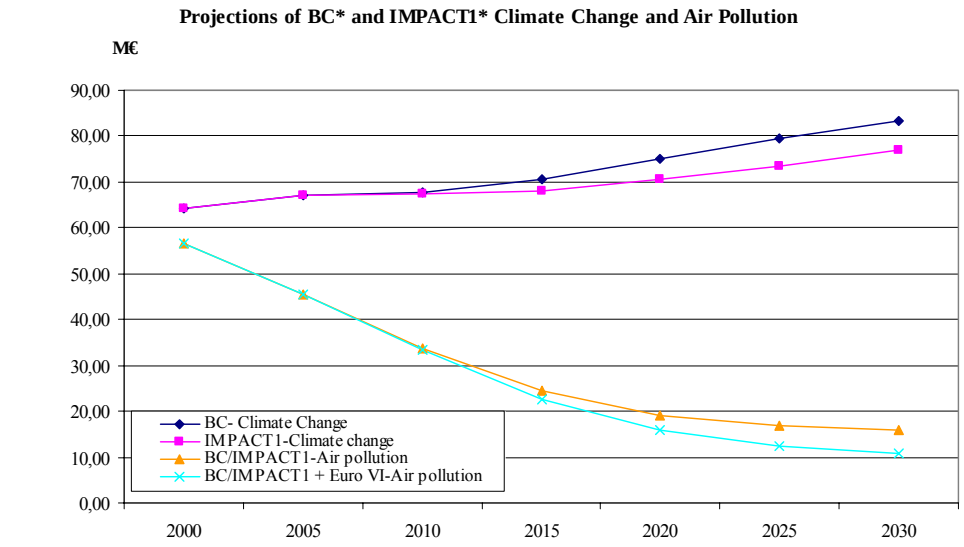
The Community has already proposed measures to reduce environmental emissions or to vary charging in sensitive zones. These actions are expected to reduce nuisances

generated by transport. Some of these measures are approved but not yet implemented while others are still under scrutiny (Commission proposals aiming at fighting CO2 emissions from transport). These measures will be assumed to be approved and not subject to appraisal here. Taking into account existing and envisaged measures[28], most external costs will continue to increase.

Interestingly, air pollution trends show a sharp decrease, at least till 2020. The decreasing trend is even stronger when taking into account the impact of EURO VI (see graph 2.6). These trends do not include evolution in maritime transport and may thus underestimate the evolution of air pollution in all modes of transport.

By contrast, climate change costs display a high increase after 2020. However, the inclusion of air transport in ETS (reference scenario IMPACT, graph 2.6) has obviously a positive impact on the evolution of CO2 compared to scenario which does not include it (Baseline of TREMOVE, graph 2.6). Here again, these projections do not include maritime transport.

Graph 2.6: Projections of climate change and air pollution costs



** BC: Reference scenario of TREMOVE. IMPACT1: Reference scenario of IMPACT*
*** Maritime not included. Well to tank emissions excluded*

Source: TREMOVE baseline and IMPACT baseline

The increase in transport traffic will lead to an increase of noise and accident costs.

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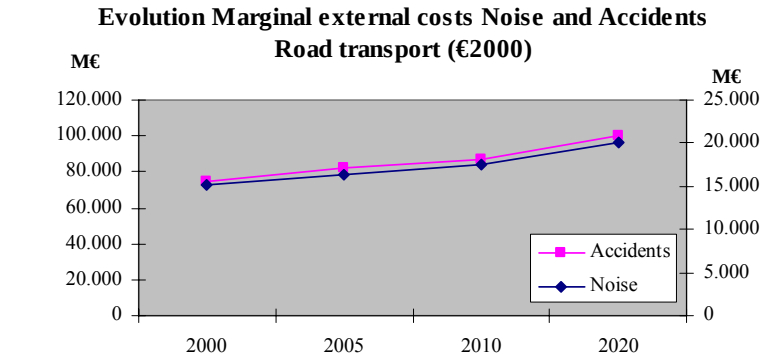
28 The reference scenario of this impact assessment will include these measures (see part 4 for the full description of the policy option "no new action"). However, the proposal to reduce air pollution for EURO VI has not been included in the reference scenario as the impacts were not yet analysed when defining the current reference scenario (see part 4). Graph 2.6 shows the positive impact on air pollution when including this proposal. Another possibility would have been to take a "business as usual" scenario as it is the case in the pre-existing TREMOVE baseline derived from the 2005 ASSESS study. Compared to the reference scenario of the current impact assessment, the TREMOVE scenario displays less positive trends regarding environmental external costs, in particular climate change costs which is the externality addressed by the measures in the pipeline.

Graph 2.7: Projections of accident and noise costs



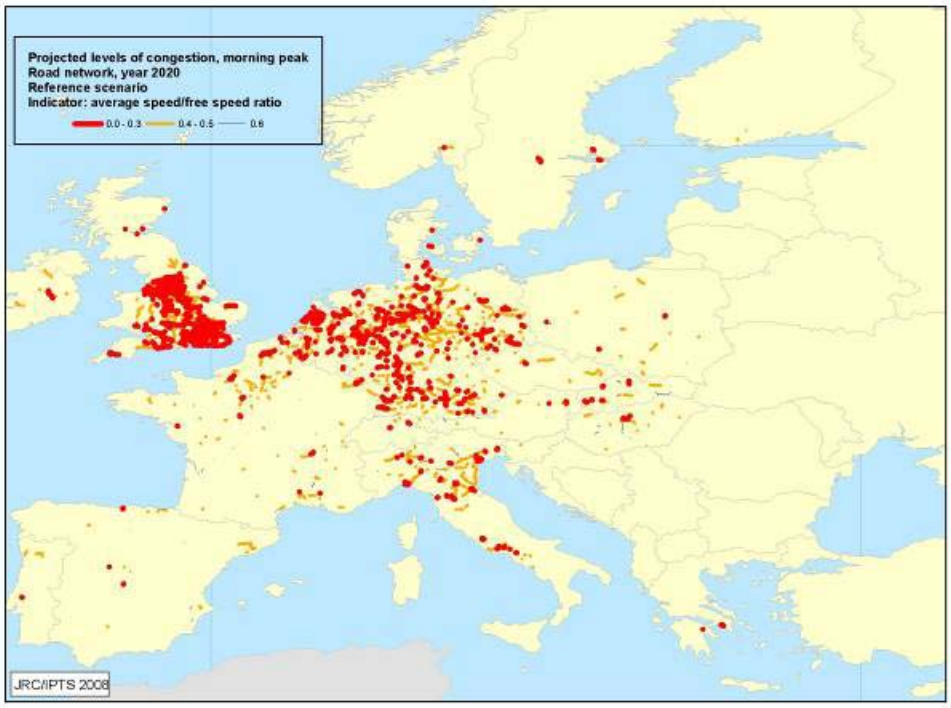
Source: IMPACT

Source: IMPACT

Projections also show that congestion will not improve. Graph 2.8 shows projections of congestion in morning peak in 2020. It provides the ratio between average speed and free speed. The lower the ratio becomes, the higher the congestion is. The map below identifies bottlenecks in some parts – UK, BE, NL[29].

Graph 2.8: Evolution of interurban congestion in Europe

[29] TRANSTOOLS projections. Another way of presenting congestion has been to compare the share of driving below free speed with the total driving time. Following this approach, it appears that 28.6% of EU27 network will be congested in 2020.



Source: TRANSTOOLS

2.4.3. The level of internalisation will not improve

The level of internalisation will not improve if no new actions are taken. Annex 7 provides the evolution of the level of internalisation (equity approach) in road transport and other modes and it clearly appears that the situation will not improve. As a result, external costs will increase following the foreseen increase in transport volumes.

2.4.4. Who is affected

Transport users and society at large will be affected as the level of internalisation will not be improved and external costs will continue to increase. Densely populated areas with dense interurban networks and sensitive zones will be mostly affected. Low-income classes are likely to suffer the most since they tend to inhabit the areas where externalities (congestion, air pollution, noise) are more severe.

2.5. EU right to act

The internalisation of external costs contributes to achieving the objectives of the Common Transport Policy set out in article 71 of the Treaty.

The internalisation of external costs is a way to apply the "polluter-pays" principle as it has been requested by the European Parliament. The "polluter-pays principle" is treaty-based: article 174 of the Treaty states that, "environmental damage should as a priority be rectified at source" and that "the polluter should pay". The Directive on charging HGV

and the Railways directive also provide the possibility for Member States to apply the "user pay" principle in recovering the cost of infrastructure.

Box 4: Polluter Pays Principle and Cheapest Cost Avoider Principle

During the public consultation, some stakeholders mentioned that any policy on internalisation of external costs should be based on the "cheapest cost avoider principle" rather than on the polluter pays principle. Such an approach consists in taking into account possible action from pollutees as well as from polluters when defining a strategy to internalise external costs.

The cheapest cost avoider principle has been inspired by the economist R. Coase, who, in his article of 1960, highlighted the reciprocal nature of the externality problem. A possible interpretation is that there can be circumstances in which the cost to society of abating externalities can only be minimised if responsibility for action is placed on the party which could prevent the nuisance at the lowest cost. Crucial to this result is the presence of sufficiently high transaction costs.

The EU Treaty establishes the "polluter pays principle" for environmental externalities, which amounts to entitling the citizens with the right to a proper environment (clean air, silence, etc) and which is closer to the Pigouvian principle according to which the polluter that generates the nuisance should bear the costs of the effects he imposes on others. This principle has been acknowledged as the principle of action of EU sustainability policy. While the polluter pays principle always puts the burden of adjustment on the polluter side, it is not opposed to a negotiated settlement that could reduce the overall cost to society. However, it must be said that transport externalities are generally so diffuse that the transaction costs to reach an agreement would be very high due the number of possible participants (transport users and the affected population). On the other hand, technical solutions would generally be cheaper if applied to the polluter side than to the exposed population which is very large in case of air pollution, accidents and noise and even more so in the case of climate change. Accordingly, in the case of transport externalities, it is to be expected that the Polluter Pays Principle and Cheapest Cost Avoider Principle would lead to the same result. In the case of congestion the distinction is not relevant since the same category of actors that generate the externality, suffer from its consequences. It should also be stressed that the Pigouvian tax leaves incentives to the pollutees to take private actions to avoid the externalities, but at an efficient level.

The Community has to ensure the proper functioning of the internal market and the absence of distortions of competition between transport undertakings in the Member States. The current situation as regards taxation and charging in transport reflects a wide variety between Member States approach and between different modes of transport. Charging for external costs may also make more difficult the control of possible abuses by setting charges at a disproportionate level or in an arbitrary manner, which would be incompatible with the general treaty principles, notably its Articles 23 to 31 and with the Common Transport Policy (article 79 on non discrimination on national grounds). Harmonisation should continue as it has started with a number of directives on taxation

and infrastructure charging (Directive 2003/96/EC (energy taxation), Directive 2006/38/EC (road), Directive 2001/14/EC (rail)[30]).

As mentioned above, the EU legislation does not allow, in most cases, to charge heavy duty vehicles for external costs while it allows infrastructure managers to charge railways undertakings for external costs under limited conditions (no extra revenues for infrastructure managers unless there is similar charging in competing modes). Obviously, as long as the EU legislation does not explicitly authorize charging road freight transport for external costs, Member States can not initiate the reforms of charges structure which would be required to internalise external costs in land transport.

3. OBJECTIVES

3.1. General and specific objectives

The general objective for the EU is to "*to ensure that our transport systems meet society's economic, social and environmental needs whilst minimising their undesirable impacts on the economy, society and the environment*[31]".

However, **this impact assessment is only concerned with a specific objective of the Commission which, following the precise request of the legislator, is to propose a strategy to internalise external costs generated by transport**. By internalising external costs, transport prices are expected to give the right signal to transport users, to improve the efficiency of infrastructure use and contribute to reducing negative externalities such as congestion, accidents and environmental emissions. This objective should not hamper the competitiveness of the economy and should avoid any undue burden on transport.

This objective would ensure consistency with other transport policies, but also with other Community policies. For many years, the Commission has been advocating the internalisation of external transport costs through fair and efficient pricing. The Green Paper published in 1995 opened the debate while the White Paper in 1998 outlined an initial strategy for transport infrastructure charging. The White Paper of 2001 on the EU general transport policy and its mid-term review in 2006 confirmed the need to implement fair and efficient pricing.

The internalisation of external costs is also consistent with the EU agenda by contributing to improving efficiency (Lisbon Agenda) and sustainability (Sustainable Development Strategy). More specifically, the Integrated Guidelines 16 of the Growth and Jobs agenda recommends to "*consider the case for appropriate infrastructure - pricing systems to ensure the efficient use of infrastructures and the development of a sustainable modal balance, emphasizing technology shift and innovation and taking due account of environmental costs and the impact on growth*"[32].

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30 COM(2007)52 Proposal for a Council Directive amending Directive 2003/96/EC as regards the adjustment of special tax arrangements for gas oil used as motor fuel for commercial purposes and the coordination of taxation of unleaded petrol and gas oil used as motor fuel.

31 Council European Union. June 2006. Renewed EU Sustainable Development Strategy. http://ec.europa.eu/sustainable/docs/renewed_eu_sds_en.pdf.

32 COM(2007)804. Proposal for a Community Lisbon Programme 2008-2010.

3.2. Operational objectives

As already mentioned, EU legislation does not authorise Member States to levy directly from heavy goods vehicles external costs while it allows infrastructure managers to charge railways undertakings for external costs under limited conditions. Nor does it provide incentives to Member State to vary the charges according to location and time and deal with charges on roads other than the trans-European network. Accordingly, there is a need to revise EU legislation to unlock the possibilities left to Member States for internalising external costs and to ensure consistency in the way external costs are treated.

The following operational objectives are therefore to:

– propose a stepwise strategy to promote the internalisation of external costs for all modes of transport, creating incentives for users to make efficient use of transport infrastructure.

– as a first step, and taking into account the fact that a proposal for introducing an ETS in air transport has already been formulated enable and encourage Member State to implement in a consistent way on motorways and other roads efficient road usage charges leading to a more sustainable mobility. This would lead to the revision of Directive 1999/62/EC.

4. POLICY OPTIONS

Policy options will envisage the use of different market based instruments for each external cost and different spans or combinations of external costs.

4.1. Preliminary remarks: selection of policy options

4.1.1. Taking into account the various dimensions of internalisation

When defining a strategy to internalise external costs, several dimensions have to be considered.

- Which external costs?: As explained in box 2, transport activities generate different types of externalities linked to the provision and the use of infrastructure. There are some generally recognised externalities caused by the use of infrastructure – CO2 emissions, air pollution and noise. Congestion and accidents are also externalities, but the "victims" are other transport users ("club" effects). Other external costs are sometimes referred to, such as space occupancy, landscape, security of supply or biodiversity.

- Which modes of transport? The Commission had a clear mandate to tackle all modes of transport – road, rail, air, waterborne. But the various externalities have different relevance across modes and it may not be opportune to tackle all externalities in all modes.

- Which economic instruments? As discussed in box 2, internalisation can be implemented with taxation, user charges or trading systems. The most appropriate instrument needs to be selected depending on the externality and the mode of transport.

- EU level of intervention Given the local nature of external costs, policy action can be better tackled at local or national level. However, mobility of goods and persons across Europe is a key principle and the Community level may be the appropriate level for policy action when defining common charging principles in Member States.

On this basis, the public consultation[33] sought comments on the possible use of different economic instruments for each external cost, i.e. congestion, accidents, noise, air pollution and climate change and for each mode of transport, i.e. road, rail, aviation, maritime and inland waterway. 42 individual options were submitted to public consultation (see table 1 annex 9).

4.1.2. Determination of policy options

Selecting dimensions

The determination of policy options with respect to the various dimensions of the problem has been done on the basis of the prescriptions of the economic literature (summarised in the Handbook) and the opinion of stakeholders. Selected combinations of policy options have then been tested through economic modelling in order to provide additional indications on their possible joint implementation.

External costs: the current impact assessment focuses on external costs which are related to the use of infrastructure. According to research and studies[34], congestion, air pollution, noise and accidents account for a large share of external costs (excluding infrastructure costs). The share of climate change costs is lower, but relies heavily on the assumptions made on its calculations[35]. These findings have been corroborated by preliminary results using the TREMOVE model. The total marginal external cost of climate change, air pollution, noise and accidents for all modes in the EU-19 in 2010 are estimated at 158 billion Euros. (excluding congestion cost and the cost of maritime shipping and intercontinental aviation)[36]. Accidents account for more than half of these costs; air pollution account for one fifth and climate change and noise respectively for 14 and 11%.

The present analysis covers congestion, accidents, air pollution, noise and climate change costs. While different studies may change the relative weight of these externalities between each other, they are generally accepted as the most important transport external costs. Other external costs such as land fragmentation and visual intrusion are more

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33 See consultation paper (footnote 19 and 20) at http://ec.europa.eu/transport/costs/consultations/index_en.htm.

34 UNITE – Unification of accounts and marginal costs for Transport Efficiency. November 2003. Project funded by 5th Framework – Transport RTD. INFRAS. External costs of transport. October 2004.

35 The share of climate change costs vary between 4% to 28% depending on the assumptions on the shadow price of CO2. Climate change costs have been estimated with a high reduction targets (-50% between 1990 and 2030). UNITE's shadow value is €20 euros per tonne CO2. The INFRAS study use a range of shadow value from €20 to €135 euros per tonne CO2.

36 The TREMOVE results of scenario 1 also provide data on the summarized marginal external costs, based on the estimates made in the handbook. These sums can not be interpreted as total external costs, because of the difference between marginal and average external costs (in particular for noise, accidents and congestion costs).

related to the provision of infrastructure than to its use and are as such controlled at project appraisal level. However, although accidents are part of the current analysis, the internalisation of these external costs has not been considered in the policy options for the reasons described below.

Transport mode*:* All the larger motorised transport modes are being examined but not all the five external costs are relevant for all of them. Accidents have not been considered in non road transport as these costs are very low in aviation, rail and almost zero in maritime and inland waterways. Air pollution and climate change costs have been analysed for all modes. Congestion is perceived by stakeholders as an important nuisance only in road transport. Moreover, congestion charging is already foreseen in the current railways legislation 2001/14/EC. In air transport, the European Commission has adopted a Communication on the application of the slot allocation Regulation[37] which clarifies a number of issues in order to ensure a better implementation of the existing rules and to improve the efficient use of scarce capacity at congested Community airports. In maritime, ports don't operate at full capacity[38] and when congestion is a problem, it is to some extent dealt through planning and port charges. Accordingly, in the present document, congestion is analysed only for road transport.

Economic instruments: The choice of economic instruments is dictated by the nature of the externality. Air pollution and noise costs are heavily related to the type and characteristics of the vehicle use and the location and time of the day. Congestion is also dependent on the location and time of the day. Accordingly, these externalities require differentiated charges in order to provide incentives to change behaviour (more silent vehicles, less polluting vehicles, change of driving style, postpone or cancel travel). By contrast, CO2 emissions are related to fuel consumption and a simpler economic instrument, such as fuel taxes can provide the right signal to users (see box 4 in section 2). When fuel tax is not possible, emission permits can be another way to internalise.

EU level of internalisation: In general, stakeholders favour an action at EU level, but many respondents also stressed the need to take into account the local character of some nuisances (for example congestion or accidents). As a result, the EU should play a role of enabler by providing a common framework while tackling global nuisances such as climate change. For these reasons, the role of the EU should be different and its implication should vary from providing a common framework to establishing more binding rules.

Internalisation of external accident costs

It is widely acknowledged that accidents account for an important share of total external costs. In principle, accident costs causing real financial flows are covered by insurances. However, a large part of the costs associated with accidents are non financial and are often not yet covered by insurances.

A differentiate kilometre charge system could be implemented, but would hardly meet costs drivers. Accident costs drivers are very complex and rely on parameters like

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37 COM(2008)X.

38 COMPETE (2006). Analysis of the Contribution of transport policies to the competitiveness of the EU economy and comparison with the United States.

location, time and vehicle type, but they are also related to driver characteristics and accidents history. These factors may materialize in different kinds of behaviour as to speed, alcohol driving, use of seat belts and other risk factors relatively independent from the distance travelled and which are otherwise subject to regulation and police enforcement. To take into consideration all of these aspects is complex and may be hard to implement because of privacy reasons. As a result, internalisation of accident costs is not easy. An alternative would be to charge the insurance company a lump sum at the level of the estimated external costs for each accident as they have detailed information on cost drivers and differences in the risk rates between drivers. Insurance companies would be able to pass on these costs to drivers and to differentiate these costs according to the characteristics of drivers.

The results of the public consultation display a strong support to an internalisation of external accidents costs through liability insurances (see annex 1). However, such a system would be complex to elaborate as insurance companies would be faced with increased uncertainties. Moreover, it would be even more difficult to design at EU level given the diversity of insurance systems in Europe.

For these reasons – complexity and subsidiarity – external accident costs have been discarded from the analysis.

Use of economic modelling to identify policy options

Because of the strong interaction between transport modes and between various externalities, it is desirable to test the joint implementation of policy choices with respect to the various aspects of internalisation. Since the number of the possible combinations of policy actions is very large, a few scenarios that bundle together selected uses of policy instruments have been developed and tested with modelling tools.

Because of modelling resource constraints only 6 combinations were tested. These are the ones that were considered more realistic and operational. An additional scenario had been tested, but has been excluded at an early stage (see below section 4.1.3).

4.1.3. Exclusion of policy option "Integrated approach of internalisation according to the principle of social marginal costs pricing"

A possible approach would be to charge for all external costs in all modes of transport applying social marginal cost pricing. This approach would allow the internalisation of all external costs, i.e. congestion, accidents and environmental costs in all modes of transport, freight and passengers, including private cars. In addition, the approach represented in this scenario would be based on applying the concept of marginal costs pricing as strictly as possible. As a consequence, marginal infrastructure costs would be charged on all roads, replacing all existing charges, including infrastructure charges on the sections currently tolled.

Finally, this scenario would not only consider that existing fuel tax already internalise CO2 in road freight transport, but also take into account – within the limits of tax legislation – the excess with respect to an estimated CO2 price. Accordingly, road fuel taxes would be lowered to minimum. ETS in air transport would be considered as

internalising CO2 emissions. Fuel tax/ETS would be applied in other mode of transport, i.e. maritime, IWW, railways.

Although attractive, this scenario has been dropped for the following reasons:

- Political feasibility:

Charging marginal infrastructure costs can not be sufficient to allow cost recovery of infrastructure construction costs. This would go against the existing EU legislation in the road freight transport (Directive 1999/62/CE) and would require an extensive revision of this Directive which would go far beyond the request of the EU legislator.

In addition, the inclusion of a decrease in fuel taxes to minimum in road transport would be difficult to implement as Member States are free to use fiscal charges provided they respect the minima set by the EU legislation.

- Lack of sustainability of transport

Moreover, preliminary modelling results show that the decrease in fuel tax in road transport contribute to increasing traffic, which generates an increase in external costs (air pollution and CO2) and fatalities. Mobility is improved at the expense of sustainability which goes against the objective set by the EU.

For these reasons, this strict marginal cost scenario has been discarded as the results reflect a trade off between higher mobility, and less sustainability.

In conclusion, the policy options suggested below take into account the practical implementation of internalisation and its political and practical feasibility. They propose alternative strategies of internalisation by combining differently:

– the scope of modes of transport taking into account their freight or passenger transport activities,

– a variable span of external costs (environmental costs excluding climate change, all environmental costs, congestion),

– the use of different economic instruments (charges, taxes or emission trading),

– and the extent to which policy instruments should bind Member States or just enable them to internalise external cost.

4.2. Scenario 1: No new actions

The reference scenario (No new actions) does not consider any new proposal to ensure the internalisation of external costs, but takes into account the forthcoming measures aimed at reducing environmental nuisances. These relate mostly to climate change external costs; they are not part of a comprehensive strategy for internalisation and do not cover all modes of transport.

The reference scenario includes, notably, the following proposed measures by the Commission:

– The proposal for a binding fuel efficiency target for new passenger cars (130 CO2 g/km target + 10% biofuel target), which largely replaces the pre-existing voluntary agreement.

– The proposal[39] to include aviation in the EU emission trading schemes (ETS), which would allow airlines to purchase allowances for all emissions of aircraft above the historic emission levels of 2004-2006.

– The proposal on the harmonisation of commercial diesel[40], which aims at reducing distortions of competition and environmental damage in the transport haulage by reducing fuel tank tourism.

– The passengers' car taxation. According to this proposal[41] by 2008, at least 25% of the total revenue from annual circulation taxes and registration taxes shall come from a carbon-dioxide based element in the tax structure. This share should be 50% by 2012. By 2016, it is proposed that all registration taxes should be abolished.

As mentioned in part 2, this reference scenario assumes that all these measures will be implemented. Compared to the baseline scenario of TREMOVE, it incorporates additional measures and shows a more favourable evolution of CO2 costs. It is therefore more optimistic as it considers that various measures proposed by the Commission to fight CO2 from transport are already in place; these measures are not subject to assessment in this document. As the reference scenario assumes a certain reduction of CO2 emissions, the calculations of impact could be larger if such measures were not implemented.

By contrast, it should be noted that the reference scenario does not include the proposal for further reducing emission limits for HGV (Euro VI)[42]. Such a proposal help reduce air pollution emission. Therefore, impacts of charging air pollution in the current analysis could be lower if such a proposal was implemented following the rythm of market penetration of the new trucks from 2013 on.

4.3. Scenarios 2: Efficient charging of heavy goods vehicles

The analysis in the second part of this impact assessment shows that road transport accounts for the very large majority of external costs. Within road transport, the level of internalisation is lower for heavy goods vehicles than for cars.

Road transport is regulated at EU level in the field of heavy goods vehicles by a legislation whose initial main aim was to avoid distortions within the internal market by disproportional and discriminatory charges.

This set of scenarios analyses charging only heavy goods vehicles in the framework of the EU legislation. It would ensure that external costs can be charged in road freight

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39 COM(2006) 818

40 COM(2007)52

41 COM(2005)261

42 Impact Assessment of the Proposal for a Regulation on the approximation of the laws of the Member States with respect to emissions from on-road heavy duty vehicles and on access to vehicle repair information. SEC(2007)1718.

transport and focus on a modification of Directive 1999/62/EC. As mentioned before, the Directive provides a framework on infrastructure charging. With respect to the current situation, Member States would be allowed to charge for external costs on top of their current charges.

The framework for the possible charging of external costs would be extended beyond the Trans-European networks (TENs) in order to avoid inconsistent pricing which may lead to traffic diversion and impediments to the internal market. This entails a change of scope of the current Directive, which only applies to TEN roads.

Three main variants are envisaged:

2.A. Charging for air pollution and noise while considering CO2 internalised through existing fuel taxes

A road user charge for air pollution and noise would be levied for all Member States. It would add to the current infrastructure tolls where they exist. The charge would be set at recognised median values of air pollution and noise costs generated by lorries and would vary according to the EURO class of vehicle, and the location (urban/interurban). Existing fuel taxes are considered to cover climate change.

Annex 10 describes the different assumptions made. A sensitive analysis has been carried out with:

– charging higher values of external costs

– optional charging, meaning that, in the modelling, only some Member States charge for external costs

The analysis of these policy options is detailed in annex 10 and 12. The analysis below deals with PO2 assuming all Member States charge on the basis of median values of external costs. This allows comparison with other policy options in a consistent way.

2.B Charging for air pollution, noise and CO2

A similar system as in 2.A (median values of external costs, all Member States) would be applied. In addition a CO2 charge would be added on top of the air pollution and noise charge. Member States may choose to add this CO2 charge in their fuel tax or in the tolls. Those above the EU average fuel tax level could be inclined to opt for an increase of tolls.

Annex 10 describes the assumptions made on the level of fuel tax.

2. C. Charging for air pollution, noise and congestion

Here again, a similar system as in 2.A (median values of external costs, all Member States) would be applied. On top of the environmental costs, a congestion mark-up would be applied on some sections/links (basically, when marginal infrastructure costs are higher than average infrastructure costs, reflecting the pressure on the use of infrastructure). Due to model limitations, the implementation of congestion charges is

simulated in an extremely rudimentary way as they would not vary according to peak and off-peak.

Here again, a variant on the scope of congestion charge will be tested (inclusion of passenger cars) and is described in annex 10.

4.4. Scenarios 3: Efficient charging in all modes of transport

This set of scenarios would ensure that external costs can be charged, not only in road freight transport like in scenarios 2, but also for all other modes of transport, i.e. rail, aviation, maritime and inland waterways in order to ensure equal treatment in all modes of transport.

Scenarios 3 would not only consider externalities for HGV on all roads requiring modification of Directive 1999/62/EC as in scenarios 2, but also imply legislative changes in other modes of transport.

Two main variants are envisaged

3.A. Charging for air pollution and noise in all modes and charging for CO2 in maritime, IWW and railways (diesel)

In this option, charging for air pollution and noise is made possible in all modes. Climate costs are considered to be internalised by existing fuel excise duties in road transport and by the proposal to include air transport in the ETS. Maritime, IWW and diesel trains would be subject to a fuel tax.

3.B Charging for air pollution, noise and CO2 in maritime, IWW, railways (diesel) and road freight transport

In this case, a similar system would be applied. In addition, a CO2 charge would be added on top of air pollution and noise charge in road freight transport.

Table 4.1: Summary table on scenarios

Modes **Policy option**	**Road freight transport**	**Road Passenger cars**	**All modes of transport**
Policy option 2A	- Charging for **air pollution** and **noise** on top of current infrastructure cost. - Charging on all roads - Charging in all Member States*.		-
Policy option 2B	- Charging for **air pollution** and **noise**		-

	on top of current infrastructure cost. - **CO2** mark-up. - Charging on all roads - Charging in all Member States		
Policy option 2C	- Charging for **air pollution** and **noise** on top of current infrastructure cost - Charging on all roads - Charging in all Member States - **Congestion** charging in bottlenecks.	*Sensitivity analysis: congestion charging in bottlenecks (PO2Call)*	
Policy option 3A	- Charging for **air pollution** and **noise** on top of current infrastructure cost. - Charging on all roads - Charging in all Member States.		- **Air pollution** and **noise** charging in short sea shipping, inland waterways, railways, air transport. . **CO2** charge (fuel tax) in maritime, IWW, railways (diesel). - ETS assumed to already internalise CO2 in air transport and railways (electric). - Charging in all Member States
Policy option 3B	- Charging for **air pollution** and **noise** on top of current infrastructure cost. - **CO2** mark-up. - Charging on all roads - Charging in all Member States		- **Air pollution** and **noise** charging in short sea shipping, inland waterways, railways, air transport. . - **CO2** charge (fuel tax) in maritime, IWW, railways (diesel). - ETS assumed to already internalise CO2 in air transport and

			railways (electric). Charging in all Member States

* A sensitivity analysis has been made on this policy option, considering some only some Member States charge for air pollution and noise costs (see annex 10).

5. ANALYSIS OF IMPACT

The analysis of impact is supported by quantitative and qualitative analysis. Three models – TRANSTOOLS, TREMOVE[43] and ASTRA – have been used in order to assess the impact on transport demand and on the rest of the economy (see annex 11 for the description of the models and their use in the analysis of impact). The reference scenario is described in annex 12 as all policy options are compared against it. Annex 13 describes the various modelling exercises that have been made for each set of policy options and gives additional details on the results of modelling.

Different impacts have been assessed: the impact on transport, the impact on the economy, the impact on environment and the impact on society. In addition, implementation costs of charging in road transport have been estimated. Administrative costs have also been assessed. Finally, the use of revenues has an influence on the overall impact and alternative use of those revenues is discussed in the last section.

All the results provided by the models give useful indications of the impact. However, the models can neither capture all the situations (time or location differentiation of charges and taxes) nor the impact of local passenger traffic (see box 6). Accordingly, the improvement of the level of internalisation is likely to be higher than it is estimated and the reduction of external costs could also be greater. In addition, the economic effects do not capture the economic positive impact of the reduction of fatalities or the improvement of health (due to a reduction of air pollution). As a result, the modelling results have to be combined with qualitative analysis and complemented by other empirical studies.

Box 6: Limitations of modelling internalisation of external costs

The complexities of the transport sector require the use of models for a comprehensive analysis to be carried out. Models of course simplify the real world and thus have their limitations. The negative effect these limitations can have on the quality of the analysis can be alleviated by complementary qualitative analysis but it is important to be clear about what economic models can contribute to an analysis (and what they cannot).

The transport sector comprises two very different markets: passengers and freight. In addition, many modes of transport often compete for the same infrastructure e.g. trucks and cars. Moreover, urban traffic conditions are very different from interurban ones. Cost is determined not only in money terms but also by time spent travelling. Interactions are

[43] TREMOVE has been used in the context of the IMPACT study and some comparisons can be made with the TREMOVE results.

complex e.g. an increase in aviation kerosene prices (or taxes) can have a negative impact on rail freight competitiveness through increased high speed train demand.

External costs further complicate the analysis as they depend on changing situations and on the characteristics of the infrastructure. Human activity patterns produce rush hours. Wind direction or strength determines pollution impacts. Moreover, there are interactions between different types of external costs: a worsening of congestion could improve safety. The interactions among the different markets, populations and infrastructures are so complicated that models – which are simplifications of the reality – can provide very useful insights.

The current Impact Assessment covers the whole European transport sector with all its diversity. The key element in pricing for external costs is that internalisation charges are targeted at the actions that produce them, thus they have to be highly differentiated according to time and place. But to facilitate things (and also for lack of information), models tend to be highly aggregated. The possibility of differentiating charges is quite limited and models cannot capture all the derived benefits. It must be said that in real life the more differentiated pricing is, the more difficult and expensive it becomes to implement it. The downside of aggregation is that the impacts are also aggregated and lose most of their visibility. In these conditions, models should be considered as useful tools that may confirm the predictions of theory and often show the direction of interactions.

The economic model used in this impact assessment is a standard, well-known and tested model. It does not capture positive benefits such as health improvement, the reduction of CO2 emissions, the decrease in fatalities, the improvement of the quality life of citizens and the incentive to innovate and change the fleet mix to cleaner vehicles. Most of these effects will improve GDP in the long run, an aspect not included in the modelling results. Economic theory would suggest that internalisation improves social welfare since when "polluters" are confronted with correct prices reflecting true costs, society ends up with a level of pollution it considers optimal (see also box 2). . The application of a Pigouvian tax leads to an improvement of efficiency provided each goods/service is sold at its social price (including external cost) and that revenues are promptly and properly used.

In the current impact assessment, the model estimates that the negative impact of an increase in transport prices outweighs other positive effects of internalisation. Taking a longer term horizon could have helped identify the adaptation of the economy: private investments do not happen in the ASTRA model as a time delay is implemented in the model. A simulation until 2030 would lead to much stronger impacts on private investments. This would lead to a boost in GDP. Hence, the model results are likely to understate the long term net benefits and they should be taken as an indication only, since they do not capture the entire complex mechanism and interactions of internalisation.

Finally, as explained in annex 11, because of the comparative static nature of TRANSTOOLS, starting and end values for transport volumes and travel times have been fed into the economic model ASTRA. The inputs from Trans-Tools have been linear interpolated to derive the input for the whole simulation period from 2000 to 2020. This technical limitation does not allow analysis on how quickly the economy adapts and the initial costs are recouped in social benefits.

5.1. Impact on transport

Charging for external costs has an impact on transport costs which in turn influences transport volumes (trips, tons lifted and passenger and ton kilometres). This impact is expected to be different across modes which would modify the share of modes of transport and lead to modal shift. The magnitude of these impacts varies across policy options. Finally, the impact on congestion will be assessed as it influences the time spent in transport.

5.1.1. Impact on transport costs

Increase in transport user charges

The principle of internalisation is that transport users bear the costs they generate – private and external. In order to make transport users pay for these external costs, all the policy options have envisaged a user charge based on the estimation of those external costs.

The level of pricing measures aimed at internalisation of an externality should ideally be based on the corresponding marginal external costs. The estimation of marginal costs for the various cost categories has been elaborated from the Handbook on external cost estimates[44]. These results have been taken as starting point. The value transfer procedures presented in the Handbook have been applied to retrieve values for all Member States.

Table 5.0 describes the increase in charging in all modes of transport. The increase depends on the scope of external costs covered - air pollution, noise, CO2 and congestion.

The internalisation of external costs will lead to the following increase in charges according to the different scenarios. As an example, under scenario 2A, a truck would have to pay 0,037 euros corresponding to a marginal external cost of air pollution and noise for each kilometre it would travel.

Table 5.0: Summary of simulation results – Increase in charges in 2020

	Road freight transport	**Rail freight**	**Short-sea shipping****	**Inland waterways**	**Passenger rail**	**Air (passenger)**
	€/vkm	€/vkm	€/port call	€/vkm	€/vkm	€/LTO***
PO 2A Charging Air	0,037	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant

[44] Climate change costs and air pollution costs per tonne of emission, accidents and noise costs estimates per vehicle-kilometre (differentiated to urban/interurban, vehicle size, Euro standard) or LTO, congestion costs per vehicle-kilometre, as function of the capacity use of the road (used for TRANSTOOLS runs only). For the translation of the changes in taxes and charges per tonne of emission to changes per vehicle-kilometre, LTO or litre of fuel, data from the TREMOVE reference scenario output has been used (fuel consumption, vehicle-kilometre and emissions). The result of this translation was a set of input data for EU-19. The Joint Research Centre has extrapolated the input data for the other 6 EU Member States, in order to run the TRANSTOOLS model for EU-25.

pollution and Noise						
PO 2B Charging Air pollution, noise and CO2	0,064	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant
PO 2C Charging air pollution, noise and congestion	0,076	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant
PO 3A Charging air pollution and noise. CO2 in non road.	0,037	1.20	2012**	2.88	0.58	306
PO 3B Charging air pollution, noise and CO2 in all modes	0,064	1.20	2012**	2.88	0.58	306

* Charges are expressed in €2000. It is assumed that all roads would be charged and that all Member States would charge for external costs. Annex 12 shows the impact when only some Member States charge external costs in road freight transport.

** 2012 is an average. The range is between 755 to 4080 euros per port call. For maritime transport, the application of charges per port call was the only charging option that could be modelled with the TRANSTOOLS model. In addition, the lack of reliable data on international maritime transport led to the limitation of the scope of the internalisation to that of local impacts only, in a radius of 60 miles from the port. The resulting additional charges used in the simulations therefore represent only a fraction of the real external costs of maritime transport.

Source: TRANSTOOLS

Increase in transport costs

An increase in transport costs is to be expected due to the fact that some natural resources (air, silence) were used and some nuisances caused (health, lower air quality, noise, increased time) and they were not paid for. Although the magnitude of the costs of the internalisation for transport depends on the importance of the nuisance, it will be reduced by the response of transport users.

The response of transport users will involve a re-organisation of travel whilst continuing to use the same mode, better logistic organisation (reduction of empty running, increase in load factors) or the choice of alternative corridors[45]. As the EU FP5 CAPRI project explained: "Modelling studies for urban and inter-urban road pricing indicate that proposed price changes can induce small but significant changes in behaviour (e.g. a 5% to 10% demand reduction) which can make a major contribution to the reduction of congestion and other externalities. In some studies a small reduction in demand has been shown to result in the marginal external cost of congestion falling to 20% of the pre-charge level[46]. Thus the increase in transport costs is to some extent self-correcting

[45] See "Third Annual Thematic Research Summary- Pricing, Taxation and Financing Tools" Paolo Delle Site pages 13 and 15. EXTRaWEB Project DG Energy and Transport

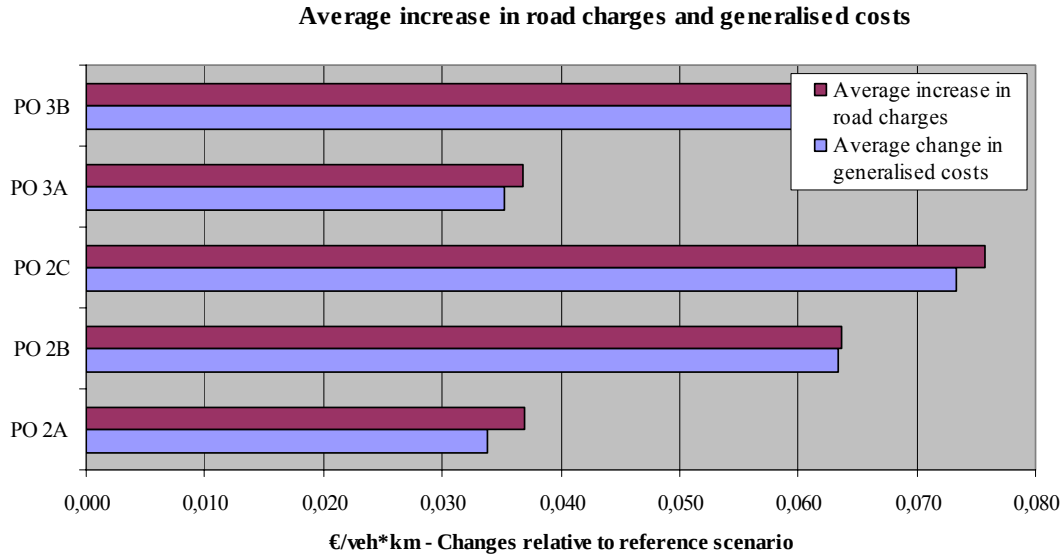
[46] Concerted action on transport pricing research integration CAPRI C. Nash, T.Sansom, B. Matthews and alt. Page 17. Transport RTD programme 4th FP

through the behavioural changes it induces which in turn allow a reduction in user charges.

Therefore, the consequence of internalisation on transport costs is not straightforward. First, the increase in charges impacts directly on transport costs. But, a reduction of time costs due to freer flow traffic can compensate for the user itself the increase in charges. As a result, one needs to consider both effects in order to assess the magnitude of impacts.

The modelling results show that the increase in charges leads to an increase in generalised costs which is generally lower than the first one. This is likely to be due to a reduction of time costs which slightly compensate the increase in charges (see graph 5.1[47]). Charging would induce an increase in operational costs between 3 and 7%. However, the reduction of time costs (between -0.04 and -0.14%) compensates a bit the increase in generalised costs. The level of aggregation of the model hides to some extent the real effect, although it points at the right direction.

Graph 5.1: Increase in road charges and generalised costs in road freight transport



Source: IMPACT/TRANSTOOLS

5.1.2. Impact on traffic and performances

The increase in transport cost will therefore give a clear signal to transport users. Those who value their trip below this cost will choose not to travel at that moment in time and/or to use alternatives means. By contrast, those who value their trip above this cost will continue to travel. As a result, a change in traffic flows should be expected. Most important is to see whether mobility is reduced, maintained or increased. In addition, the

47 Note that the evolution of generalised costs is not so straightforward in other modes as the model cannot capture the impact of capacity constraints. As a result, it is more relevant to display these results only for road.

mobility pattern is expected to be different, whether road freight transport is charged alone or if other modes are charged.

Mobility of goods

The reference scenario assumes that, from 2000 and 2020, transport growth will be +66% in freight transport (all modes), including +91% for international road freight transport, and +35% in passenger (all modes). The evolution of the share of road transport would be negative: -4% in freight transport, -3% in passenger transport (see annex 11).

The implementation of charges/taxes would lead to a decrease in tons lifted. The decrease in volumes in all modes is mostly explained by the decrease in road freight transport.

Graph 5.3 shows that the stronger impact on road freight transport per ton-kilometre are caused in scenario 2C (charging air pollution, noise and congestion). Changes are positive for other modes of transport, but the increase of ton lifted in other modes of transport is not sufficient to fully compensate the decrease of ton lifted in road transport.

Is there detour of traffic?

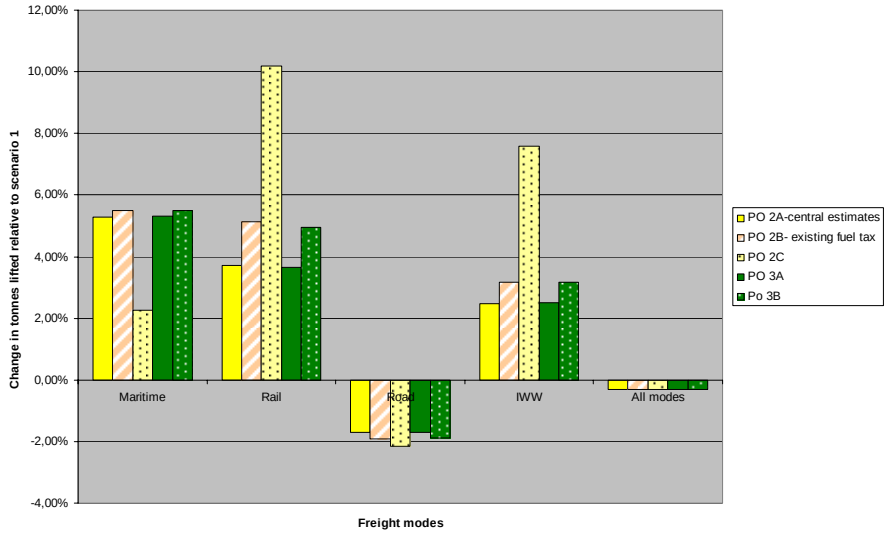
Detour of traffic can be one of the adverse effects of pricing as vehicles can be incited to take alternative roads to avoid charging. When comparing with a scenario where only motorways are tolled[48], tonne-km reduce less than tonnes lifted (-0.44% versus -1.10%) which indicates that some detour from tolled motorways to non tolled secondary roads is taking place which results in the average trip length going up.

Real life example from Germany also indicated that there was this detour effect especially in the first month after the introduction of the toll (but then it gradually reduced). It has to be noted that the quality of the available secondary road network is crucial as it makes a big difference to the willingness to take the detour what is the subsequent time incurred on the secondary road. Also one would expect professional drivers to make a pragmatic economic decision balancing the cost of the toll and the time loss and extra running costs (fuel) to decide which road to take.

Here, all the policy options assume that all roads are charged in order to avoid any detour of traffic in road transport. The divergent evolution of ton-km and ton lifted shows that the average length of trips could increase or decrease, which might indicate that alternatives for road transport require a longer travelling distance. Depending on the type of goods, other modes may not be perfect substitute for road which can offer more flexibility and responsiveness to industrial needs.

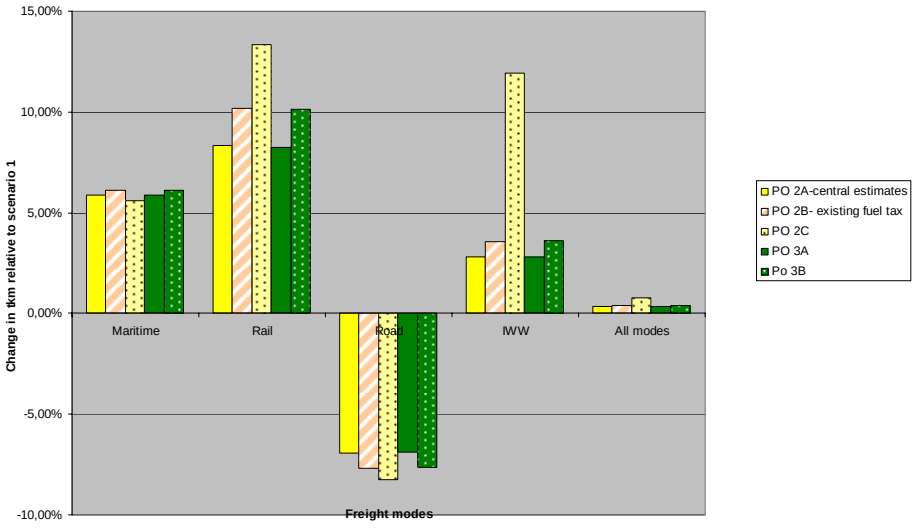
Graph 5.2: Changes in freight volumes in tons lifted per transport mode in 2020 with respect to the reference scenario

[48] Scenario 5B of the IMPACT study analyses charging on motorways. See annex 11 for the description of the scenario of the IMPACT study (Deliverable 3).



Source: IMPACT-TRANTOOLS

Graph 5.3: Changes in freight volumes in ton-kilometres per transport mode in 2020 with respect to the reference scenario

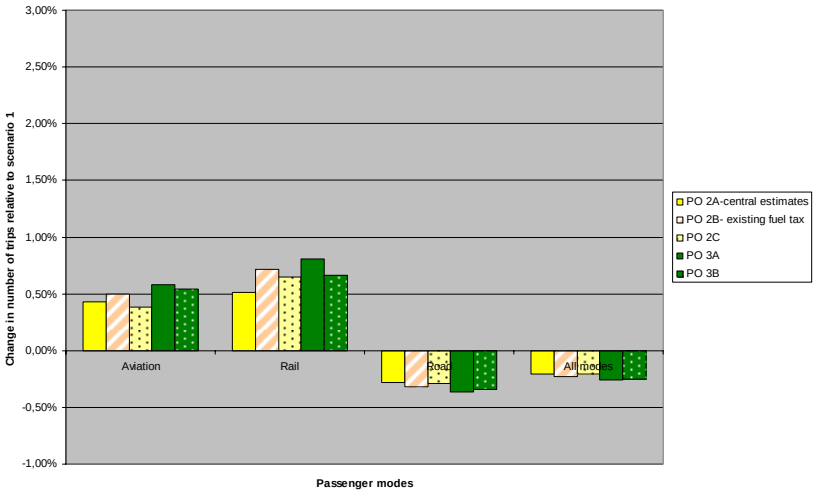


Source: IMPACT/TRANSTOOLS Modelling

Modest impact in passenger transport

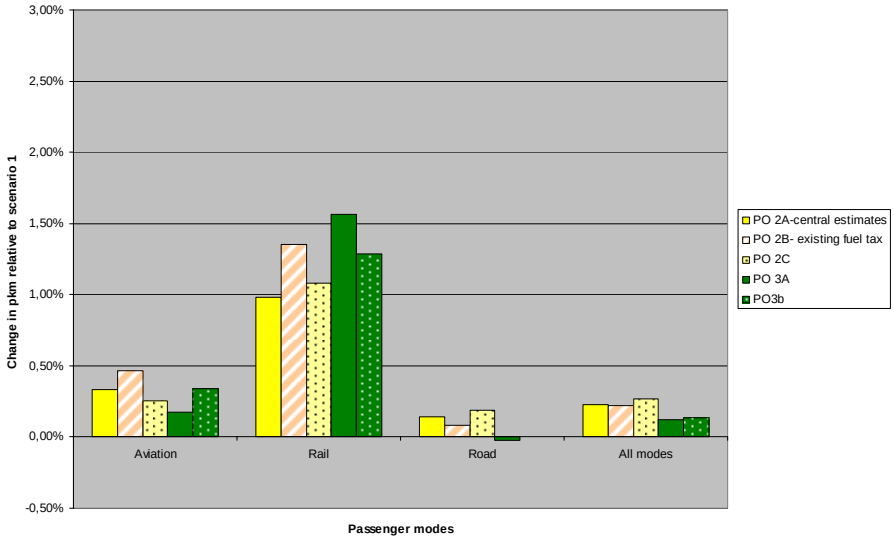
In general, passenger transport would not be affected as freight transport is charged. Scenarios 3 includes partial charging for passenger transport (air, maritime and railways). Modelling results confirm this.

Graph 5.4: Changes in passenger trips per transport mode in 2020 with respect to the reference scenario



Source: IMPACT/TRANSTOOLS Modelling

Graph 5.5: Changes in passenger volumes (measured in passenger-kilometres) per transport mode in 2020 with respect to the reference scenario



Source: IMPACT/TRANSTOOLS Modelling

5.1.3. Impact on modal shift

The various evolution of traffic in all modes of transport has consequences on modal split as the share of non road transport increases, especially in freight transport. Which of the non-road modes profits most from the modal shift, depends on the policy option. This has mainly to do with rather detailed network effects and cannot easily be explained by the price changes as such. The impact on modal shift is likely to be related to many other factors than transport cost like reliability and quality of alternative to road freight transport. Moreover, it probably depends on the market segments as certain transport like long distance transport, or transport of raw materials, are more likely to be sensitive to changes in cost structure

The impact on modal shift in freight transport is higher in scenarios 2 (charging only in road freight transport) than in other policy options where the other modes are charged. This is expected as the increase in road charging may give incentive to use alternative modes of transport, and even more so if they are not charged. Maritime and railways shares increase. Charging for congestion and other external costs (air pollution and noise) has a strong impact and leads to an increase in other modes of transport, especially in railways (see annex 12 for additional results on PO2 and 3).

Table 5.1: Modal split in freight transport

EU25 – 2020 – bn t-km	**Short-Sea**	**Rail**	**Road**	**IWW**
Reference Scenario. Modal split	36,8%	13,5%	44,6%	5,1%
Evolution of modal shares relative to reference scenario (in percentage points)				
PO2A.	2.0	1.1	-3.2	0.1
PO2B	2.1	1.3	-3.6	0.2
PO 2C	1.7	1.2	-3.0	0.1
PO2C (all)	1.8	1.7	-4.0	0.6
PO 3A	2.0	1.1	-3.2	0.1
PO 3B	2.1	1.3	-3.6	0.2

Source: IMPACT-TRANTOOLS

Table 5.2: Modal split in passenger transport

EU25- 2020-pass-km	Air	Rail	Road
Reference scenario. Modal split	11,6%	8,0%	80,4%
Evolution of modal shares relative to reference scenario (in percentage points)			
PO2A.	0.0	0.1	-0.1
PO2B	0.0	0.1	-0.1
PO 2C	0.0	0.1	-0.1
PO2C (all)	0.2	0.4	-0.6
PO 3A	0.0	0.1	-0.1
PO 3B	0.0	0.1	-0.1

Source: IMPACT-TRANTOOLS

5.1.4. Congestion

Forecasts of congestion for most European countries assume a rise in congestion levels (see section 2). To the direct costs of suffering congestion one should add the costs of avoiding it by adding a precautionary margin to the trip start as well as the costs derived from the loss of reliability in front of clients. The "COMPETE" study on competitiveness and congestion points out that the size of reliability costs is about 10 to 20% of the value of time costs[49], but it can be much more. Charging for congestion is expected to have strong impact on traffic flows.

Congestion is mainly located in cities, in roads of densely populated areas and in some corridors on a seasonable basis. Since a few years, there have been many experiences of congestion charging in cities in Europe. In February 2003, London has imposed a

[49] Compete Final report (2006). Analysis of the Contribution of transport policies to the competitiveness of the EU economy and comparison with the United States

congestion charging. Three years later, traffic was 21% lower than before charging in 2002 and congestion was 8% lower compared to 2002[50]. Similar situation was experienced in Stockholm where traffic decreased by 23% six months after the application of a congestion charge in 2006[51].

In France, variation of motorways tolls on A1 Lille Paris according to peak and off-peak periods suggests a possible reduction of rush hours of 10% (about 2000 cars less during rush hours for 4 hours each week-end)[52].

In the Netherlands the government is preparing the introduction of a nation-wide kilometre charge for all road vehicles. Since 2005, various studies have been carried out assessing the various impacts, social costs and social benefits of various variants for this system. These studies have been based on extensive model runs with the national transport model LMS (LandelijkModel Systeem). The most important variants include a charge per kilometre which is differentiated to vehicle type, location and time of the day in order to give incentives for reducing congestion. The modelling shows that the overall congestion levels can be more than halved[53]. The net social benefits of the scheme are estimated at 1.0 to 1.6 billion Euros a year. The main benefits are from congestion reduction and are valued at 1.6 billion Euros per year (in variants with 35% congestion reduction) up to 2.3 billion Euros per year (in variants with 55% congestion reduction)[54].

All these case studies show the effectiveness of a congestion charge in reducing traffic. Moreover, congestion also leads to the reduction of other nuisances such as air pollution or CO2. According to some studies[55], vehicle fuel consumption increases approximately between 10 and 30% under heavily congestion. Reducing congestion impacts positively on time saving and fuel consumption.

Results are more limited in the current modelling exercise due to the aggregation at EU level. On average, the percentage of congested network in Europe would decrease. However, an analysis at local level is likely to proved stronger impacts in dense and/or urban areas.

Unexpectedly, the results of the modelling exercise show a higher decrease in congestion in scenario 2C. In addition, charging for passenger and freight road vehicles leads to a higher reduction of congestion. Due to important model limitations (no time differentiation, partial modelling of local traffic important on congested links), these

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50 BESTUFS II. Deliverable 2.3. October 2007. 6th framework programme for research and technological development.

51 Idem.

52 Note on Tolling Variations and Measures for optimizing use of road network in France. 2008. Ministry of transport. France.

53 Ecorys & MuConsult, 2007. Effecten vormgeving kilometer-prijs bij variabilisatie van BPM, MRB en Eurovignet. Rotterdam : Ecorys & MuConsult, 2007

54 CPB (2005). Ex ante economic assessment of various road pricing schemes. Paul Besseling, Wim Groot and Rik Lebouille. Summary executive.

55 Quoted in Transportation cost and benefit analysis – Congestion costs. Victoria Transport Policy Institute. It refers to studies that have analysed the link between congestion and fuel consumption. In particular, Greenwood I.D. and Bennett C.R., "The effects of traffic congestion on fuel consumption", Road and Transport Research, Vol 5, n°2, June 1996; Johansson O., "Optimal roald pricing: simultaneous treatment of time losses, increased fuel consumption and emissions". Transportation research, Vol 2, n° 2, June 1997.

results do not fully show the theoretical benefits expected from congestion charging. One could assume that the impacts of congestion charging are much stronger than the modelling results suggest.

Table5.3: Congestion indicator (whole road network) - 2020

Scenario	Degree of congestion network	Difference
Reference	28,62%	
PO 2A-central estimates	28,35%	**-0,27%**
PO 2B- existing fuel tax	28,39%	**-0,23%**
PO 2C	27,38%	**-1,25%**
PO 2C (all-	26,56%	**-2.06%**
PO 3A	28,43%	**-0,19%**
PO3b	28,40%	**-0,22%**

Note: differences are computed with respect to Impact1
Source: TRANSTOOLS

5.2. Economic impact of transport dynamics

The previous section has analysed the increase in charges in all modes and the impact on generalised costs and on traffic. All these evolutions have an economic impact as transport plays a central role in the exchanges of goods and services as well as in the efficiency of the economy.

The primary objective of internalisation is to improve overall economic efficiency, i.e. the use of resources, and the extent to which costs and resources coincide should be re-assessed. Improved efficiency and fairness in society was also one of the major expectations expressed in the public consultation.

In addition, the macro-economic effect should be considered as transport costs increase due to the imposed transfer of funds to the public sector resulting from the internalisation. The results of the public consultation showed some concerns about possible loss of competitiveness. It is thus important to look at the effects on the economy at large. The way in which the economy will be affected depends from the magnitude of that increase after the adaptation methods and from the way and the timing in which the recycling of funds takes place. Furthermore, a sectoral analysis of the impact on industry should be scrutinised as transport is part of the cost structure of industrial sectors. Charging freight transport might have negative effects on industry and services.

5.2.1. Impact on efficiency

Internalisation will give stronger and more beneficial impact if charges are related to cost drivers. The first best option would be to allow high differentiation of charges to reflect the variation of external costs. There are some practical limits to such implementation due to technology feasibility. Charges could not vary over time, place, route chose, driving style… However, assuming differentiation of charging according to location (urban, non urban), to vehicle characteristics and time (peak, off-peak, day, night) would

help make a direct link between charges and costs and would probably improve optimum welfare. Transport users would have the incentive to make efficient use of transport infrastructure, and then to base their decision on the right prices. Only the transport activities which were more valuable than their external costs would remain after the internalisation. Scarce road space would be allocated to the most valuable uses.

One of the shortcomings of the current modelling exercise is the inability to assess the improvement of efficiency, due to the limited differentiation allowed by the model, which is a key element in a social marginal cost pricing system. As a result, the impact of efficiency is difficult to measure, and one can rely on other experiences in this field.

ECMT research estimates[56], on the basis of 2000 data for the three biggest economies in Europe (Germany, France and the UK), that by reforming prices for inland transport and even without expanding infrastructure, net gains for society of 30 billion Euros per year could be achieved through improved efficiency. The changes in prices modelled would yield 100 billion Euros of additional revenues that could be used to cut taxes or invest in infrastructure inside the transport sector or elsewhere in the economy. The study also analysed potential welfare gains in Finland where population density and the number of cities are lower and roads are less congested. The annual welfare increase would be 300 millions euros. The largest part of the economic gains would come from reducing congestion to optimal levels on the roads (with the rest related to improved environmental performance and better use of rail and public transport). These findings show the positive role of congestion by reducing fuel consumption and time spent in transport.

5.2.2. Macroeconomic impact

Economic impacts of transport pricing depend on the type of charging and the interactions between the different sectors of the economy. For example, one can expect that congestion charges would not affect exports while all other charges imposed on long distance transport may cause significant reduction of exports if behaviour is not adapted. As a result, congestion charging tends to impact GDP less negatively than other charges[57].

In a medium term, internalisation can improve productivity as transport users may be incited to use vehicles more efficiently. This has been one of the positive results of the Swiss experience. Since Switzerland has implemented a charging scheme for HGV, productivity has increased and has compensated the short term increase in prices[58].

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56 Reforming Transport Taxes and charges, ECMT, May 2003. The gain in welfare recorded is a net gain after substracting the reduction in consumer surplus of motorists from the various elements of the welfare gain such as the increase in revenues, the reduction of travel times or the reduction in pollution and accidents, and so on. The research undertaken modelled the optimum with the replacement of all existing taxes by a new externality tax (similar to a differentiated km charge). The research suggests significant higher charges for cars, trucks and vans in urban areas and on some inter-urban routes. Price increase in peak periods can be around 100% for small petrol cars in cities such as Munich, Ile de France (compared with the prices prevailing in 2000). These increase suggests why the modelling exercise has larger effects.

57 W. Schade, C. Doll. Macroeconomic analysis of transport pricing regimes for the EU. Advanced OR and AI methods in transportation.

58 The charging scheme has been implemented with an increase of weight limitations on heavy traffic from 28 tons to 35 tons and then to 40 tons in 2005. Bundesamt für Raumentwicklung

In the current analysis, the modelling exercise using ASTRA model shows the macroeconomic impact of transport evolutions. The time horizon is 2020 and the model may not be able to capture the long term adjustment of the economy. In addition, ASTRA does not compute market equilibria and does not deliver welfare impacts.

The reference scenario assumes a favourable competitive situation of EU27 economies (see annex 10). Exports and investments are dynamic while industrial sectors display good performances. GDP, Gross value added, consumption and TFP (total factor productivity) grow by an average annual growth rate of about 2%. Against this reference scenario, the evolutions of macroeconomic variables have been assessed.

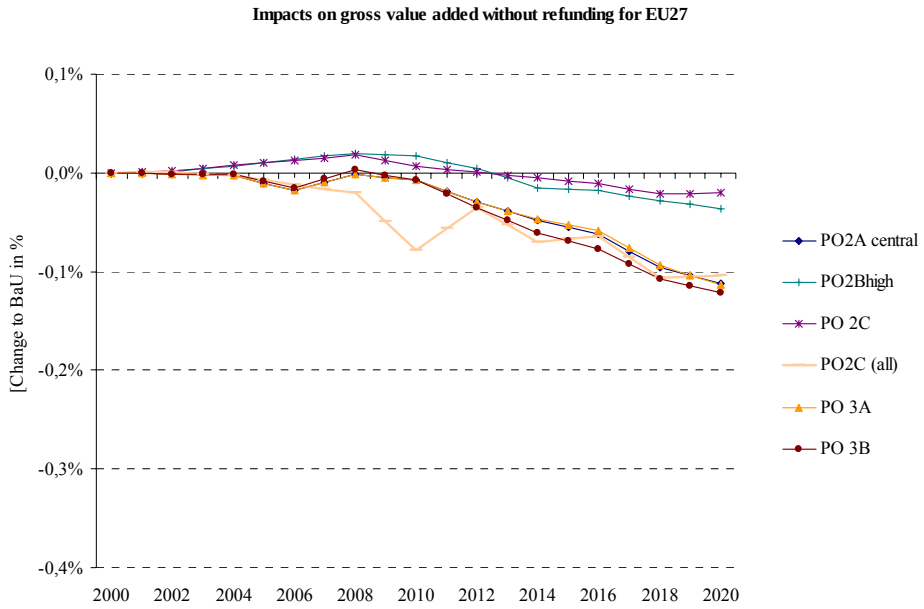
The impact of the policy options analysed is negative on the macro-economic dynamics as these policy options envisage a net increase in charges and taxes. It should also be noted that the graph below measures the changes relative to the reference scenario. Therefore, all the options assume an increase of the macro-economic variables, but at a lower pace than foreseen in the reference scenario.

The increase in transport costs leads to a negative evolution of exports and consumption (households have to face increased costs of transport). Investments and gross value added also display negative trends although investments exhibit a temporarily growth after introduction of road charges, which could be explained by an improvement of national budget leading to a decrease of interest rates which support investment activities. The evolution of total factor productivity (TFP) is negative apart in scenario 2C. Option 2C charges for congestion and environmental costs, which leads to a reduction of congestion (see table 5.3) and an improvement in freight time. Here again, the evolution of TFP is probably limited by the limitations of the model which cannot capture all positive effects. Congestion charging allows goods to flow faster, which should be reflected in the evolution of TFP.

The evolution of employment is affected by the negative trends of the economy even if in the short term, there is a temporarily growth in some policy options.

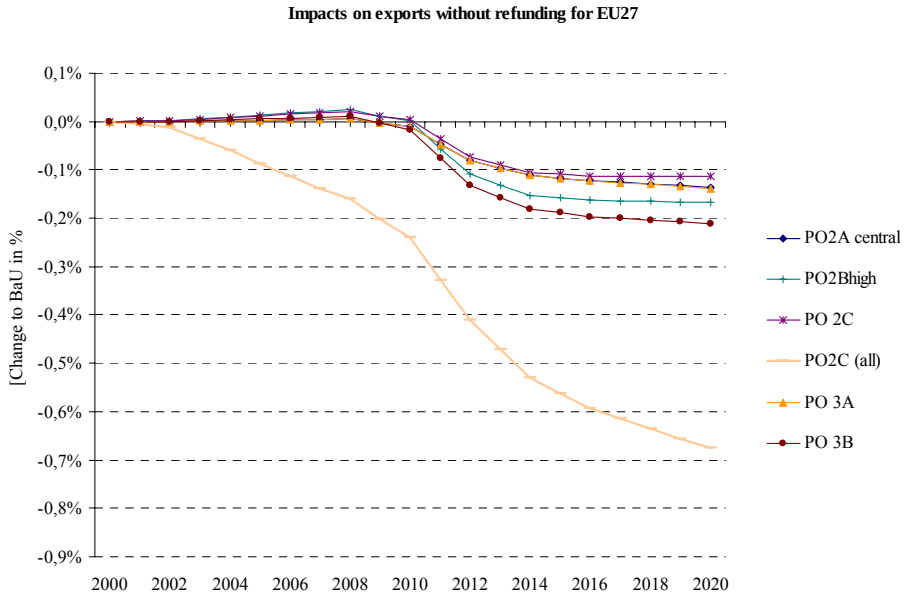
Graph 5.6: Impact on Gross value added for EU-27 (in € 2000)

ARE. Schweizerische Eidgenossenschaft. Volkswirtschaftliche Auswirkungen der LSVA mit höherer Gewichtslimite", 2007.



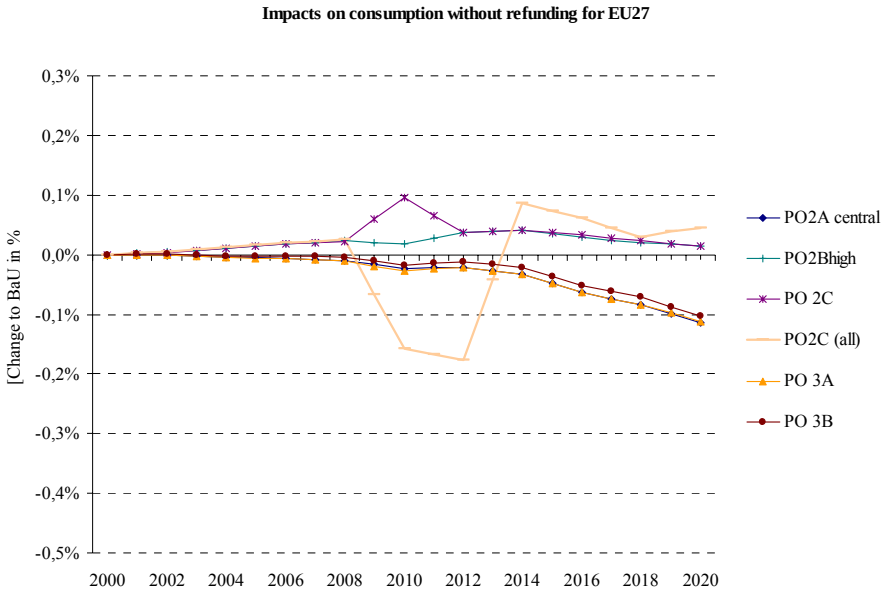
Source: IMPACT/ASTRA

Graph 5.7: Impact on exports for EU-27 (in € 2000)



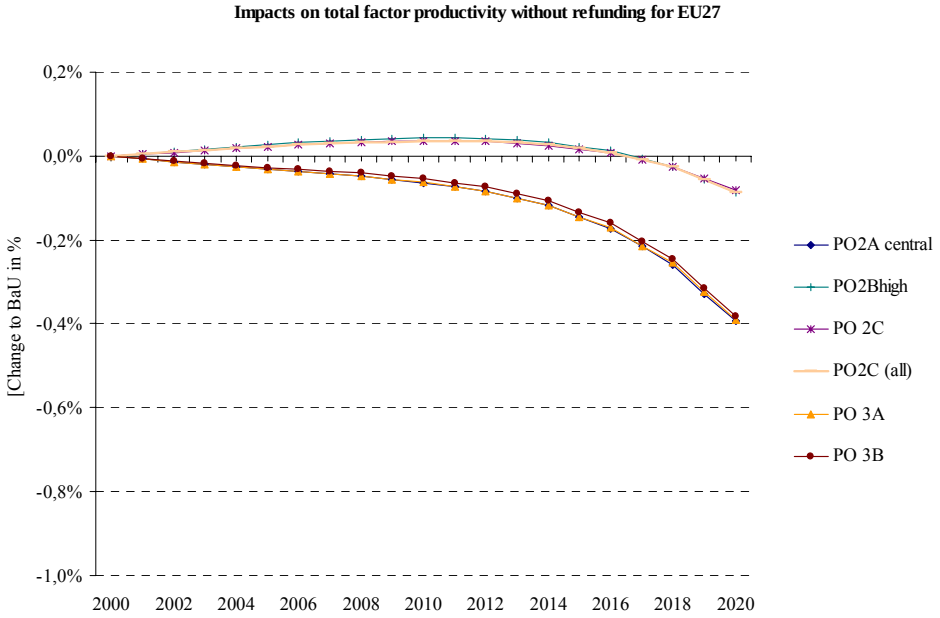
Source: IMPACT/ASTRA

Graph 5.8: Impact on consumption for EU-27 (in € 2000)



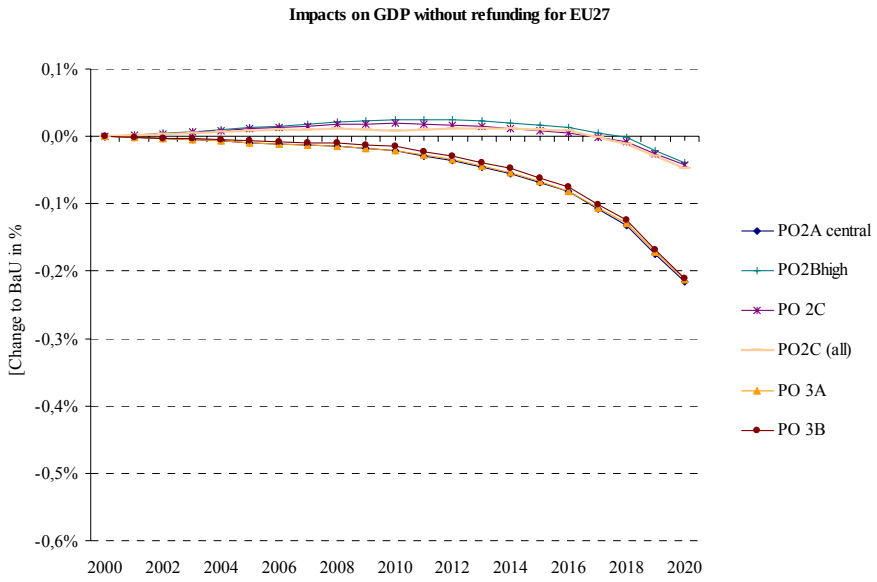
Source: IMPACT/ASTRA

Graph 5.9: Evolution of total factor productivity for EU27 (in € 2000)



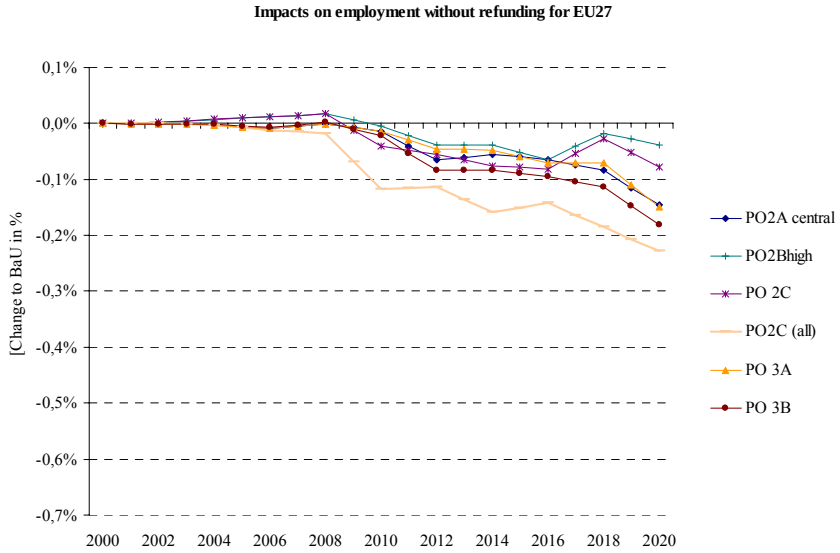
Source: IMPACT/ASTRA

Graph 5.10: Impact on GDP for EU-27 (in € 2000)



Source: IMPACT/ASTRA

Graph 5.11: Impact on employment for EU27



Source: IMPACT/ASTRA

5.2.3. Macroeconomic impact if taxes are lowered

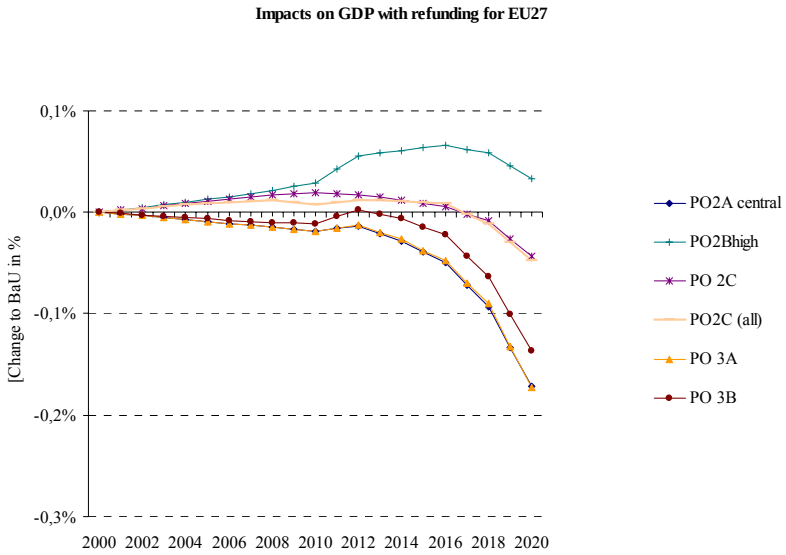
The use of revenues (i.e. the tax/charge recycling pattern) has an influence on the impact of charging. Section 5.7 will discuss about the different uses of revenues.

In the modelling exercise, all the scenarios have been modelled with the assumption that revenue goes to the general budget and is not refunded to some specific objectives. Another assumption has been made on the use of revenues to decrease other taxes (lowering direct taxes). Revenues from road charges can be fed back into the system via

refunding the revenues for direct tax reductions. In this case, the expenditures are given back to all private households balancing their total disposable income.

In this case, investment and consumption would display positive changes compared to the situation where the refunding does not take place. Refunding revenues induces positive growth of employment, investment and consumption which softens the impact on GDP (see annex 12 for other macroeconomic evolutions). In policy option 3B, refunding revenues has a positive impact on employment. The impact remains nevertheless slightly negative with respect to baseline. This is because transport activity as a whole is reduced and modelling does not take into account the positive impact on GDP of reduced externalities.

Graph 5.12: Impact on GDP for EU27 with refunding (in € 2000)



Source: IMPACT/ASTRA

5.2.4. Impact on Industry and Services

Transport is part of the cost structure of industry and may range from 1% to 9% of final product value[59].

In general, transport costs are an instrument for adaptation as firms have to adjust quickly to changing competitive situations. The incidence of transport costs on industrial sectors depends on raw material prices (transport costs matter as these products are often imported through sea transport), the overall value added, the overall production costs and the distribution network. Recent trends such as the fragmentation of the value chain that goes beyond the simple relocation of production to low cost countries show that transport has become a lower component of the overall cost of producing and distributing[60]. One expectation expressed during the public consultation was that internalisation would

[59] 9.5% for tomato versus 3.9% for auto. Energy use and Cost in freight Transport Chain. TRT Trasporti e Territorio. December 2005.

[60] Idem

increase the incentives to produce locally in Europe leading to a reduction of relocation to third countries. At this stage, the impacts are too small to trigger such effects, especially in sectors where transport costs are not the major part of the cost structure.

Based on an analysis of selected sectors – processed food, automotive, coffee and textile- the conclusion is that transport is not so critical for the competitiveness of the EU as transport modifications are rather a consequence of strategic choices. The overall incidence of transport costs on the final prices of goods on average ranges between 5 and 10% for the processed food, is under 4% for the automotive and 1-3% in the textile sectors[61].

Accordingly, the way services and goods might be affected by transport pricing is not straightforward as an increase in transport prices may not be transferred to clients.

In the modelling results, the introduction of transport charging would have a negative impact on consumption, gross value added (GVA) and employment in industrial sectors. The impact varies across sectors.

Annex 12 describes extensively the impact on consumption, gross value added and employment of industrial sectors.

5.3. Environmental impact of transport dynamics

Internalisation is a way to influence behaviour and is expected to decrease externalities. It should be noted that the model results cannot capture some major impacts that are to be expected with regard to emissions, in particular shift to cleaner vehicles within each mode. Based on the evidence from the Swiss and German charging schemes, charges that are effectively differentiated on the emission class of the vehicle will accelerate fleet renewal and will therefore deliver a significantly improved environmental performance of the vehicle fleet resulting in a substantial reduction of air pollution costs.[62]

As a result, the overall impacts on emissions that are to be expected from the various internalisation policy options are much larger than shown in the graphs below.

5.3.1. Air pollution and CO2

The evolution of external costs under the reference scenario has been described in part 2 "what happens if nothing is done". The trends display an increase of external costs, which is not linear over the years (in particular for air pollution and CO2).

CO2 emissions would increase. However, the reference scenario displays a more favourable evolution of CO2 costs (see part 2). This shows the positive impact of pipeline measures if they are to be adopted (in particular the inclusion of air transport in ETS). Air pollution projections exhibit a decrease.

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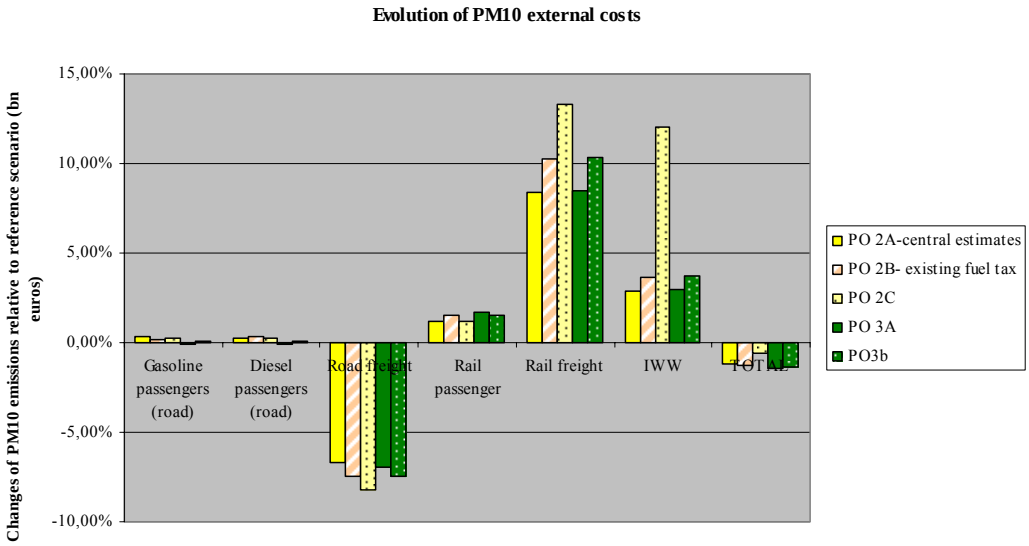
61 Idem

62 Presentations on the German case by W. Rothengatter and the Swiss case by C. Küng at Transport and Environment Conference on road pricing on 9 April 2008. http://www.transportenvironment.org/News/2008/2/9_april_2008_eurovignette_conference_road_charging/.

Internalisation of external costs is expected to decrease those external costs as transport users will have incentive to maximise their utility at the lowest costs (including external costs). According to pricing experience, a decrease in air pollution and CO2 happens when charging for these external costs. The research undertaken by ECMT shows that optimal charging would lead to a reduction of air pollution and CO2 by 54% in United Kingdom, 50% in France and 42% in Finland (see footnote 56 for the scope of the research)..

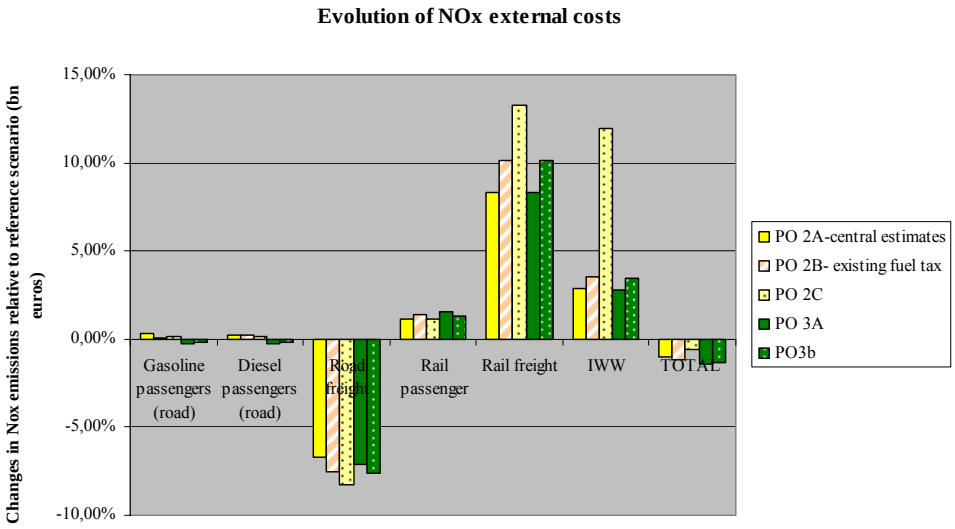
In the modelling exercise, the implementation of a charging scheme leads to a more modest reduction of air pollution costs due to the model limitations previously described. The reduction of environmental external costs is estimated at about 1 billion euros per year. Obviously, charging all modes reduces more external costs rather than charging only road transport.).

Graph 5.14: Impact on PM emissions in 2020



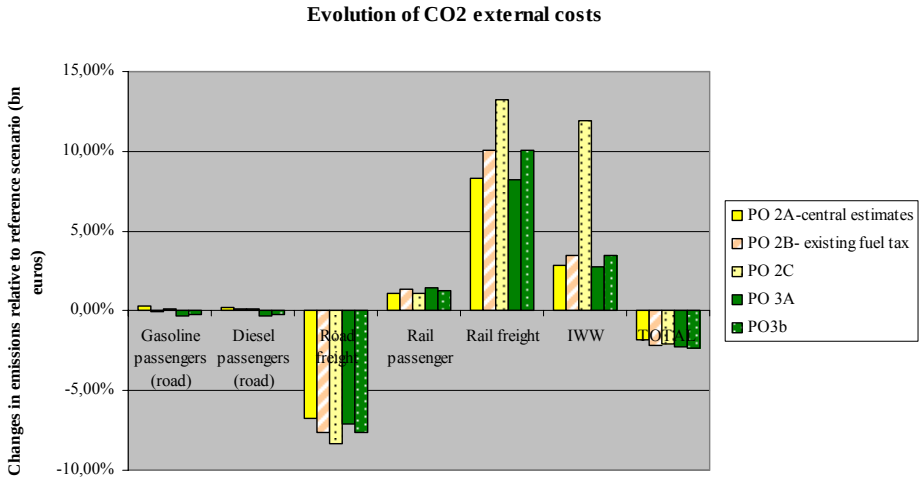
Source: IMPACT/TRANSTOOLS Modelling

Graph 5.15: Impact on Nox emissions in 2020



Source: IMPACT/TRANSTOOLS Modelling

Graph 5.16: Impact on CO2 emissions in 2020



Source: IMPACT/TRANSTOOLS Modelling

5.3.2. Noise

Charging for noise costs should lead to a reduction of exposure to noise, especially in areas with heavy traffic. The impact on noise of the alternative policy options is difficult to assess at an aggregate EU level. REFIT provides indicators on the level of exposure of people to road noise. The level of population exposed to noise varies across Europe from 3% to 9%, the average at EU25 level being 6%. The figure is quite low compared to other estimates made by the European Environmental Agency, but here it is used to assess the variation due to the impact of charging. The results show that no changes

across scenarios seem to appear when charging for external costs[63]. However, one could expect an improvement of the situation at local level when some people are particularly exposed to noise.

5.4. Social impact of transport dynamics

When charging for external costs, mobility is expected to be preserved while improving safety in transport. How the cost increases distribute among people and across regions is also important to analyse.

The analysis of social impact will have several dimensions. First, the impact on mobility should be assessed as keeping mobility is a key dimension of the EU transport policy. Second, the impact on income should be scrutinised as it gives an indication of the increase/decrease in wealth of the national economies. Third, the impact on equity needs to be analysed. The results of the consultation had shown that respondents were expecting increased equity in society. And finally, the impact on safety will be assessed.

5.4.1. Mobility of persons

Overall mobility would be slightly reduced (see graph on number of trips), but those who keep travelling have longer trips (see graph 5.5). The changes in passenger kilometres would induce relative changes in favour of railways. As a result, the impact on mobility would be modest and charging would not hamper mobility of the society as a whole.

5.4.2. Health effect

One aspect the models cannot capture is the positive effect of the reduction of external costs on health. The reduction of air pollution will have a positive impact on health, especially in dense populated areas and in alpine and other populated mountain valleys. Transport is one of the main sources of air pollution, notably for NOx (the main source), VOC and PM2.5 but also for SO2 in the case of shipping. There are, however, many other domestic (heating) and industrial sources which are also responsible of the health damages produced by air pollution[64]. Nevertheless transport measures are an important element of the EU thematic strategy on air pollution. While the main measures concern improved standards they have been so far backed by fiscal incentives, their effectiveness would be much improved by internalisation charges which are also mentioned in the thematic strategy. Increasing dieselisation and growing traffic and congestion will all raise emissions. On the other hand social vulnerability will also increase due to growing urbanisation and to the ageing of the population. Therefore transport measures in this field are urgent notably the kick adoption of cleaner standards supported by the application differentiated charges.

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63 Note that this indicator has some limits due to model limitations. Vehicle-kilometres on the motorways and main roads are extracted from TRANSTOOLS, while the vehicle kilometres on urban roads are calculated by TREMOVE. Both baselines are therefore not correlated, which may influence the reliability of the indicator. See REFIT January 2008.

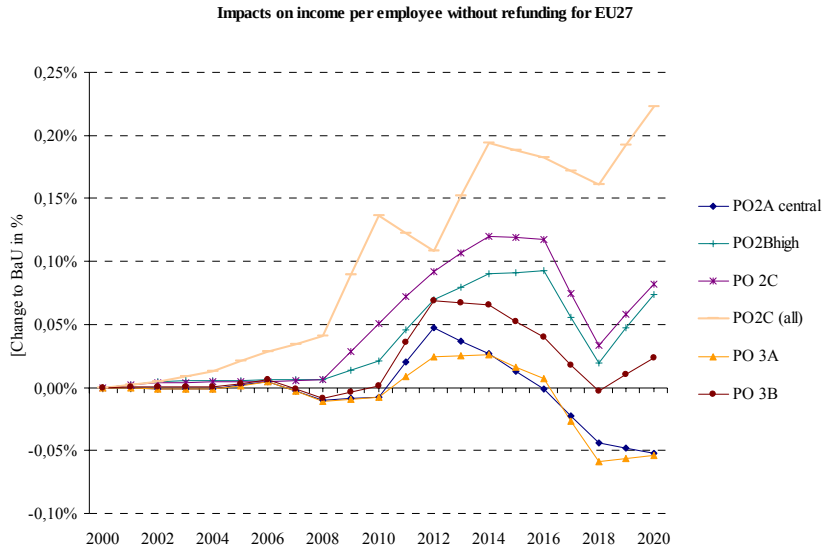
64 The effects on life expectancy of exposure to particulates were estimated at over 300 000 premature deaths equivalent in year 2000 and those associated with ozone at some 21 000 premature deaths (SEC(2005)1133 Impact Assessment of the Thematic Strategy on Air Pollution.

5.4.3. Impact on income per employees

The reference scenario assumes that disposable income for EU27 will increase in real terms until 2020 by an average annual growth rate of about 2%.

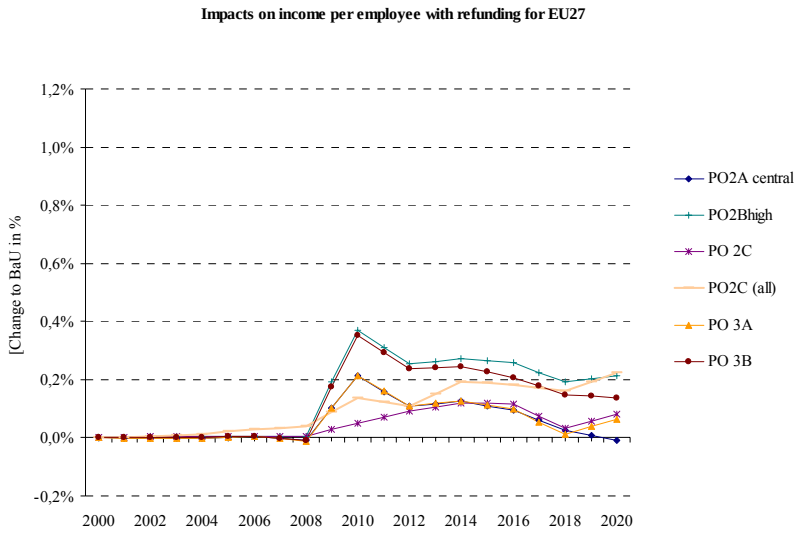
Graph 5.17 shows the evolution of income per employee in the two recycling cases (refunding and not). Obviously, the impact of different options on both is very modest. The income per employee would increase temporarily (likely due to a decrease in employment). Interestingly, the impact increases strongly if revenues are refunded to lower direct taxes.

Graph 5.17: Impacts on income per employee in the EU-27 until 2020 (without refunding) (in € 2000)



Source: IMPACT-ASTRA

Graph 5.18: Impacts on income in the EU-27 until 2020 (with refunding) (in € 2000)



Source: IMPACT-ASTRA

5.4.4. Distributional impacts

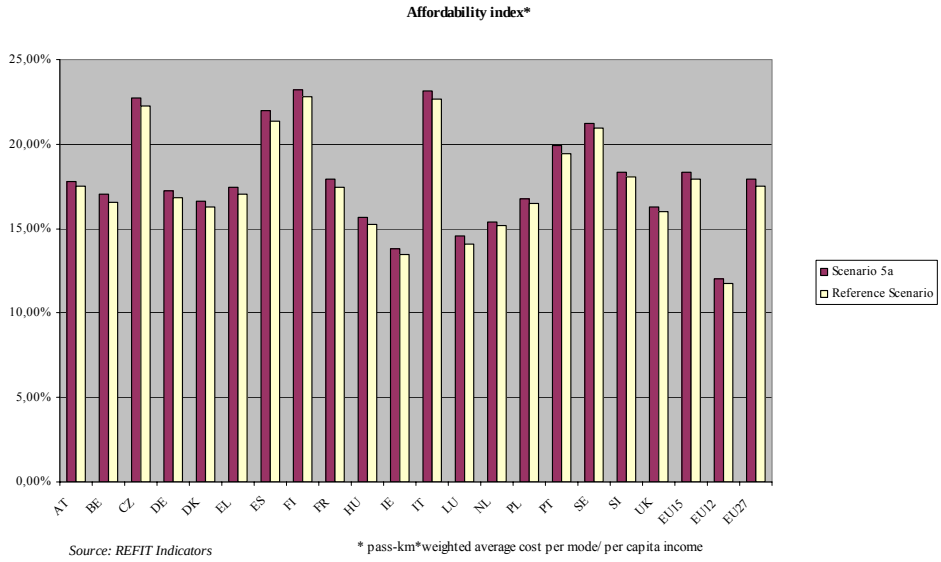
The distributional impact of the policy options can be assessed in at least two fundamentally different ways: on the one hand the REFIT calculates indicators like the Gini-coefficient or the affordability index which inform about changes in the overall income distribution. On the other side is a mainly descriptive analysis of the impacts the internalisation might have on the most vulnerable groups.

The Gini-coefficient is an indicator which comprises the whole income distribution. Because of this macro-economic perspective, it is not surprising, that results do not differ much between the different options furthermore the REFIT results for the baseline scenario still show some deviation from the figures provided by Eurostat. In so far this indicator has not been used in the current analysis.

The affordability index is defined as the fare expenditure made by household as a percentage of its income. It indicates that the share of income to be spent on mobility will slightly increase when scenario 5a of the IMPACT study will be realised[65]. Overall these changes will be minor. Still it does not cover the question how different income groups might be affected.

Graph 5.21: Affordability index

65 The REFIT indicators are based on scenario 5a of the IMPACT study described in annex 10. Compared to Policy Option 3A, scenario 5A includes accident costs and applies marginal infrastructure costs. The increase in the affordability index would be lower under policy option 3A.



From a social point of view the question whether there are groups which might be cut off from mobility and by that socially excluded is very important. In that respect most significant will be the impact of the internalisation on private cars. The proposed policy options do not charge passenger cars, except in the variant of PO2C where passenger and freight can be charged for congestion.

Beyond that, the existing charging of passenger car is not primarily oriented towards internalisation of external effects, but more towards raising revenues. In so far moving towards an internalisation strategy might coincide with a) shifts of the payments and b) with increases. The exact extent will differ among the Member States and between different types of vehicles and mobility patterns. Overall simulations show that prices in urban areas will increase more significantly than in rural areas as congestion and noise are more problematic in agglomerations. This also means that on average price increases are more likely to occur where public transport is better developed.

On average lower income people tend to use more public transport although in some countries the proportion of low income people owning a car is almost half of households. When they use public transport, they will not feel impacted by charging private cars. According to a study carried out by Gallup in 2007, the predominant profile of the owner of private car is a man, 25-39, living in a rural area and having a high level of education. Studies tend to show that low-income people are less numerous to own their car. It might be added that respondents of the public consultation have suggested that low-income people are typically more exposed to externalities, as they tend to live in areas where real estate prices are lower often due to externalities. Accordingly, they might benefit proportionally more from the reduction of externalities – an effect that is not captured in modelling.

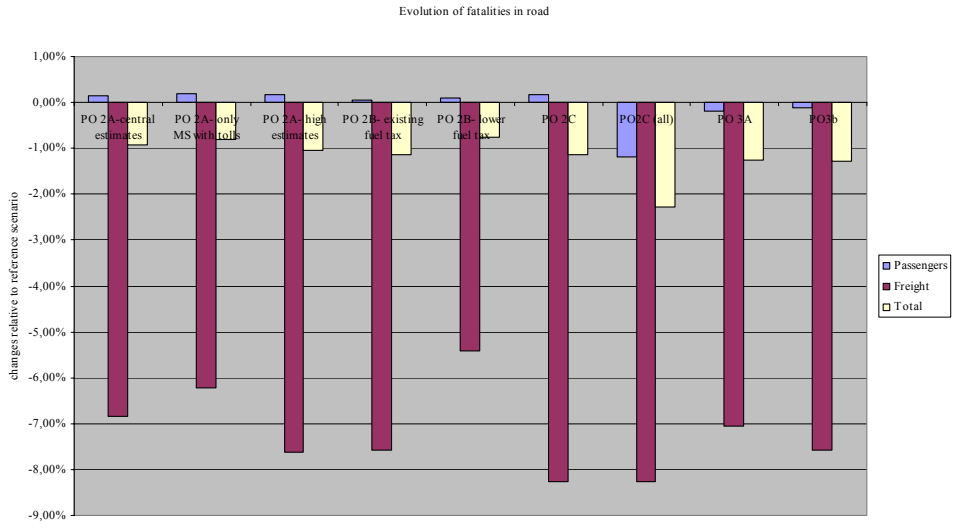
Although in most cases social inclusion will as far as foreseeable not be compromised, there might be specific situations where a full internalisation of external costs leads – without compensating efforts – to a socially undesirable situation (e.g. unduly limiting the mobility of physically handicapped, preventing low-income earners to work). In such exceptional cases which are – given the regional type of changes – better assessed on the Member States or regional level compensatory measures are to be put in place.

Finally the social impact of the internalisation will vary very much with the way the revenues are used.

5.4.5. Fatalities

The change in mobility patterns is expected to lead to a decrease in fatalities as most of accidents occur in road transport mode. Unsurprisingly, fatalities would decrease as compared to the reference scenario.

Graph 5.22: Fatalities



Source: TRANTOOLS

5.4.6. Welfare and regional impact

Internalisation should improve welfare as the reduction of external costs is expected to compensate the increase in transport costs (see section on efficiency above).

In the current modelling exercise, the positive impact of the decrease in externalities is higher than the loss of welfare due to the increase in transport costs. Table 4 in annex 13 reports the distributional effect of charging across regions and shows that congestion charging leads to higher net welfare. Welfare gains range between 800 millions and 2 billions euros.

However, the distribution of welfare is not equal across Europe and some regions might lose from it.

Obviously, the impact on regions will be different across Europe according to their geographical situation. Some regions are losing, but overall the negative impact is quite moderate across Europe. The results provided by TRANSTOOLS provide evidence of the evolution of welfare across regions in Europe. The welfare gains/losses depend on the increase in the generalised costs of transport and the change in external cost (see annex 12 for methodology).

The GRACE study on socio economic effects pricing uses the CG Europe model to analyse the welfare effect in regions. Three scenarios are analysed: (1) fuel tax for cars and flat km tax for trucks covering air pollution, congestion, accidents, noise and wear and tear, (2) fuel tax to internalise climate change and flat km tax for other external costs, (3) combination of fuel tax and km tax with differentiation by country, time, zone, road type and vehicle. The overall effect on regions is negative for all scenarios as transport prices are raised, which affects products supply (reduced product diversity) and welfare. The percentage of real income reduction is maximum -0.11% in EU27, but would need to be corrected for gains in congestion, environment and accident costs of more than 2%[66]. The gains/losses vary across regions. The most negative effects accrue to the peripheral regions (northern Sweden and Finland), Greece, southern Spain, Baltic states).

5.5. Sensitivity analysis

The analysis above has described the impact of the three broad policy options – represented in scenarios 2, 3 and 4. In order to deepen it, the variants of scenario 2 have been tested against other assumptions (described in annex 12). These different tests aim at checking:

– the EU approach to charging (binding or optional for Member States)

– the impact of having high values of external costs

– the impact of the level of fuel tax

– the impact of including passenger cars in congestion charging as congestion is caused by both cars and freight vehicles.

These variants are described in annex 10.

Variant PO2A has differentiated between optional and binding charging for air pollution and noise. Therefore, optional charging has only been modelled for some countries having already tolls. In addition, another variant tests the same charging taking high value of external costs.

Variant PO 2B has assumed two levels of fuel tax to reflect CO2 mark-up.

Variant PO2C has tested two ways of charging for congestion. The first one would charge congestion only for freight transport. The second one would extend congestion charging to passenger cars.

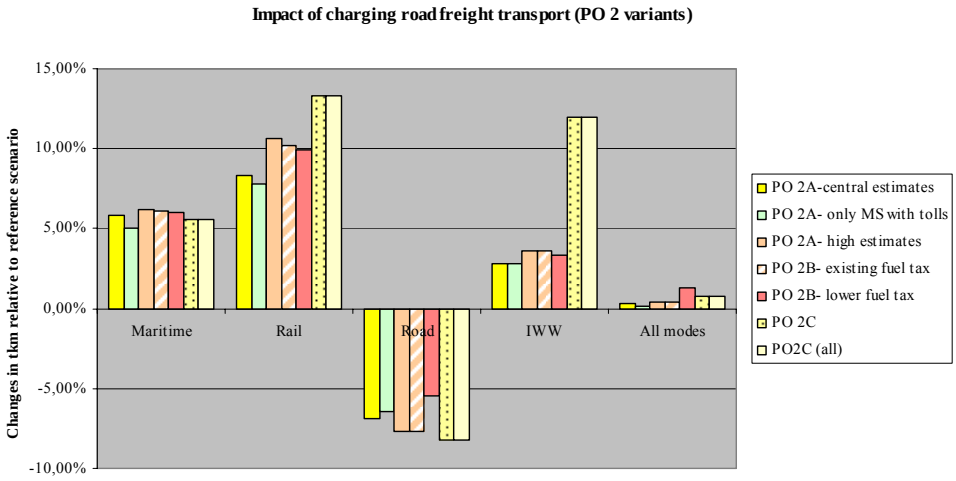
Assuming that only Member States with existing tolls charge for external costs reduces the decrease in road freight traffic. The two variants of PO2C display the strongest impact in terms of modal shift and reduction of road freight traffic. Obviously, congestion charging for passenger cars has a negative impact on their mobility.

Interestingly, the reduction of environmental costs is stronger in PO2B with existing fuel tax (-2.14% of CO2 costs, -1,29% of PM10 costs) and PO2C all (-2.84% of reduction of

[66] The socio economic impacts of transport pricing reforms. GRACE, Deliverable 9, January 2008.

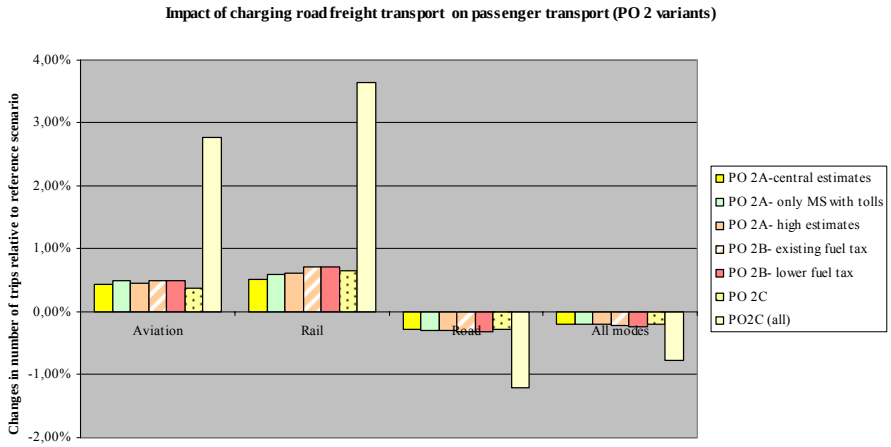
CO2 costs, -1,27% of PM10 costs). This means that charging for congestion in freight and passenger leads to the same range of reduction of environmental external costs as charging for CO2 (see annex 13 for graphs). This finding is not surprising and is consistent with empirical literature. The strong reduction of CO2 emissions in PO2C(all) is mostly due to the reduction of fuel consumption (see section 5.1.4 on congestion).

Graph 5.22: Analysis of impact on freight transport (ton km)



Source: IMPACT/TRANSTOOLS

Graph 5.23: Analysis of impact on passenger transport (passenger-km)



Source: IMPACT/TRANSTOOLS

All the variants induce a reduction of congestion except scenario 2B with a lowering of fuel tax. The reduction of congestion with optional charging is almost zero (-0.04%) compared to the other variants (see annex 12 table 2).

5.6. Implementation Costs

Implementing a charging system would lead to implementation costs. Obviously, most of the costs would arise in road transport.

5.6.1. Implementing charging in road transport based on a GPS based technology

Road freight transport

In scenario 2, no kilometre charging is introduced for passenger cars, but only for HGV (on all roads). Such a wide geographic scope for HGV km-charging would be more efficient if carried out through a GPS based technology, and for that reason the implementation costs of such a system will be estimated with the help of the cost figures found for the HGV charging in Germany. Based on these figures the investment costs of HGV km-charging on all roads in the EU-29 would be equal to 5 billion euros, and the operational costs would be 4 billion euros. The GPS based technology installed in lorries can also be used for other road freight regulatory (e.g. tachograph) or commercial (fleet management) applications.

Extending the system to passenger cars

To estimate the implementation costs for passenger cars of applying congestion charging in Europe the costs per user found by Ministry of Transport of Germany (2005) are multiplied by the total number of passenger cars in Europe. In this way the implementation costs are probably overestimated, because not all European passenger cars are confronted with bottleneck charges. Therefore, if it is assumed that 50% all European passenger cars are confronted with congestion charges, the implementation costs of the congestion charging for passenger cars would be around 8 billion euros (investments) and 5 billion euros (operational costs).

Table 5.4: implementation costs in road transport

Mode	Internalisation measure	Investment costs (billion €)	Operating costs (billion €)
Road	Kilometre charges for HGVs, bottleneck charges for all vehicles	5 8	4 5

Source: IMPACT

Overview of costs as % of revenues from tolls according to policy options

Taking the revenues from tolls from different policy options, operational costs would vary from 12 to 25% of revenues in EU25.

Table 5.5: Operational costs as percentage of revenues from tolls – Road transport

2020	Revenues from road tolls in bn €	Operational costs as % of revenues from tolls
Reference Scenario	3,6	
PO 2A	15,7	31,81%

PO2A only MS	14,1	20.53%
PO 2B	24,4	20,51%
PO 2C	27,4	18,24%
PO 2C (all)	35,6	25,30%
PO 3A	15,7	31,85%
PO 3B	24,4	20,49%

Source: TRANSTOOLS and IMPACT study.

Obviously, the estimates of implementation costs are high and do not consider existing schemes (especially for PO2A with only Member States). In some countries such as Germany, Austria or Czech Republic, an electronic system is already in place and operational costs range between 15 and 20% of revenues. Accordingly, the estimates provided above might be lower in some Member States.

At the same time there are uncertainties on the cost-effectiveness of the charging systems in Member States with low traffic densities. Given the technological complexity and the level of implementation costs involved, it would be reasonable to start the rollout of any new charging technology with pilot projects that allow experience a gradual build-up of experience in both system implementation and operation

5.6.2. Implementing charging in other modes of transport

In comparison, implementation costs in other modes would be lower as they would not require additional investment.

Table 5.6: implementation costs per transport mode

Mode	Internalisation measure	Investment costs	Operating costs
Rail	Mark-up on existing infrastructure charges, increased fuel duty, ETS	Low	Low
Aviation	LTO charges	Low	Low
Inland shipping	Kilometre charge	Low	Low
Maritime shipping	Harbour charges, ETS	pm	Pm

Source: IMPACT

5.7. Impact of the use of revenues: earmarking to transport

Charging transport users for the negative consequences on others in society of their transport decisions leads to revenues. The issue of the recycling of these revenues must be considered in the appraisal of internalisation strategies: firstly, the overall net welfare effects of internalisation and their distribution over various groups in society depend considerably on the destination of the revenues; secondly, as already discussed in section 2.3.4, the revenues can be used to enhance simultaneously the user acceptability and effectiveness of the internalisation scheme, namely through helping making available suitable transport alternatives. Moreover, the decisions on how to spend the revenues may affect the political acceptability of internalisation.

5.7.1. How to use revenues from internalisation?

The revenues of internalisation can get the following destinations:

- Government debt reduction.

Member States are often recommended to reduce their government debt so as to arrive at more sustainable public finances[67]. Paying off government debt relieves pressure on the annual government budget arising from the interest payments on outstanding debt, and hence allows for reduction of the deficit in all future years or for more productive use of government spending. In the short term government debt reduction has a deflationary impact on the economy as the revenues are taken out of effective demand (more precisely said, the former holders of the government bonds are generally less likely to spend than the charged transport users or the government would).

However three countervailing effects should outweigh this negative demand effect on the medium and long term. Firstly, public finances become more sustainable allowing for more productive government spending. Secondly, the reduction of government debt exerts a downward pressure on the interest rate on national capital markets (depending on the share of government debt service and roll-over on these markets). Thirdly, the private sector faces less the prospect of future tax increases needed to finance and pay off the government debt. The second and third effect together will lead to more private investments and durable consumption.

The net outcome has been estimated through model calculations (see section 5.2 for results and box 6 for model limitations).

- Reduction of taxation, specifically wage taxation

The revenues of the internalisation charges can be used as an alternative way to finance government spending as compared to the taxes already in place. This option would leave government deficit (or surplus) and government spending (both total amount and destinations) unaltered. It allows for lower taxes elsewhere.

The most logical way to recycle the internalisation revenues is through a wage tax reduction, both on equity and efficiency grounds. The equity argument is that the wage tax is a broad tax (i.e. paid by many in society as opposed to other income taxes, wealth, profit or capital (gains) taxation). It could thus be seen as giving the revenues back to society in general[68]. However, it excludes the possibilities to further reduce the externalities and to help transport service providers and transport users more concretely to adapt to the internalisation charges.

- General increase of government spending

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67 See for instance the Broad Economic Policy Guidelines which are drafted by the Commission and subsequently approved by Council.

68 However, the literature on Pigovian taxes points out that compensating the "victims" lessens their incentives to avoid the externalities and hence undermines the rationale for internalisation. Only a lump sum transfer unrelated to the actual damage would avoid doing so, but such a transfer is unattractive from the equity perspective,

The additional revenues for the government can be used as well to increase government spending. This option assumes this will happen without any "earmarking", i.e. set-asides or reservation for specific purposes. Hence the new spending items would be selected through the standard budget selection procedure. The advantage is that this enhances the likelihood that out of all the candidate items those will be selected that offer the prospects to further enhance social welfare. However, it should be pointed out that this option amounts to an overall general tax increase which has disadvantages from both equity and efficiency perspective.

- Financing of existing transport infrastructure

The revenues from the internalisation charge can be used to recoup the costs of existing transport infrastructure. This would help to shift some of these costs from the tax payers to the actual users of the infrastructure. However, this option has serious disadvantages as there is no clear relation between the environmental cost revenues and the infrastructure costs and it finances those pieces of transport infrastructure that enable the occurrence of the externalities; moreover it makes the introduction of more efficient infrastructure financing in the future less necessary. These three disadvantages do not apply for congestion charges which represent a payment for scarce infrastructure capacity. Under the current Eurovignette regime this option is the only available as the tolls on motorways are allowed to be differentiated according to environmental damage and congestion as long as the infrastructure cost recovery condition is respected. However, because there is no reason why the internalisation revenues should be lower or equal to the infrastructure costs, it is doubtful whether the allowed variation within the toll schemes allows for adequate internalisation charges.

- Compensating charged transport users

Sluicing the money back to the charged transport users (individually or as group) would have as advantage that the burden to this group would not go up. The polluter pays principle would take into account the existing taxation burden. A restructuring of the taxation could be made in order to give the right incentive.

- Compensating externality victims

Direct compensation could be envisaged in case a selected group of individuals affected could be identified. However, in many cases, the nature of the externality renders it difficult to identify exactly the individual affected.

- Spending on mitigating measures

This type of "earmarking" aims to use the revenues to reduce the transport externalities through collective actions. It has the advantage of enhancing both user and political acceptability as it helps both the transport users and the "victims" of transport externalities. It will thus generally been seen as being equitable as well.

Mitigating measures do not affect the proper incentives for transport users as long as they keep on being properly charged for the actual marginal external costs. This implies among other things that if the mitigating measures reduce an externality the internalisation charge should be adapted so as to reflect the new marginal external costs.

- Financing transport alternatives and promoting interoperability

This type of "earmarking" aims to use the revenues to promote transport alternatives to the charged transport users. This may vary from providing different routes for the same transport mode, other transport modes, promoting interoperability (i.e. the use of more than one transport mode for the travel), and innovative efforts to reduce the externalities of the transport in question (for instance to enhance the fuel economy of engines). It may also include efforts to help transport users to learn how to "cope" with differentiated charges.

The potential significant advantage of this option is that it boosts the efficiency of the transport system (in case of congestion) and helps to reduce the magnitude of the externalities.

In conclusion, except for option related to the direct compensation of charged transport users, all options have their rationale, strong points and risks. Depending on the specific circumstances and the local social and political preferences, they may be on their own or combined the best way forward. Hence, the final choice on how to spend the revenues should be left is to the governments receiving the revenues of internalisation.

5.7.2. Rationale for earmarking:

Political acceptability

For analytical purposes it is assumed in this appraisal that the governments involved will use these revenues in ways which is socially optimal. This is likely to include "earmarking" parts of there revenues to mitigating measures and to (innovative) transport alternatives[69], because - as the discussion above has demonstrated - these options tackle the root of the problem of the externalities and so complement the incentives to transport users provided by the internalisation charge; because they are equitable towards the "victims" and because they boost user and political acceptability.

Some of the main arguments for earmarking internalisation revenues to transport investments come from the international aspects of transport and the fact that different political jurisdictions are involved which should not necessarily trust each other. Efficient charges will tend to benefit more countries at the centre where traffic including transit one is heavier than at the periphery. If the proceeds from internalisation are used to reduce labour taxes in the central or transit countries, their employment and GDP will grow while their environmental conditions will improve. However, this kind of double dividend effect would only be reaped by the countries where transport took mostly place.

As a result of internalisation the accessibility costs of peripheral countries would increase, even if they would benefit from congestion reductions in the transit countries, which could damage the Union's cohesion objective. These Member States could require some kind of compensation as their welfare would be likely to suffer from the change in respect of the current situation where external costs of use were not taxed. Although this

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[69] This is line with the policy recommendations from the researcher of the GRACE project (Nash and Matthews, ITS, University Leeds): "smart use of the revenues is as important as the design of the pricing reform."

would be a logical way to defend their national interest, from an overall EU perspective it can be asked what could be their rationale for asking such compensation.

It is important to realize that "earmarking" is just a possible instrument for an objective which is providing compensation to the party that is damaged by the change in the law. This compensation could be interpreted as a part of a cohesion objective, as cohesion could suffer the effects of the new internalisation rules. But it can also be legitimate from an efficiency point of view, as argued below.

International traffic, adequate infrastructure and Community interest

The use of the revenues from charging externalities should take into account the advantages for the community of international traffic. In the case of road transport, the share of EU27 international in total road freight traffic is 27%. However, in seven Member States, it is higher than 50% with a peak of 84% in Estonia and 77% in Luxembourg. Given the increase in international road traffic, the EU27 share is expected to reach 33% with a peak of 90% in Estonia.

In the absence of earmarking, Member States would tend to maximise their national welfare without taking full account of the benefits of sustainable mobility at Community level.

From the polluter pays point of view, it would be clear that when the peripheral country trucks use the central country infrastructure they will have to pay for the external costs they produce, once efficient pricing for the use of the infrastructure is applied.

However, peripheral Member States could be entitled to request from an efficiency point of view that the central countries apply a policy of infrastructure provision which lives up to the efficiency and environmental objectives sought through the new pricing for infrastructure use policy.

In fact the infrastructure policy of the central state carries also a "polluter" responsibility because the user-polluter can only choose among the existing infrastructure options provided by the Member State where transport takes place. A truck driver may be obliged to use the streets of a town because there are no by-passes; a transport firm may be obliged to use road transport because rail services offer poor quality. This would amount to acknowledging that transport is a joint product between the infrastructure and the vehicle. Although in the short term it is the vehicle which triggers the externality and should pay for it, in the longer term the responsibility for the provision of the right infrastructure corresponds to the state.

Thus, peripheral states could feel entitled to request as compensation for increase user costs, that the infrastructure situation is improved, so that external cost payments are not larger that what reasonable practice in infrastructure provision would require. The extreme case is the one in which the central country is deliberately keeping bottlenecks as a way to collect revenues.

Therefore, peripheral Member States could ask for some kind of assurance that the effort their transport firms pay as users will be matched by the effort of central Member States as reasonable infrastructure providers. A way to ensure a perfect match is through

earmarking, but other kind of more political assurances could be provided, which could be monitored by the EU.

Maximising welfare

Doubts have been expressed[70] that budgetary allocation procedures would always be responsive to welfare maximising objectives as decisions could be biased in favour of particular political interests. This fear of abuses would be more relevant in a system with various levels of government (European, national, regional). In this situation earmarking could be superior to normal budgetary decision-making precisely because it would reduce the margin for political choice and guarantee the provision of a specific good or service – unless funds from other sources are reduced in an offsetting way. Apart from this, in case infrastructure has to be financed, it is a superior alternative to do it through earmarking of funds from marginal cost congestion charging than through levying new taxes, as the disutility from transport charges will be lower for transport users than that of taxes for the general taxpayer. Earmarking may require the creation of a fund to allow choices of best investment opportunities, to adopt a network approach instead of a link by link one, and also to minimise administrative and financial costs.

5.8. The need to provide an EU framework

Given the role of transport in the internal market and the importance of international transport for the trade between Member States, an EU framework is needed to ensure the respect of basic principles like non-discrimination between users and proportionality of the charges. The possible traffic detours from one Member State to another in case of uncoordinated tolling also plead for coordination mechanisms between Member States. Various measures can be envisaged ranging from simple a posteriori controls leaving a great flexibility to Member States when setting and collecting the charges to more precise EU rules ensuring transparency and accountability.

The absence of such rules could also result in some cases in overcharging international transport, which in turn may impact negatively the mobility within the internal market. Overcharging may also have negative impacts at local level. First experiences of tolled motorways in Hungary in the 90' have for instance failed because of charges set at a level beyond the capacity to pay of users. The modelling results in Annex 12 gives some indication of the impact of charging external costs on the basis of high estimates (variant of Policy option 2). It has to be taken into account that Member states are already allowed to charge tolls that make the full recovery of infrastructure costs possible, which can have a significant effect on the operating costs of transport users.

Moreover the approach taken in Directive 1999/62/EC as far as the recovery of infrastructure costs is concerned was to set such types of EU rules ensuring transparency and accountability. Modifying the Directive to enable external cost charging without

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[70] "The economics of Earmarked taxes" James Buchanan Journal of Political Economy 1963, vol 71. The REVENUE project on the use of revenues from transport pricing (5th Framework Programme) provides a further discussion of these and other arguments on earmarking, as well as an overview of the different cases of earmarking in Europe. See deliverable 6 (pages 37 and 61) in: http://www.revenue-eu.org/deliverables.htm

similar rules would constitute a radical change which would go beyond the request of the EU co-legislator.

5.9. Administrative costs

Administrative costs have been assessed in road freight transport as a revision of the Eurovignette directive is proposed. Administrative costs would be related to the implementation of the revised Directive 1999/62/EC and would concern national administration and the need to enforce this directive. It should not entail administrative costs to companies.

Table 2 in annex 14 gives indications of administrative costs for Germany (data available). Assuming that 10 Member States will decide to apply an external cost charge, administrative costs related to enforcement and reporting would amount to 11 500 euros per year (on the basis of German labour costs). Costs related to the setting of an authority to estimate the charges would lead to extra costs of 137000 euros (on the basis of German labour costs).

6. COMPARISONS OF POLICY OPTIONS

The analysis of impact described above has relied on quantitative results and qualitative analysis. The comparison of scenarios should allow identifying the policy option of internalisation which could better contribute to achieving the general objective of sustainable transport. It should also lead to a selection of policy options implementing the operational objective, i.e. proposing a strategy of internalisation of external costs for all modes of transport and allowing the revision of Directive 1999/62/EC.

6.1. Comparing Policy options

Which policy options ensure sustainable mobility?

As mentioned above, internalisation helps providing a correct price signal to the transport users. Improved social efficiency is expected to modify behaviours and hopefully to decrease externalities. This impact assessment has also established the limits to assess correctly social efficiency and the extent to which the level of internalisation is efficient.

The comparison of options looks at several criteria based on mobility, competitiveness, environment and social cohesion. First, as stressed in the White Paper of 2001 and its mid term review in 2006, mobility should be maintained in order to ensure the circulation of goods and persons. Second, sustainability is crucial when promoting mobility. Therefore, the decrease of environmental nuisances will be another important aspect of the comparison. Third, sustainable mobility should be consistent with the objectives set by the Lisbon agenda which is to promote the competitiveness of EU economies. As a result, economic impacts of internalisation should be taken into account. Fourth, internalisation should not threaten social cohesion. Finally, implementation costs of a charging system should not burden too much. Otherwise, they would water down the benefits of the exercise.

These elements should be reflected in the different patterns of mobility which in turn influences the decrease in external costs. Welfare should be improved as long as the

reduction of external costs compensates the increase in transport costs. This positive circle should affect positively competitiveness in a longer term.

From the comparison of options, some trends can be identified.

In all policy options, internalisation of external costs does not hamper mobility in Europe although charging modifies the choice of transport users and influences modal split. However, it appears that charging for congestion in road transport leads to more positive effects as it contributes to saving time while decreasing fuel consumption and environmental nuisances. As congestion is mainly concentrated in road transport, the positive effects are largely captured when charging congestion in road transport only and not in other modes. The economic impact of internalisation of external costs is negative in the short term as the increase in transport costs overbalances the other effects. On the whole, one could think that the reduction of external costs – congestion, environmental costs, and the reduction of fatalities will improve the overall competitiveness of Europe as these costs are currently borne by the European society at large. Moreover, charging for congestion induces savings in time which will be translated in productivity gains for business.

Table 6.1: Comparison of policy options based on selected criteria: Revising the Eurovignette Directive

	PO 2A **Charging for Air pollution and noise in road freight transport**	**PO2B** **Charging for Air pollution, noise and CO2 in road freight transport**	**PO2C** **Charging for Air pollution, noise and congestion in road freight transport**
Mobility	Mobility is maintained in freight and passenger transport: + 0.33% The sensitivity analysis has shown that impacts are reduced if only some Member States charge (freight mobility increases by +0.09%).	Mobility is maintained in freight and passenger transport: +0.38%	Mobility has the stronger increase as modal shift is higher in this scenario. +0.77% in freight. Congestion charging for passenger and freight induces a decrease in passenger traffic (-0.42%).
Congestion	Low impact	Low impact	Congestion charge reduces congestion. Charging for all transport users (passenger and freight) strengthens the positive impacts.
Sustainability	Reduction of air pollution (-1.17%) and co2 costs (-1.81%).	In this scenario, the reduction of CO2 is comparatively higher as a CO2 charge is applied (-2.14%). Air pollution costs	Congestion charges have positive effects on the reduction of air pollution (-0.76%) and CO2 (-2.09% and -2.84% if passenger

		decrease by -1.33%.	and freight are charged for congestion). Interestingly, the impacts are similar to applying a CO2 charge.
Competitiveness	In the short run, the impact on GDP is negative (-0.2%) as transport costs have increased.	In the short run, the impact on GDP (-0.03%) is slightly negative as transport costs have increased.	Charging for congestion increases time savings which may have positive impact on efficiency. The reduction of GDP is slightly (-0.04%)
Employment	Almost no effect (-0.14%)	Negative effects (-0.02%)	Negative effects (-0.04%)
Equity	No impact	No impact	This policy option would have impact on equity as passenger would be charged. However, the example of London shows that improving alternatives may have also positive impacts.
Fatalities	The reduction of road traffic induces a decrease in fatalities (-0.8%).	Decrease in fatalities (-1.07%)	Congestion charges induce a higher modal shift. As a result, the reduction of fatalities would be higher (-1.06%).
Welfare	Net welfare gains (+0.8 bn euros, 2020)	Net welfare gains (+0.8 bn euros, 2020)	Net welfare gains (+1.8 bn euros, 2020).
Implementation costs	High. However, if some Member States having already toll system to implement such charging, implementation costs would be lower.	High.	Lower as revenues from congestion would be higher. However, charging for passenger will increase costs.
Public acceptability	Environment is seen as an importance nuisance.	Environment is seen as an importance nuisance.	Congestion is seen as an importance nuisance in road transport. The results of the consultation show strong support to charging congestion for passenger and freight. (44.8% for all respondents, of

			which 64.2% are citizens and 35.7% are organisations)
EU value added	Current restrictions to internalisation have to be raised. Internal market freedoms require coordinated approach.	Current restrictions to internalisation have to be raised. Internal market freedoms require coordinated approach.	Current restrictions to internalisation have to be raised. Internal market freedoms require coordinated approach.
Technical feasibility	Learning period required for some countries and interoperability issues.	Learning period required for some countries and interoperability issues.	Learning period required for some countries and interoperability issues. Implementation more difficult if passenger charging is foreseen.
Regulatory feasibility	Proposal to revise Directive 1999/62/EC	Proposal to revise Directive 1999/62/EC	Proposal to revise Directive 1999/62/EC

* % corresponds to % of change in 2020 relative to reference scenario.

From the quantitative and qualitative analysis, the option including congestion charges seems to offer the best results. First, the reduction of time spent induces positive effects in the economy as transport goods flow more easily. Second, congestion charging induces strong reduction of external costs. Freer flows impact on fuel consumption, which in turn induces less CO2 emissions. For these reasons, welfare effects are higher in this scenario.

As regards the other modes of transport, policy options 3A and 3B show the positive impact of including all modes of transport. The difference between 3A and 3B comes from the application or not of a CO2 mark-up in road freight transport. As a result, the decrease in CO2 and air pollution is stronger when road freight transport is charged for CO2. However, the comparisons of all variants of PO2 (charging in road freight transport) has shown that congestion charging had roughly the same magnitude of impact on environment and was contributing to improving overall efficiency.

Policy option 3 shows that when charging all modes of transport, mobility is maintained while environmental emissions and fatalities decrease. Congestion is not analysed, therefore all the positive impacts due to congestion charging are not provided in this case. From an acceptability point of view, the public consultation has shown strong support to charge for all modes of transport. However, the international dimension of maritime and air transport needs to be considered when implementing an internalisation strategy.

Table 6.2: Comparison of policy options based on selected criteria: Strategy to internalise external costs in all modes of transport

	PO3A **Charging for air pollution, noise and CO2 in non road transport. Charging for air pollution and noise in road transport**	**PO3B** **Charging for air pollution, noise and CO2 in all modes.**
Sustainability	Reduction of air pollution costs (-	Reduction of air pollution costs (-

	1.5%) and CO2 costs (-2.2%).	1.5%). The reduction of CO2 (-2.3%) is comparatively higher as a CO2 charge is applied in road transport.
Mobility	Mobility is maintained in freight (+0.3%) and passenger (+0.1).	
Competitiveness	In the short run, the impact on GDP (-0.2%) is negative as transport costs have increased.	
Employment	Negative effects (-0.14%)	
Equity	No impact	
Fatalities	Reduction of fatalities (-1.2%)	
Welfare	Net welfare gain (+0.8 bn euros in 2020 for 3A, 0.9 bn euros in 2020 for 3B)	
Implementation costs	High.	
Public acceptability	High as all modes of transport would be treated on the same ground.	
EU value added	Need of a coordinated approach.	
Regulatory feasibility	Need to take into account the international regulatory framework for air transport and maritime.	

Preferred options: Strategy to internalise external costs in all modes

For reason of fairness, all modes of transport should be concerned by internalisation. However, given the international framework of maritime, aviation and inland waterways, the strategy will be developed in a longer term perspective.

The comparison of scenarios gives some indication of the preferred policy option. Option 3 covers other modes and would involve internalising air pollution, noise and CO2 in the other modes. Enlarging internalisation to other modes of transport improves overall sustainability.

On this basis, a work programme would be elaborated, taking into consideration the convenience of charging for external costs (air pollution, noise, CO2) in other modes of transport.

In railways directive, this impact assessment has already mentioned that charging external costs was already foreseen in the existing EU legislation (Directive 2001/14/EC).

In air transport, the inclusion in ETS is an important step to fight against CO2 emissions. Ongoing work on the reduction of Nox emissions would give the opportunity to analyse pricing mechanism in this context.

In maritime, the growth of CO2 and air pollutants emissions shows the need to have actions in this field. Given the international framework for maritime, a solution such as ETS could be one of the outcomes of the analysis.

Finally, reflection will also be carried out in inland waterways, taking into account that many of them have their specific regulatory environment, e.g, the Mannheim Convention.

Preferred options: Revision of Directive 1999/62/EC in June 2008

As mentioned above, road freight transport contributes to a large share of external costs. Internalising these costs, which requires a modification of Directive 1999/62/EC is therefore an essential component of the broader strategy to internalise external costs in all modes of transport.

Tackling road freight transport external costs is not the first step of this broader strategy since a proposal has already been made for inclusion of aviation in ETS. The revision of Directive 1999/62/EC provide further opportunities to internalise external costs in rail transport.

Acting in road transport while other policy initiatives in other modes are being developed would not negatively affect the trend in externalities, since it would be consistent with higher relative charging of the mode with larger externalities.

In this framework of analysis, the policy options corresponding to 2C seem to offer the best combination in terms of mobility and sustainability. Differentiated charging scheme based on the costs of air pollution and noise allows taking into account local environmental externalities. Integrating into such schemes a congestion charge produces time savings which lead to a positive impact on the economy at large. Congestion charging is more efficient if passenger and freight transport are concerned as both compete for the same infrastructure. This element is supported by the result of the public consultation which gave support to an option "charging for freight and passenger cars". In addition, the reduction of travel time also contributes to reducing CO2 emissions. Interestingly, charging for freight and passenger cars leads to a reduction of environmental costs similar to policy options that include a specific CO2 mark-up.

The analysis has assumed that all Member States are charging. However, the benefits and drawbacks of a mandatory versus and optional/empowering approach have been considered together with the link to subsidiarity issues. A number of considerations suggest considering first an empowering approach:

- There may still be uncertainties related to the costs, benefits and the enforcement of the required tolling systems on the networks of some Member States with lower traffic hence with low levels of externalities.

- A binding approach based on a mandatory charge would constitute a radical change compared with the current Directive and could hardly be envisaged without a transitional period.

- Member States have traditionally followed differing approaches regarding infrastructure charging and consequently have different levels of experience with the tolling technology involved. Interoperability issues are not yet solved.

- A flexible and gradual phasing in approach would allow the new charging schemes and tolling technology to be trialled in Member States where the geographical conditions are the most appropriate.

- The actual implementation and operational experience gathered in the early adopter Member States would allow at a later stage to carry out a thorough stocktaking. A joint assessment of the pros and cons of making external cost charging mandatory for all Member States and the required degree of EU co-ordination can be reassessed then.

Member States which experience an increase of traffic diverted from charging neighbouring countries would have an incentive to start charging for external costs. This incentive could also exist under the current Directive 1999/62/EC.

Such a policy option, based on an enabling approach, would entail the revision of Directive 1999/62/EC as a first step of the strategy of internalisation. The main modifications would be: to authorize the calculation of road charges on the basis of the external costs, namely air pollution, noise and congestion and to differentiate the charges accordingly. Such charging schemes would be subject to a number of conditions to improve their efficiency and their chance of success like the use of electronic free flow tolling technologies to facilitate implementation by reducing costs, local inconveniences and allow a subsequent extension to all roads. For subsidiarity reasons, the Directive will not cover passenger cars. However, charging to reduce congestion is more effective if other road users outside the scope of this Directive are also covered by a scheme of similar nature. This positive impact should be acknowledged.

6.2. Common principle: earmarking of the revenues

Earmarking revenues to transport

Part 5 has shown that the use of revenues contributes to improving the economic impact in the short term as it compensates for the draining of resources that has taken place through charging. Recycling revenues in the economy boosts investment and consumption in the short term, which induces smoother impact on employment and GDP. It may be through lowering direct taxes, earmarking to transport and/or to the reduction of externalities. In all cases, public expenditure has to be subject to appraisal with the same quality benchmarks.

Transport economists agree on the importance of acceptability when implementing a new pricing scheme[71]. Earmarking to transport is one aspect that can contribute to improving the acceptability by transport users. Such preference was also expressed during the public consultation (see annex 1).

Earmarking in the context of the revision of Directive 1999/62/EC

In the case of road transport, the use of the revenues from charging externalities should take into account the advantages for the community of international traffic. In section 5.7, it has been stressed that the share of international road traffic is expected to grow and

[71] See I. Mayeres, Taxes and Transport Externalities, WPn°2002-11. See also research projects AFFORD, PRIMA described in . Sikow Magny (footnote n° 26).

could reach one third of the total road traffic. For this reasons, Member States could be tempted to ignore the benefits of this traffic and invest in projects that would not correspond to the Community interest.

It should also be considered that in the particular case of congestion charging, it has to be recalled that payments reflect the capacity scarcity and indicate the need and provide resources for further expansion.

The argument for earmarking of charges to infrastructure funding as an alternative to relying on traditional budgetary allocation is particularly relevant when considering road transport in the European Union. In this case road charges will be borne initially by the transport firm and at the end by the consumer, but in the case of transit flows, it is quite clear that both the transport firm and the final consumer are residents in other countries. Therefore, there is no particular reason why they (and their Member States) should be confident at all that the budgetary processes in the transit country will provide them with any kind of satisfactory expenditure programme. While they may admit that their trucks should be obliged to pay, they will be asked to accept a loss with respect to the situation currently established by the Eurovignette Directive without any kind of guaranteed use for the new charges they will have to pay

As a result, earmarking of the revenues will be proposed in the context of the revision of Directive 1999/62/EC and in the broader strategy of internalisation in all modes of transport.

6.3. Ensuring EU coordination

The EU should oversee that the introduction of charging for external costs is done in a coordinated way to preserve the integrity of the internal market and the freedom of circulation for people and goods.

As said before, the most important provisions in the current Directive on charging trucks aim at ensuring the proportionality (avoid overcharging) and non-discrimination, hence transparency and accountability of the charging schemes used to recover infrastructure costs. These provisions are the recourse of common charging principles, including a common method to calculate the costs. Member States can decide to recover only parts of the costs calculated according to this common methodology.

As to external cost charges, a similar approach appears a reasonable way of ensuring the required accountability whilst leaving some flexibility to Member States.. The new Directive would therefore allow external cost charging provided that the external costs are calculated according to a common method. Other measures like the designation of independent authorities and reporting mechanisms would reinforce the transparency and the accountability.

7. MONITORING

7.1. Monitoring of external costs

In line with the general, the specific and the operational objectives of the impact assessment it is proposed that the effectiveness of the implemented measures is evaluated

through the monitoring of the level of negative externalities generated by the transport activities. It is suggested that as much as possible existing indicators are to be used for the monitoring.

Congestion levels will be monitored only on the road or other infrastructure sections that are subject to congestion charging measures implemented in the framework of this proposal.

Accident levels will be monitored using the number of road fatalities.

Air pollution generated by transport will be monitored within the framework of Council Directive 96/62/EC on ambient air quality assessment and management and Commission Decision 2004/461/EC specifying the format and content of member States Annual Report on ambient air quality in their territories. This directive describes the basic principles as to how air quality should be assessed and managed. Monitoring will focus on NOx, PM10 and SO2 emissions. Furthermore the EEA and Eurostat have developed indicators to monitor the impact s of air pollution on human health and the environment.

Greenhouse gas emissions generated by transport will be monitored using the fuel consumption statistical figures.

Measurement of noise generated by transport will be done in the framework of the Directive on Environmental Noise (Directive 20002/49/Ec of 25 June 2002) which requires the competent authorities in Member states to draw up "strategic noise maps" for major roads, railways, airports and agglomerations, using harmonised noise indicators. These maps can be used to assess the number of people annoyed and sleep disturbed.

It is acknowledged that, as the internalisation of external costs of transport is likely to be used in combination with other policy instruments such as regulation, infrastructure policy or research support, it will not always be possible to clearly establish to what extent a particular impact is due to any specific policy measure.

7.2. Reporting on the Directive 1999/62/EC

Furthermore, to ensure that any tolls or user charges introduced pursuant to the proposed Directive amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures function in a transparent and non-discriminatory manner, it is proposed that the Member States which levy an external cost charge shall draw up a report on the application of the external cost charge every two years. This report will show the total revenue raised in the Member State through the external cost charge, the total number of vehicle kilometres travelled on the road sections subject to the charge (with both indicators calculated for the vehicles to which the external cost charge applies) and the specific amounts of the external cost charge levied for each combination of class of vehicle, type of roads and period of time.

7.3. Extending the analysis to other external costs

A mid term review could be carried in order to update, if needed, estimates of external costs. In addition, the mid term review could also comprise other external costs such as space occupancy, biodiversity, landscape use, etc.

Annex 1: Results of public consultation

1 BACKGROUND

The Commission is currently developing a model for the assessment of external costs of transport. This was requested by the European Parliament when it approved the Eurovignette Directive in May 2006 which states that: "*No later than 10 June 2008, the Commission shall present, after examining all options including environment, noise, congestion and health-related costs, a generally applicable, transparent and comprehensible model for the assessment of all external costs to serve as the basis for future calculations of infrastructure charges*". The Directive adds that: "*This model shall be accompanied by an impact analysis of the internalisation of external costs for all modes of transport and a strategy for a stepwise implementation of the model for all modes of transport. The report and the model shall be accompanied, if appropriate, by proposals to the European Parliament and the Council for further revision of this Directive*".

The Commission is now carrying out an impact assessment which will support the strategy on internalisation of external costs. To this end, a consultation paper (available at http://ec.europa.eu/transport/costs/consultations/index_en.htm) has been prepared and an on-line questionnaire was submitted.

The consultation started on 29 October 2007 and closed on 31 December 2007. The questionnaire received 469 replies and 16 position papers on the matter were submitted in the meantime.

2 GENERAL INFORMATION ON RESPONDENTS

Out of the 469 respondents, 68% were individual respondents and 31% were organisations. Among the individuals, many are young people. Most come from the EU. The majority of the respondents live in cities (metropolitan or towns). They use car and public transport for their daily mobility and use train, car and planes for longer journeys.

As regards organisations, most of them are professional organisations. All modes of transport are represented.

3 EXTERNAL COSTS OF TRANSPORT

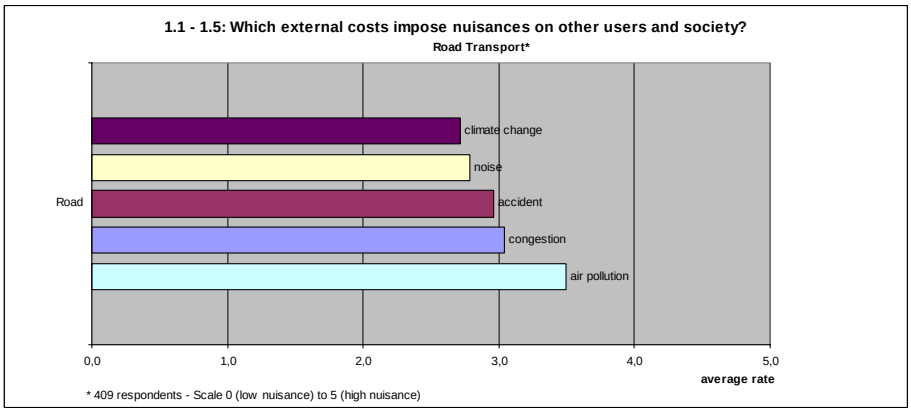
The questionnaire[72] asked the participants to rank the following external costs – congestion, accidents, noise, air pollution, climate change – according to their magnitude. According to respondents, environmental costs – air pollution, climate change, noise – are the most important nuisances in transport (in all modes).

The picture slightly differs across modes of transport. In road transport, air pollution and congestion appear as the most important nuisance for the majority of respondents. In railways, noise is seen as the most serious one. In aviation, environmental costs – noise,

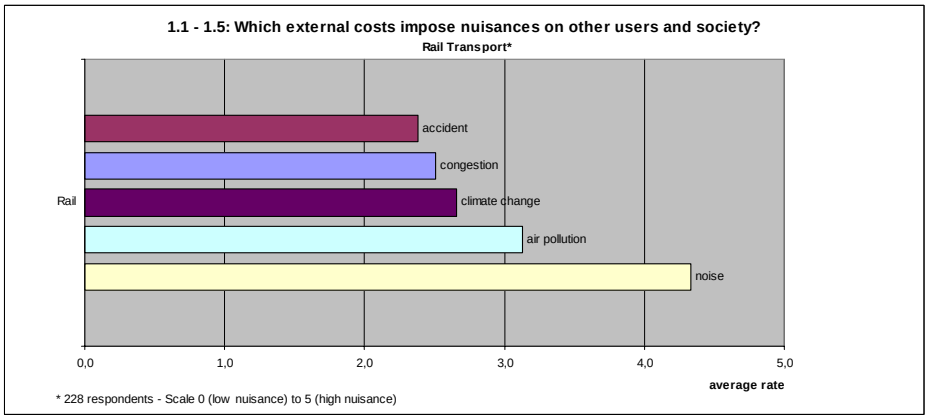
[72] See Annex 1 the full Questionnaire.

air pollution and climate change – are considered as the most important while air pollution and climate change have been ranked first in maritime and inland waterways.

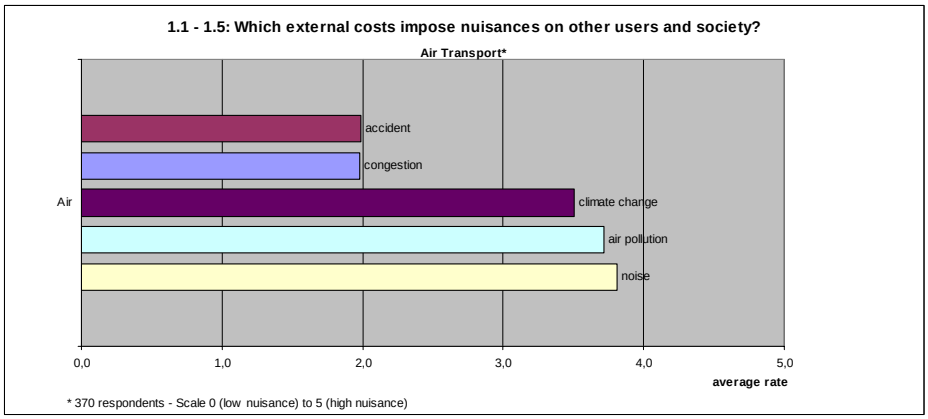
Graph 1a



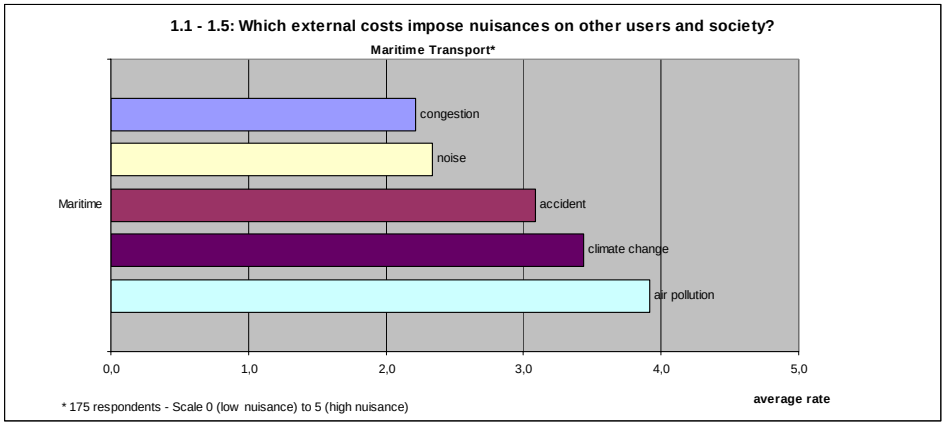
Graph 1b



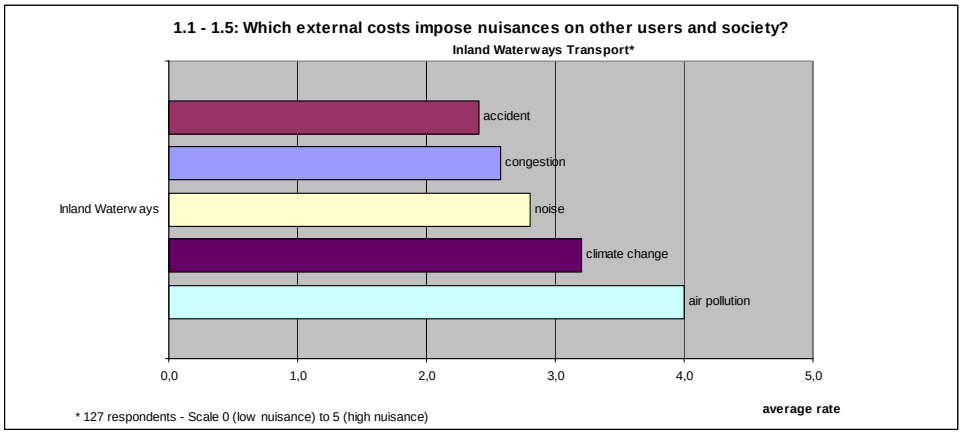
Graph 1c



Graph 1d



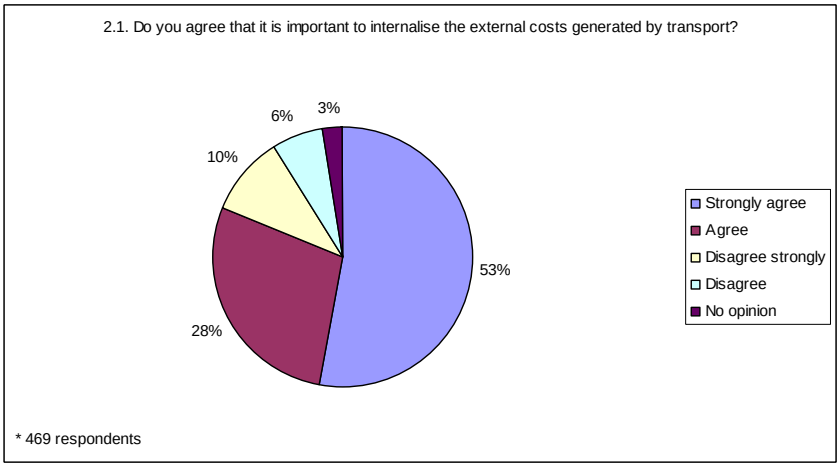
Graph 1e



4 WHAT ARE THE MAIN EXPECTATIONS OF INTERNALISATION OF EXTERNAL COSTS?

The primary objective of the internalisation of external costs is to ensure that the prices paid by transport users reflect the costs they generate, including external costs. More than 80% of all respondents agree or agree strongly with the principle of internalising external costs generated by transport.

Graph 2



Participants were asked to express their views on the main expectations they have with regards to internalisation. More specifically, they were asked to describe advantages and disadvantages of internalisation for the economy, society and the environment.

Advantages/Disadvantages for the economy

According to respondents, increased **efficiency** is one of the most important expectations. The internalisation of external costs is seen to allow the elimination of market failures and the improvement of the allocation of resources. It would decrease distortions of prices created by the fact that users do not always bear the full costs of their decisions. Efficiency is also considered to mean more efficient use of transport and then a decrease in logistics costs.

Respondents also expect **local production to increase**. In other words, the internalisation of external costs could lead to the relocation of activities from third countries to EU, which would benefit to the whole economy.

Among the concerns expressed, appears the **increase in costs of transport** which could affect European competitiveness. It could also favour inflation and have negative effects on the aggregated demand. In addition, a reduction of mobility could also affect the freedom of circulation of people and goods.

Some of the respondents highlighted the need to make a thorough impact assessment on these effects. Moreover, they stressed the need to take into account existing charges and taxes.

Advantages/Disadvantages for society

In general, respondents think that the advantages for society would be important. Most of them expect a reduction of nuisances and an improvement of the quality of life, as well as positive effects on public health and road safety. The internalisation of external costs would lead to **promote fairness in society** to the extent that transport users would bear all the external costs they generate.

Some respondents have highlighted that low income social categories are the most affected by nuisances (living near noisy and polluted areas). If those nuisances are reduced, these categories would benefit the most from it.

As regards social effects, on one hand, respondents think that the development of new activities (due to increased attention to environment) could create new jobs. On the other, if is feared that the loss of competitiveness due to increased costs could lead to job losses.

Investment in public transport is considered to improve equity and favour low revenue social categories.

Advantages/Disadvantages for the environment

Respondents expect environmental nuisances to decrease. It is hoped air pollution, noise, congestion and accidents could be reduced and that the use of cleaner modes of transport – public transport, cycling and walking – would also contribute to reducing environmental nuisances.

According to participants, the internalisation of external costs could lead to modal shift in favour of cleaner modes of transport. Therefore, the impact on environment would be positive and a reduction of externalities could be expected.

Not all respondents, however, agree that internalizing external costs would have a positive impact on environment. Some of them consider that increased transport prices would not imply a significant decrease of traffic flows; therefore, the impact on environment would be negligible.

How could the negative effects be reduced?

Very often, respondents consider that pricing is a good instrument. However, for many of them pricing should be part of a combination of other policies. Technology policy is identified as an important one as innovation is one of the key drivers to reduce externalities. Many think the policy mix should also include "classic" instruments such as traffic management, provisions for car-free city centres, etc. Standards also play an important role. In addition, it has been emphasized that one should not underestimate the positive role of investing in infrastructure and in public transport.

Public transport, especially in urban areas, is considered a key point to develop clean transports and sustainability.

4 HOW TO INTERNALISE? POLICY OPTIONS TO INTERNALISE

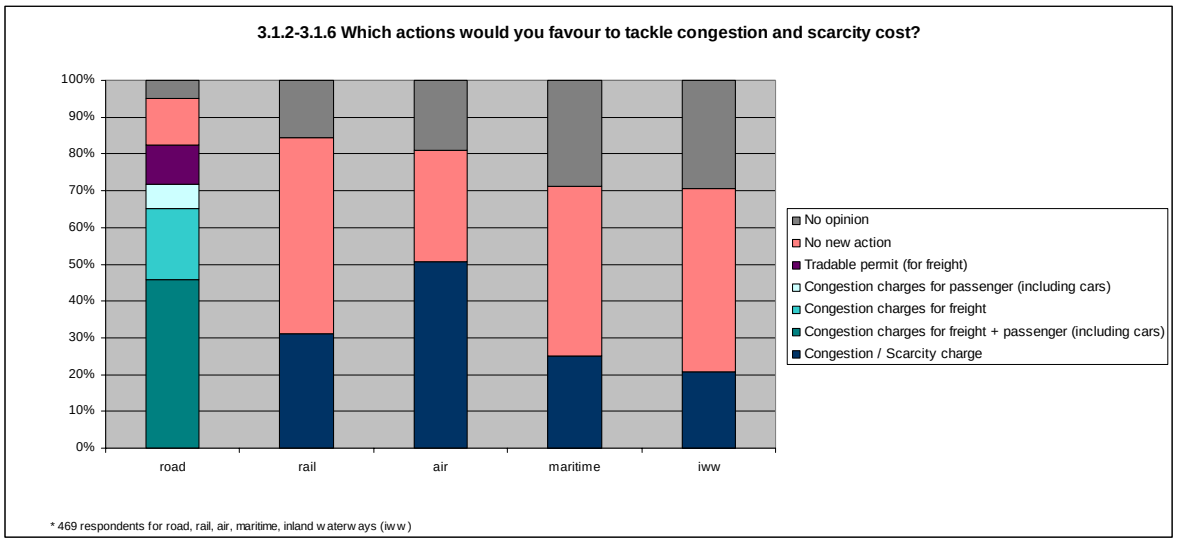
The consultation paper describes possible ways to internalise using options to use economic instruments for each external costs – charge, tax and tradable permits. All these instruments have their own advantages and disadvantages and can be adapted to deal with specific external costs.

Congestion costs

Most of respondents welcome the internalisation of congestion costs. They stress that congestion is mostly a local or regional problem and this needs to be taken into account. Respondents also highlighted the need of harmonisation at EU level. Complementary instruments such as the development of the infrastructure network and information technology were also mentioned in the comments. As regards congestion in road, participants seem to prefer charging for all users – passenger and freight – rather than charging only freight. In scheduled transport, participants recalled that congestion charging is already implemented in some airports or within the existing railways directive.

Some of the respondents, however, did not agree on congestion costs being an externality, as they claim these costs (time loss) are already internalized amongst road users themselves.

Graph 3

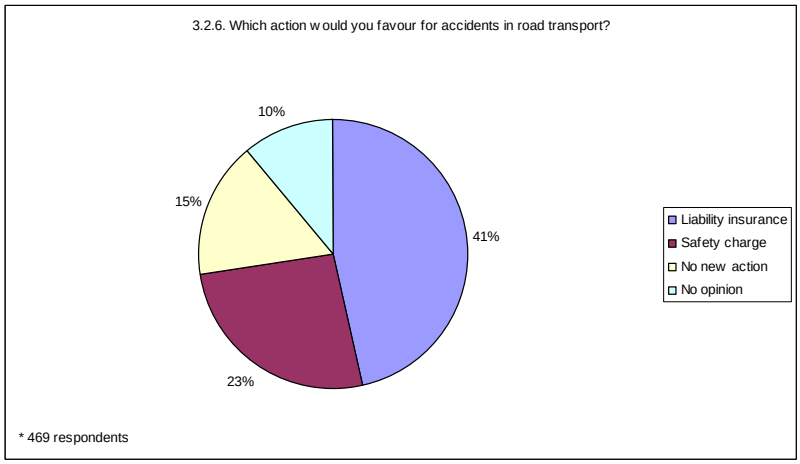


Accident costs

In general, respondents favour taking into account accidents when internalising. Moreover, the majority would like this internalisation in all modes of transport, and not only in road transport.

However, some participants were opposed to this arguing that these costs are already internalised through insurance prices. Some stressed that instruments such as controls, penalties and information campaigns would be more efficient to deal with accidents.

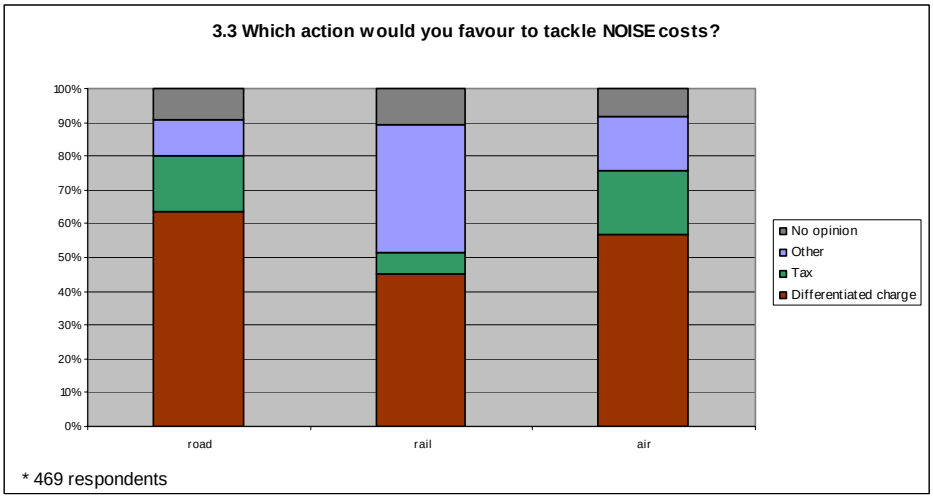
Graph 4



Noise costs

Participants welcome the internalisation of external costs in the field of noise. Many of them stressed that noise restrictions or charges were already applied in some airports or by infrastructure managers in railways. Technology was also mentioned as a key element to fight against noise. Some respondents have the feeling that noise costs are already internalized via lower land prices in the proximity of noisy transport infrastructures.

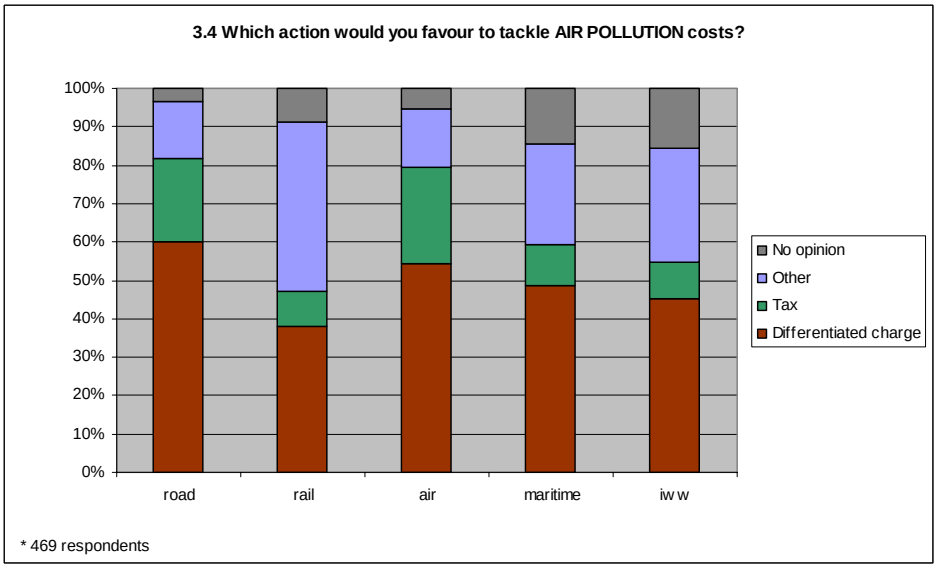
Graph 5



Air pollution costs

Most of respondents think that differentiated charges are the best way to take into account the characteristics of air pollution (which depend on time, location, etc…). Some of them raise the issue of technology and innovation which help limit air pollution emissions. Other respondents claim more stringent legislative standards on emissions from vehicles.

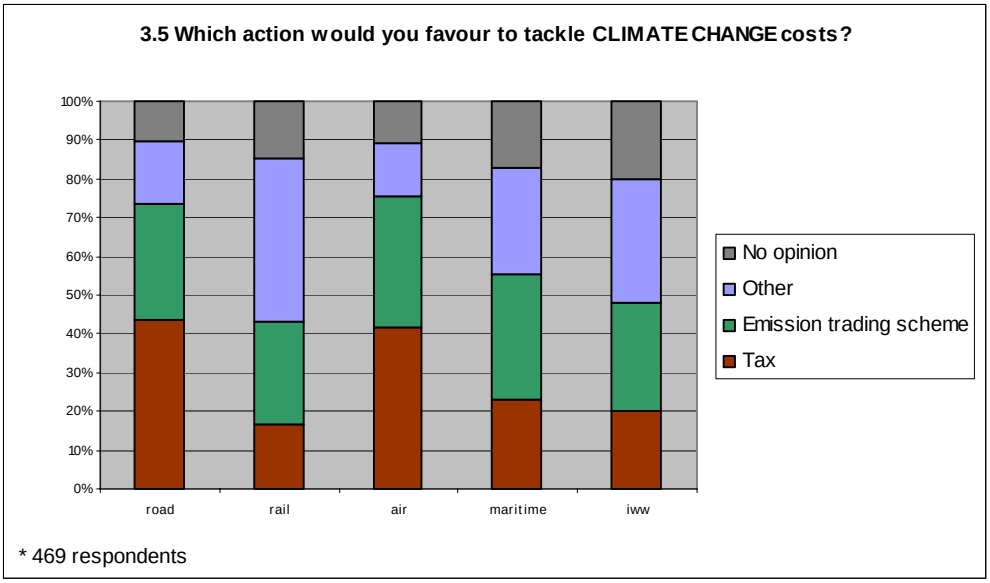
Graph 6



Climate change costs

As regards climate change, respondents would prefer the application of ETS in all modes of transport or some of them (railways, maritime). Other participants favour the use of taxation which is seen as the best way to influence CO2 emissions. Most respondents highlight the global aspects of climate change costs and the need to have an action at EU level.

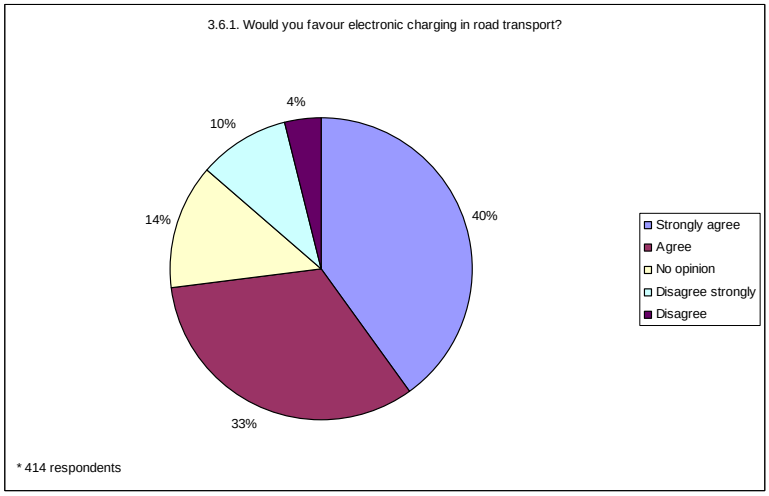
Graph 7



Other instruments?

Many of the participants highlighted the advantages of electronic charging. Electronic charging is seen as the best way to encapsulate all the external costs and make the user pay in an effective way. At the same time, other instruments such as norms, standards, research policy, information campaigns, intelligent transport system (ITS) were mentioned.

Chart 8



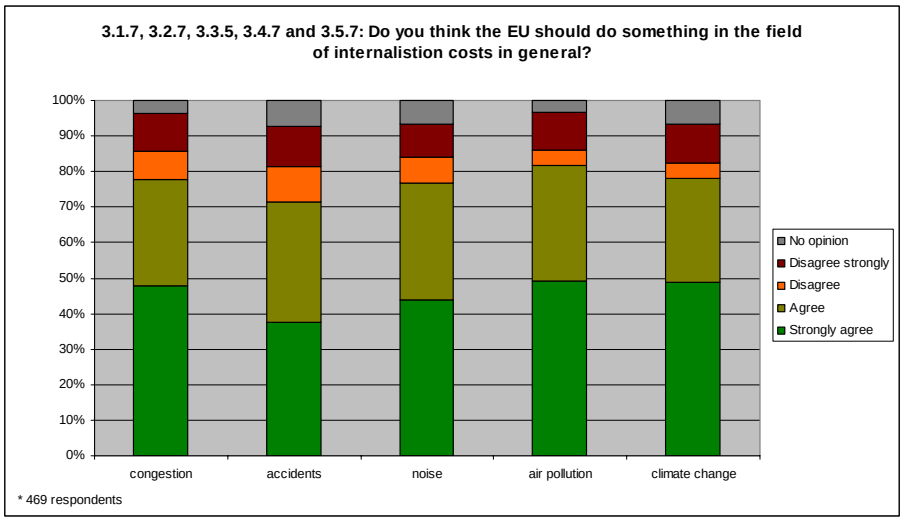
In addition, some respondents highlighted the need to take into account the specific case of regions such as the Alps. Other tools such as transit permits could be effective to tackle nuisances.

5 THE NEED FOR EUROPEAN ACTION

In general, the need for European action is acknowledged and the vast majority of participants expect the EU to act in this field. At the same time, participants mentioned

that most of these costs are local and this should be reflected in the way economic instruments are applied.

Graph 9



6 SHOULD TRANSPORT REVENUES GO TO TRANSPORT?

The questionnaire asked to which purpose the revenues of internalisation should go. Most respondents think that revenues should go to transport, more specifically to the mode that is taxed or charged. Many respondents stressed the need to avoid cross-subsidisation between modes of transport; some of them, however, stressed the need for investing in intermodal transport. Revenues should be used to improve infrastructures if needed and above all to invest in cleaner technologies and develop environmentally friendly transport. The development of public transport and the promotion of cycling and walking are also considered a good way to improve the sustainability of transport. Revenues could be used to this end.

The majority of participants consider that revenues should be used to reduce negative externalities.

Chart 10

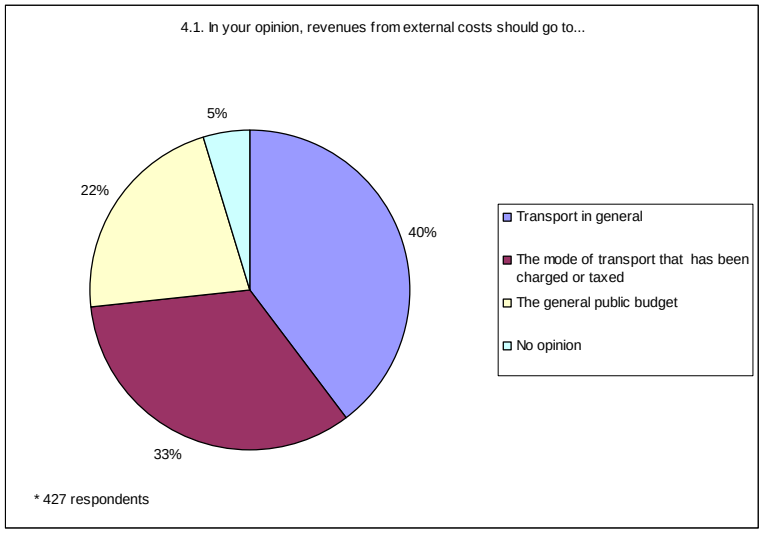
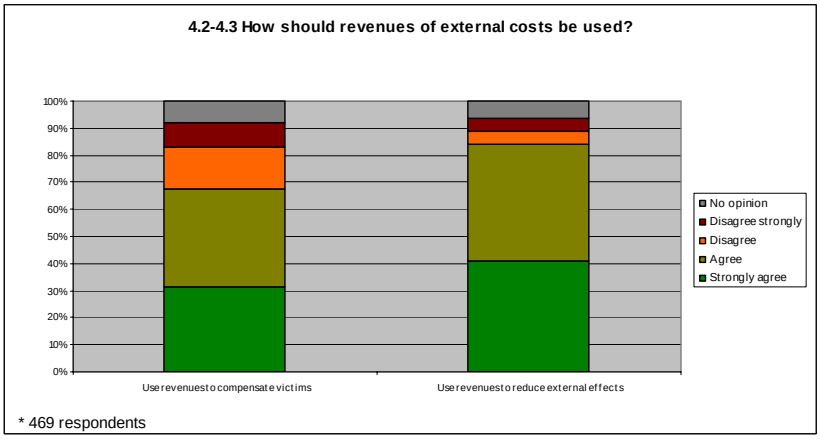


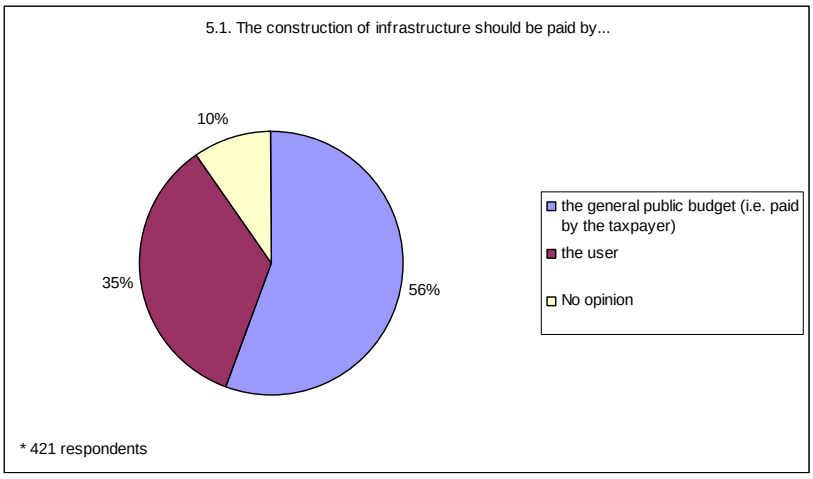
Chart 11



7 FINANCING INFRASTRUCTURES

The majority of respondents think that infrastructure should be financed – mostly if not entirely – by the general budget. The comments allowed giving more details on the way infrastructures could be financed. Many participants highlighted that both – users and general budget – should contribute to financing the building of infrastructures. In addition, most of them suggested promote public-private partnership (PPP) as a viable way of financing.

Chart 12



8 SUMMARY OF POSITION PAPERS

In response to the Public Consultation on the Internalisation of external costs launched by DG TREN in December 2007, 17 position papers were sent to the Commission.

Internalisation of external costs

The majority of stakeholders agree on internalisation at differentiated prices, mentioning road and air transport as priorities and based on the following assumptions: it should aim at modal shift towards more sustainable modes of transport; it should lead to a fairer competition among transport operators and modes; it should be a chance for a "double dividend".

In some cases a step by step approach dealing with individual externalities is preferred as well as a double-tier approach taking into account also externalities induced by insufficiently maintained infrastructure; in others a full recovery of externalities is envisaged. In no case internalisation should evolve into additional taxation or introduce forced changes in the modal split.

Differentiation is often mentioned, stating the need of taking into account: existing charges and/or taxes already internalising some externalities; variations in domestic policy and variations of external costs both regionally and among modes and flows (transit and local).

It is also stressed that external costs and decisions on transport policy should be reflected in pricing mechanisms and in the appraisal processes used to support the policy decision-making process; furthermore charging should be fair and understandable to achieve a higher acceptance.

Only two position papers disagree on the merits of internalisation, showing scepticism on the possibility of internalising external costs for all modes of transport, of having a common model for assessing external costs and of reducing externalities through pricing. It is also stated that internalisation risks penalising home/work commuting lower income categories, reducing employment and leading to environmental degradation.

Expectations

Expected advantages include an increased sustainability in transport through modal shifts; fairer competition between different modes, removing current taxation inequalities; availability of revenues to invest on modes generating less externalities and to reduce existing taxes; rearrangement of production and retail systems in favour of proximity locations to cut down transport distances; improvement of environment, quality of life, road safety, employment, public transport; technological innovation leading to fleet renewal and promotion of less polluting vehicles.

In such a scenario, a uniform system integrating and charging the external costs of all transport modes in accordance to co-modality and as part of general mobility policy is envisaged by some respondents.

On the other hand, it is widely feared that charges will result into increased costs and prices - especially when no alternative modes are available - and into risks for European competitiveness.

It is also underlined that internalisation involves pricing external costs but not reducing externalities. However, the aim of the exercise should also be considered from the environmental point of view, rather than the economic aspects alone.

Policy options

It is generally agreed that tackling externalities requires a combination of technological, regulatory and pricing measures, including investments in environmentally friendly modes of transport, enhanced network capacity, land use policies, availability of co-modality and promotion of public transport, trading schemes as well as taxation, incentives and subsidies. Such combination should take into account the complementarity of the different modes, the specificity of each one and the global frame of mobility policies.

Measures suggested to tackle each externality vary though.

Congestion is mostly seen as a local problem - especially related to road transport - which therefore requires local solutions. Anti-congestion measures mentioned include pricing such as differentiated charging and non-pricing tools such as improvement of the infrastructure in terms of capacity and connections, smart Intelligent Transport Systems, parking and traffic control policies, provision of public transport alternatives to allow modal shifts, as well as the rearrangement of logistics in terms of locations and short-distance trips.

Internalisation is not considered a proper instrument to reduce **accident** costs as they are already internalised by insurances, whose liabilities are envisaged to be expanded in order to cover them totally. Road safety charges are also suggested, being composed by a fixed part (annual insurance) and a variable part according to distance (charge).

On **noise** reduction, positions are divided between those who suggest to tackle this externality with differentiated charging and those who rather support regulatory measures such as land use or new technologies for engines and screens (e.g. use of low-noise rolling material in urban areas). Mountainous areas are particularly aggravated by this externality; therefore noise charges are suggested by some to reflect this peculiarity.

In order to tackle **air pollution** some are in favour of differentiated charging (according to location, day or week time, Euro class), whilst others rather support regulations and fleet renewals, stressing that air pollution strongly depends on local meteorological conditions and emissions, as well as being to some extent a global issue.

Climate change is considered a global and interdisciplinary issue to be connected with air emission schemes and global warming. Taxation and permits are mostly suggested, in addition to technical and legislative measures; in particular the following tools are envisaged for air transport: a homogeneous air traffic control system (Single European Sky) and fleet renewal.

As far as integrated charging is concerned, the use of electronic tools allowing differentiation as well as the uniformity of methods (or the interoperability of systems) is often proposed by respondents.

Role of European revenues

Although there is a general consensus on harmonisation at European level, positions vary from disagreement on the need for a generalised or statutory EU model for internalising external costs (due to national, regional and local differences) to wishing strict regulation for all transport modes in terms of level and composition of the charges at EU level. On the one hand it is suggested that European Union should limit its role to non-binding guidance and legal proposals in accordance with the principle of subsidiarity, on the other it is believed that it should intervene in the internalisation of external costs in order to create a level-playing field between the different modes and to foster modal shift.

Revenues

It is generally agreed that revenues from charges should be earmarked to the transport mode that has generated them and used to decrease external costs through infrastructure construction or upgrading as well as through technological innovation. Although cross-subsiding is much less accepted, it is also mentioned that revenues should go to those modes of transport generating less externalities.

Differentiation in revenues is also suggested, locally distinguishing revenues generated by transit traffic from those generated by exchange or local traffic. In one case, it was stressed that a distinction should be made for revenues generated by urban congestion charging – which should be used for all modes of transport of the city - and those generated by non urban congestion charging, which on the contrary should be used to infrastructure adaptation in the mode of transport that has been charged.

When the victims of the externalities cannot be clearly identified, revenues are suggested to go to public budget and be used to reduce burden on society.

Other comments

The aim of internalisation is stressed not to be the payment of charges but the reduction of externalities, therefore paying for externalities should be used as an instrument to achieve this goal.

Other significant issues identified by respondents as needing debate concern the extent to which the external cost charging approach is applied in other important branches of the economy and the extent to which it may be possible to apply the "polluter pays" principle as distinct from the "user pays" principle.

It is underlined by many that in rail the primary source of energy and its impact in terms of CO2 emissions should be considered; in this perspective it is remarked that European railway sector is working hard on the electrification of the remaining diesel lines in order to reduce air pollution.

The need for extending port capacity and improving access roads and intermodal connections has also been stressed in strong terms.

ANNEX TO THE QUESTIONNAIRE

GENERAL INFORMATION

Your Profile
Citizen
Organisation

(for Citizens)

Gender
Male
Female
Age
<24
25-34
35-44
45-54
55-64
>65
Current occupation
Employee
Manual worker
Self-employed
Without a professional activity
Other
Would you say you live in a ... ?
Metropolitan zone
Other town/urban centre

Rural zone

Other

What is the mode of transport you use most for your daily mobility?

Car

Public transport

Powered two wheelers

Bicycle

Walking

Other

What is the mode of transport you use most when travelling over 500 kilometres?

Car

Train

Plane

Ship

Coach

Other

(for Organisations)

Organisation name

Organisation type

Associations/non-governmental organisations

Chamber of Commerce

Consultancy/Lobbying

Educational establishment

Employers organisation

European institution or body

Government, Ministry

Industry, business

International organisation

Library

Local government

National government

Not-for-profit association

Parliament

Press

Private company

Public sector body

Publishing

Regional government

Scientific/research institute

Trade union

University

Other

Main field of activity

Freight transport services

Fuels

Infrastructure

Policy and legislation

Public transport services

Taxi services

Transport equipment

Users associations

Other

Which mode of transport do you represent?

Air transport

Inland waterways transport

Maritime transport

Rail transport

Road transport

Urban transport

Other

Region

European Union (list of countries)

Europe outside EU (list of countries)

Other

EXTERNAL COSTS

External cost is a cost that is not included in the market price, e.g. a cost that is not incurred by those who generate it. This means that when engaging in a transport activity, a person will incur private costs linked to the use of a mode of transport (tolls or fuel use), but will not be taking into account nuisances imposed on others such as congestion, accidents, noise, pollution and emissions of CO2.

1.1. In your opinion, do you think that road transport imposes nuisances on other transport users and society?

Yes

No

No opinion

IF YES

Could you please rank the five following nuisances generated by road transport in order of magnitude (1=smallest nuisance, 5=greatest nuisance)

Congestion, Accident, Noise, Air pollution, Climate Change.

Comments (if any) on road external costs

1.2. In your opinion, do you think that rail transport imposes nuisances on other transport users and society?

Yes

No

No opinion

IF YES

Could you please rank the five following nuisances generated by rail transport in order of magnitude (1=smallest nuisance, 5=greatest nuisance)

Congestion, Accident, Noise, Air pollution, Climate Change.

Comments (if any) on rail external costs

1.3. In your opinion, do you think that air transport imposes nuisances on other transport users and society?

Yes

No

No opinion

IF YES

Could you please rank the five following nuisances generated by air transport in order of magnitude (1=smallest nuisance, 5=greatest nuisance)

Congestion, Accident, Noise, Air pollution, Climate Change.

Comments (if any) on air transport external costs

1.4. In your opinion, do you think that maritime transport imposes nuisances on other transport users and society?

Yes

No

No opinion

IF YES

Could you please rank the five following nuisances generated by maritime transport in order of magnitude (1=smallest nuisance, 5=greatest nuisance)

Congestion, Accident, Noise, Air pollution, Climate Change.

Comments (if any) on maritime external costs

1.5. In your opinion, do you think that inland waterways transport imposes nuisances on other transport users and society?

Yes

No

No opinion

IF YES

Could you please rank the five following nuisances generated by inland waterway transport in order of magnitude (1=smallest nuisance, 5=greatest nuisance)

Congestion, Accident, Noise, Air pollution, Climate Change.

Comments (if any) on inland waterway external costs

1. Internalisation of costs

Internalisation is a way to attribute external costs (such as pollution, congestion, noise, …) to users and to ensure that prices paid by transport users reflect social costs, i.e. private and external costs.

The cost of transport can be split into private/internal costs (those directly borne by the person engaged in transport activity) and external costs (i.e. those that are imposed on others but not supported by the user). The sum of private and external costs represents social costs.

2.1. Do you agree that it is important to internalise the external costs produced by transport?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

ADVANTAGES/DISADVANTAGES EXPECTATION

Assuming that full internalisation if possible in all modes of transport, some patterns of transport may become more expensive, the effects may not be the same on all modes of transport, thus making some forms of transport more or less attractive than others. What are the main advantages/disadvantages you expect on the following:

2.2. What are the main advantages/disadvantages you expect on the economy?

2.3. What are the main advantages/disadvantages you expect on the social situation?

2.4. What are the main advantages/disadvantages you expect on the environment?

2.5. In your opinion, how could the negative effects of congestion, accidents and environmental nuisances be reduced?

2. Policy Options

Policy options will envisage the use of different market based instruments for each external cost – tax, charge and trading scheme. A tax is a required payment of money to governments that are used to provide public goods and services for the benefit of the community as a whole. Examples are fuel tax, circulation tax, registration tax. A charge is a proportional payment required in exchange for a clearly defined service. For example, a toll charge will give access to the use of a specific infrastructure (bridge, motorway, etc…). A tradable permit scheme is a mechanism by which the authorities set a maximum level of pollution or use of an infrastructure and assign to individuals/operators a quantity of permits that corresponds to this level. The individuals/operators can then trade permits, improving the efficiency in the distribution of efforts or in the use of the infrastructure.

3.1. Congestion Costs

3.1.1. In general, which instrument would you favour to tackle congestion costs?

Charge	Tax	Tradable permit	Other

3.1.2. In road transport which action you would favour to tackle congestion costs?

No new action	Congestion Charges for freight	Congestion Charges for passenger (including cars)	Congestion Charges for freight + passenger (including cars)	Tradable permit	No opinion

3.1.3. In rail transport which action you would favour to tackle congestion costs?

No new action	Scarcity charge	No opinion

3.1.4. In air transport which action you would favour to tackle congestion costs?

No new action	Scarcity charge	No opinion

3.1.5. In maritime transport which action you would favour to tackle congestion costs?

No new action	Congestion	No opinion

charge

3.1.6. In inland waterway transport which action you would favour to tackle congestion costs?

No new action	Congestion charge	No opinion

3.1.7. Do you think the EU should do something in the field of internalisation of congestion costs?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

Comments (if any) on congestion cost

3.2. Accident Costs

Accidents are mainly a road problem (in 2005, there were 105 killed in rail accidents) even though the number of road fatalities has considerably decreased since 1990. In general, insurance companies do not cover total costs of accidents but only partial ones. The remaining part is not borne by transport users.

3.2.1. Do you agree that accidents costs should be internalised only for road transport?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

3.2.2. Should accident costs also be internalised in rail transport?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

3.2.3. Should accident costs also be internalised in aviation?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

3.2.4. Should accident costs also be internalised in maritime transport?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

3.2.5. Should accident costs also be internalised in inland waterway transport?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

3.2.6. Which action you would favour for accidents in road transport?

No new action	Safety charge	Liability insurance	No opinion

3.2.7. Do you think the EU should do something in the field of internalisation of accident costs in road transport?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

Comments (if any) on accident cost

3.3. Noise Costs

3.3.1. In general, which instrument would you favour to tackle noise costs?

Differentiated charge	Tax	Other	No opinion

3.3.2. Which action you would favour to tackle noise costs in road transport?

No new action	Differentiated charge	Tax	No opinion

3.3.3. Which action you would favour to tackle noise costs in rail transport?

No new action	Differentiated charge	Tax	No opinion

3.3.4. Which action you would favour to tackle noise costs in air transport?

No new action	Differentiated charge	Tax	No opinion

3.3.5. Do you think the EU should do something in the field of internalisation of noise costs?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

Comments (if any) on noise cost

3.4. Air pollution costs

3.4.1. In general, which instrument would you favour to tackle air pollution costs?

Differentiated charge	Tax	Other	No opinion

3.4.2. In road transport, which action you would favour to tackle air pollution costs?

No new action	Differentiated charge	Tax	No opinion

3.4.3. In rail transport, which action you would favour to tackle air pollution costs?

No new action	Differentiated charge	Tax	No opinion

3.4.4. In air transport, which action you would favour to tackle air pollution costs?

No new action	Differentiated charge	Tax	No opinion

3.4.5. In maritime transport, which action you would favour to tackle air pollution costs?

No new action	Differentiated charge	Tax	No opinion

3.4.6. In inland waterway transport, which action you would favour to tackle air pollution costs?

No new action	Differentiated charge	Tax	No opinion

3.4.7. Do you think the EU should do something in the field of internalisation of air pollution costs?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

Comments (if any) on air pollution cost

3.5. Climate Change Costs

3.5.1. In general, which instrument would you favour to tackle climate change costs?

Emission trading scheme	Tax	Other	No opinion	

3.5.2. In road transport, which action you would favour to tackle climate change costs?

No new action	Emission trading scheme	Tax	No opinion

3.5.3. In rail transport, which action you would favour to tackle climate change costs?

No new action	Emission trading scheme	Tax	No opinion

3.5.4. In air transport, which action you would favour to tackle climate change costs?

No new action	Emission trading scheme	Tax	No opinion

3.5.5. In maritime transport, which action you would favour to tackle climate change costs?

No new action	Emission trading scheme	Tax	No opinion

3.5.6. In inland waterway transport, which action you would favour to tackle climate change costs?

No new action	Emission trading scheme	Tax	No opinion

3.5.7. Do you think the EU should do something in the field of internalisation of climate change costs?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

Comments (if any) on climate change cost

3.6. Integrated charging

3.6.1. Would you favour electronic charging in road transport?

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

3.6.2. Are there other policy options you would suggest?

3.6.3. Are there other pricing instruments you would suggest for congestion, noise, accidents, air pollution or climate change?

3.6.4. Are there other non-pricing instruments you would suggest for congestion, noise, accidents, air pollution or climate change?

Comments (if any) on integrated charging

1 Use of revenues

4.1. In your opinion, revenues from external costs should go to…

The mode of transport that have been charged or taxed

Transport in general

The general public budget

No opinion

4.2. In your opinion, revenues should be used to compensate the victims of the negative effects

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

4.3. In your opinion, revenues should be used to reduce external costs

Strongly agree	Agree	Disagree	Disagree strongly	No opinion

Comments (if any) on the use of revenues

2 Infrastructure

5.1. The construction of infrastructure should be paid by…

The general public budget (i.e. paid by the taxpayer)

The user

No opinion

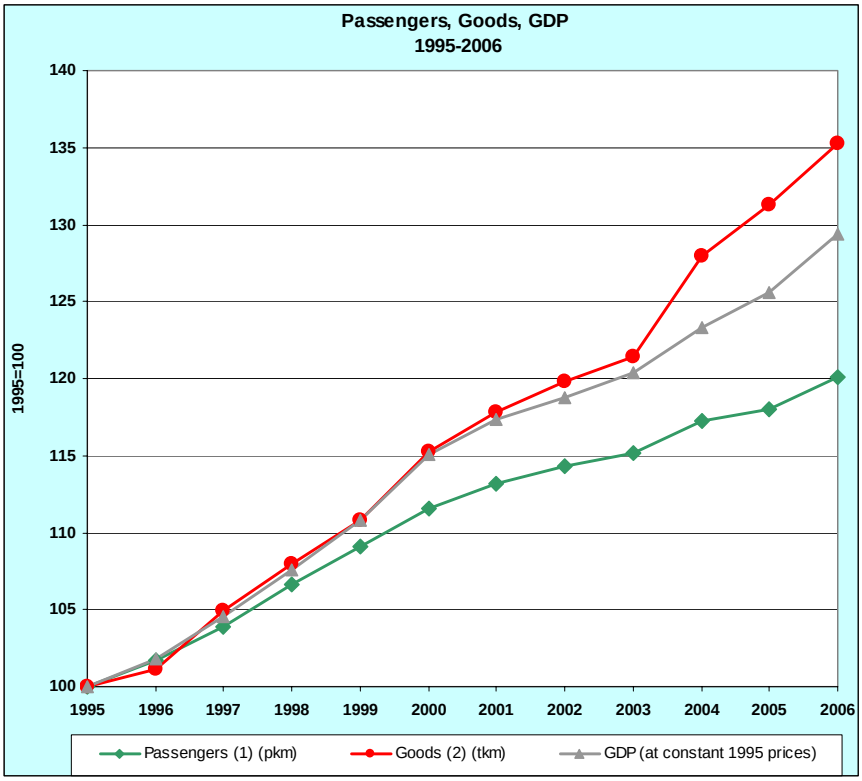
Comments (if any) on infrastructure

1 General comments

Are there other comments that you would like to make on the "internalisation of external costs" topic not covered by the above questions?

Annex 2: Evolution of nuisances in Transport

Graph 0a: Evolution of transport and GDP growth



Source: DG TREN Pocketbook (2007)

Table 0a: Performance per mode of transport (freight)

EU-27 Performance by Mode
Freight Transport
1000 mio tonne-kilometres

	Road	Rail	Inland Water-ways	Pipe-lines	Sea	Air	Total
1995	*1 289*	386	121	*115*	*1 150*	*2,0*	***3 062***
1996	*1 303*	392	118	*119*	*1 162*	*2,1*	***3 096***
1997	*1 352*	409	126	*118*	*1 205*	*2,3*	***3 213***
1998	*1 414*	392	130	*125*	*1 243*	*2,4*	***3 307***
1999	*1 470*	383	127	*124*	*1 288*	*2,5*	***3 394***
2000	*1 519*	401	133	*126*	*1 348*	*2,7*	***3 529***
2001	*1 556*	385	132	*132*	*1 400*	*2,7*	***3 607***
2002	*1 606*	382	132	*128*	*1 417*	*2,6*	***3 668***
2003	*1 625*	391	123	*130*	*1 445*	*2,6*	***3 717***
2004	*1 747*	413	136	*131*	*1 488*	*2,8*	***3 918***
2005	*1 800*	413	138	*136*	*1 530*	*2,9*	***4 020***
2006	*1 888*	435	138	*135*	*1 545*	*3,0*	***4 143***
1995 - 2006	46,5%	12,6%	14,5%	17,2%	34,3%	50,0%	**35,3%**
per year	3,5%	1,1%	1,2%	1,5%	2,7%	3,8%	**2,8%**
2005 - 2006	4,9%	5,2%	0,0%	-0,7%	1,0%	3,4%	**3,1%**

Source: DG TREN – Pocket book

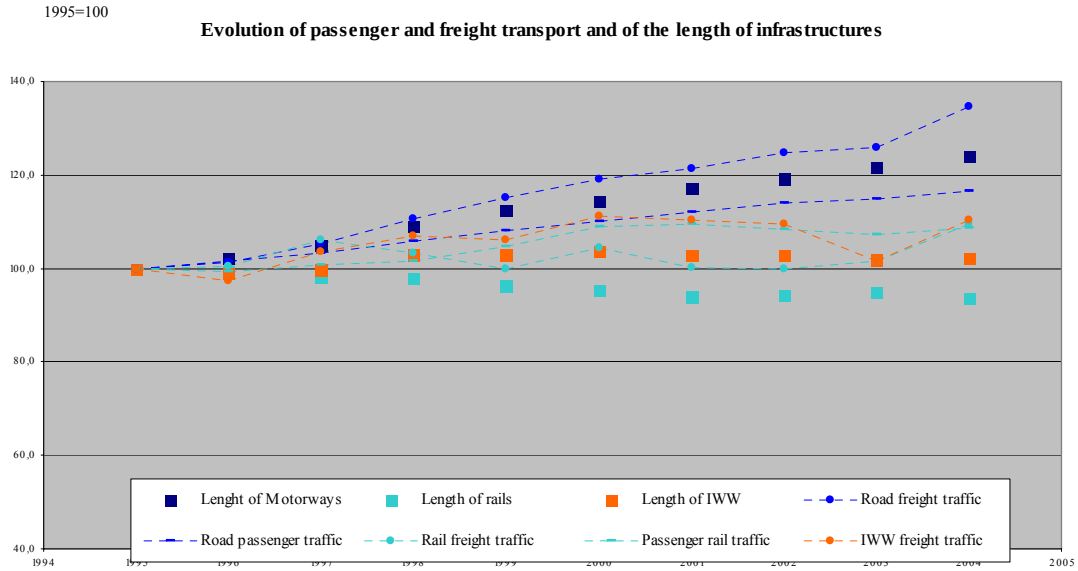
Table 0b: Performance per mode of transport (passenger)

EU-27 Performance by Mode
Passenger Transport
1000 mio passenger-kilometres

	Pass - enger Cars	P2W	Bus & Coach	Rail -way	Tram & Metro	Air	Sea	Total
1995	*3 855*	*123*	*501*	348	*65*	*335*	*44*	***5 271***
1996	*3 923*	*125*	*505*	346	*66*	*352*	*44*	***5 361***
1997	*4 001*	*127*	*504*	348	*67*	*385*	*44*	***5 475***
1998	*4 098*	*130*	*511*	348	*81*	*410*	*43*	***5 621***
1999	*4 202*	*134*	*511*	356	*80*	*424*	*43*	***5 749***
2000	*4 283*	*136*	*514*	368	*82*	*456*	*42*	***5 880***
2001	*4 366*	*139*	*516*	369	*83*	*453*	*42*	***5 968***
2002	*4 441*	*139*	*514*	362	*84*	*445*	*42*	***6 027***
2003	*4 470*	*144*	*515*	358	*79*	*462*	*42*	***6 070***
2004	*4 533*	*147*	*521*	363	*82*	*493*	*41*	***6 181***
2005	*4 524*	*150*	*523*	374	82	*526*	*40*	***6 220***
2006	*4 602*	*154*	*523*	384	84	*547*	*40*	***6 333***
1995 - 2006	19,4%	24,6%	4,3%	10,4%	28,7%	63,3%	-10,1%	**20,1%**
per year	1,6%	2,0%	0,4%	0,9%	2,3%	4,6%	-1,0%	**1,7%**
2005 - 2006	1,7%	2,5%	-0,1%	2,7%	1,8%	4,0%	-0,3%	**1,8%**

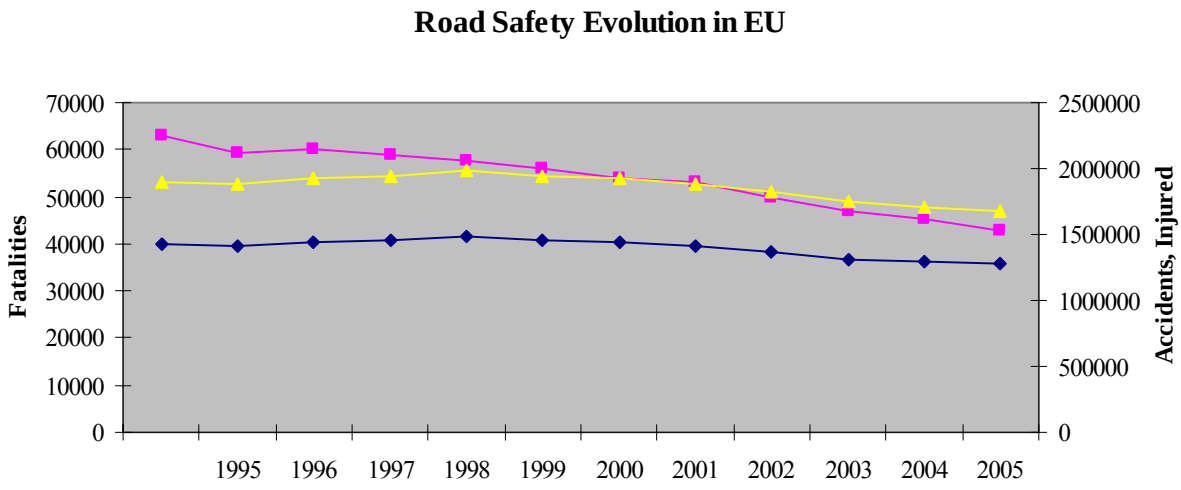
Source: DG TREN – Pocket book

Graph 1: Evolution of passenger and freight transport and of the length of infrastructures



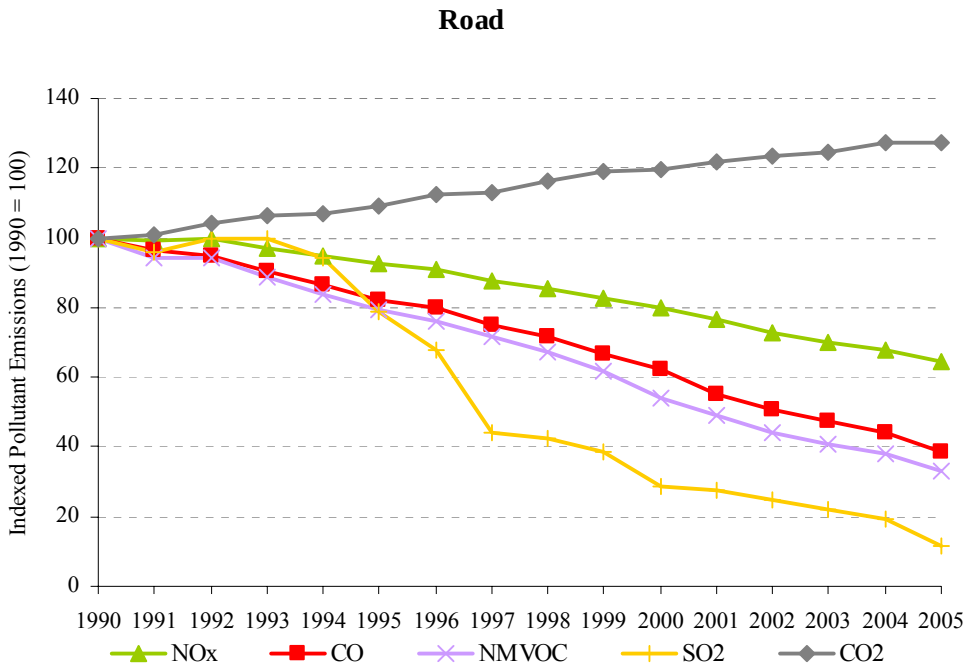
Source: EU Energy and Transport in Figures. 2006

Graph 2: Road Safety Evolution in EU



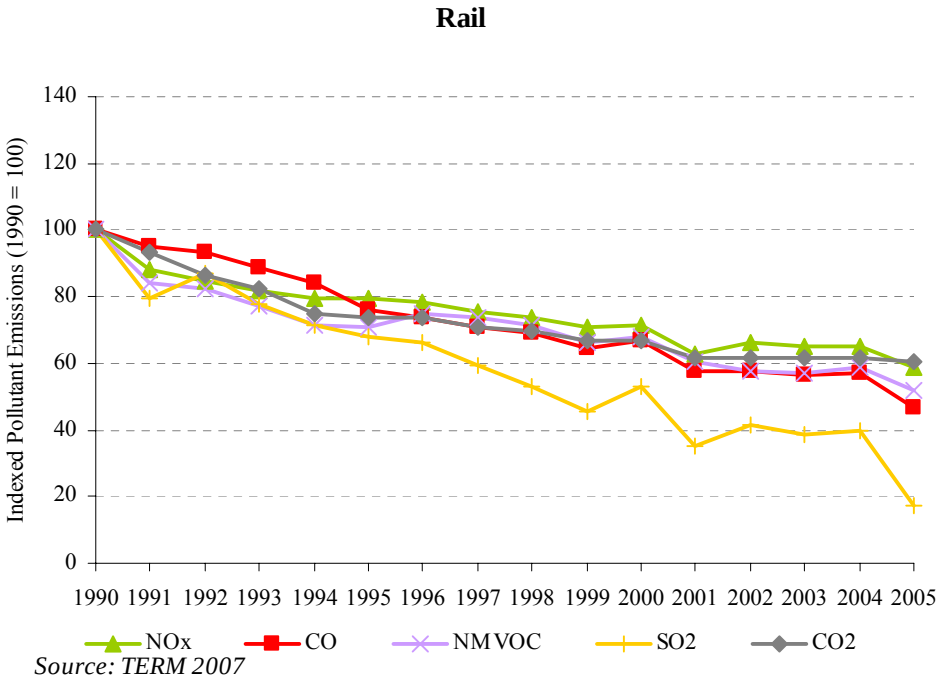
Source: CARE (EU road accidents database) or national publications. DG Transport and Energy

Graph 3a: Evolution of air pollutants (road)



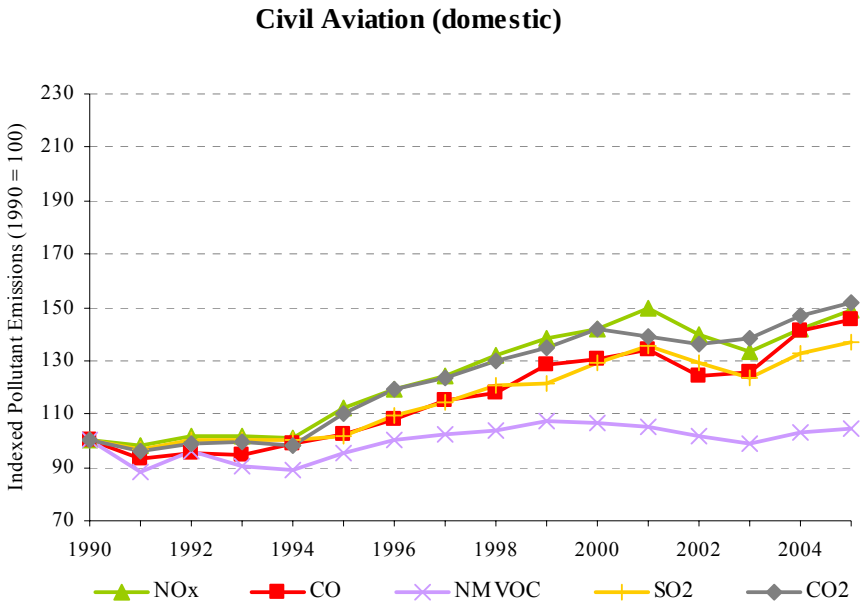
Source: TERM 2007

Graph 3b: Evolution of air pollutants (rail)



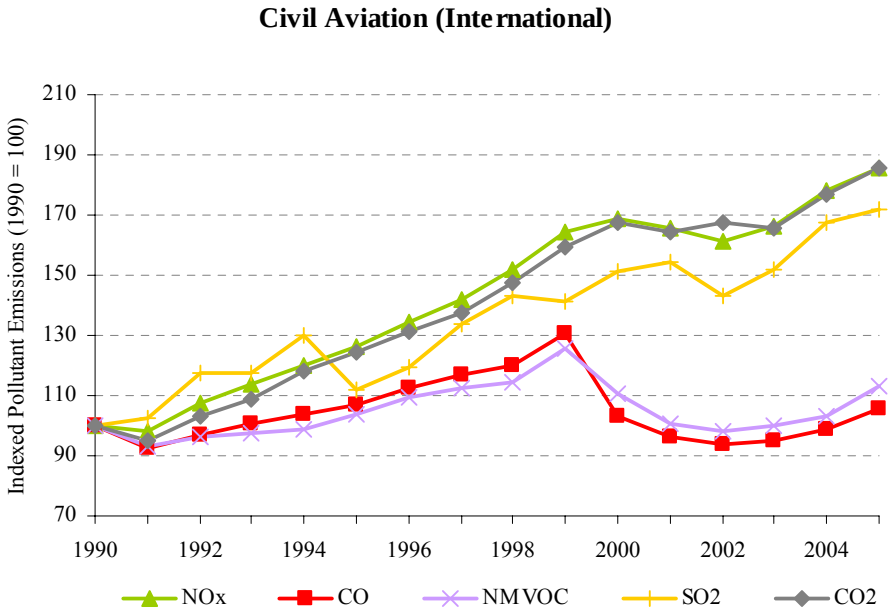
Source: TERM 2007

Graph 3c: Evolution of air pollutants (Civil aviation - domestic)



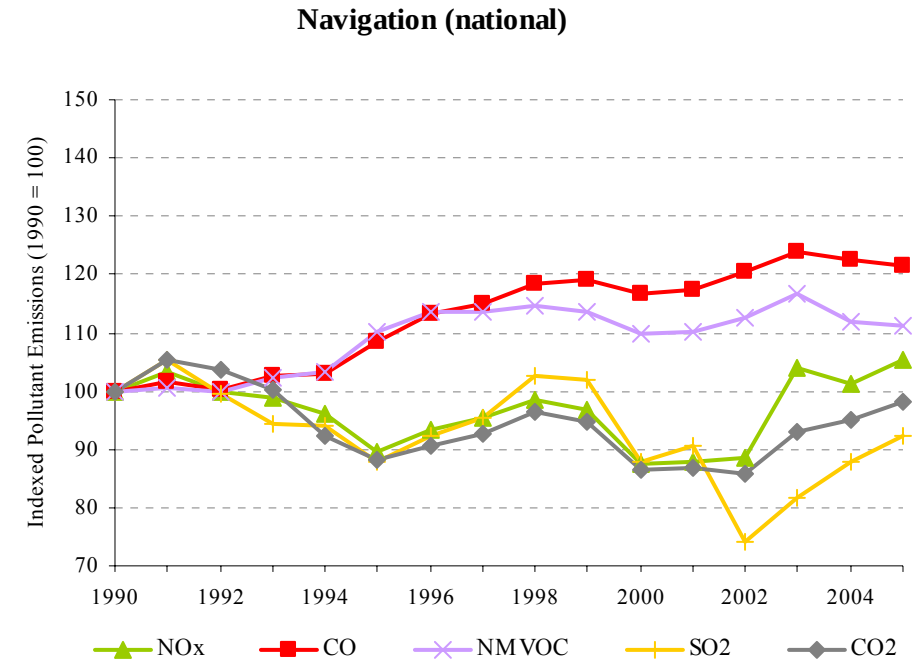
Source: TERM 2007

Graph 3d: Evolution of air pollutants (Civil aviation - international)



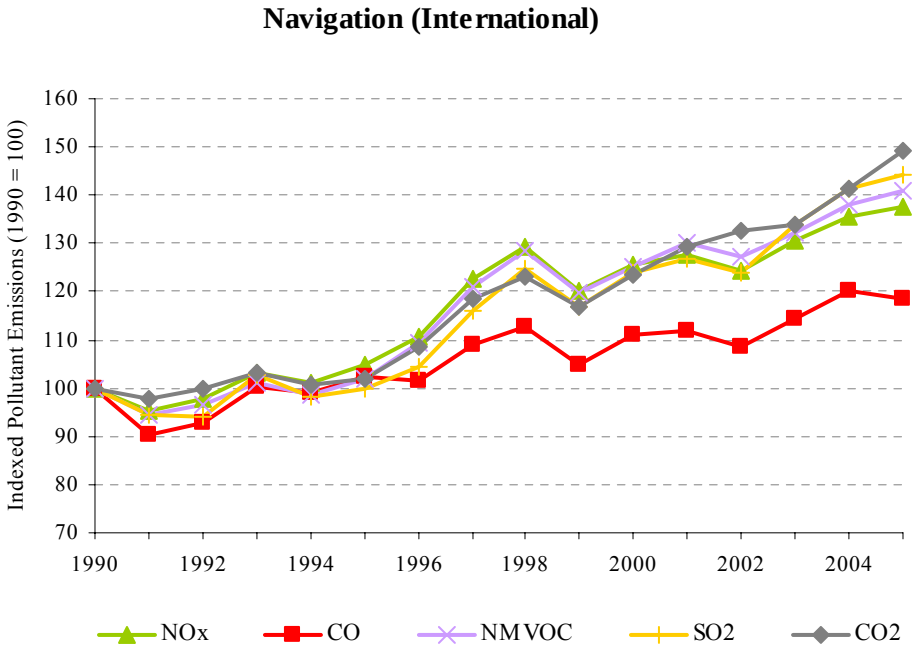
Source: TERM 2007

Graph 3e: Evolution of air pollutants (Navigation- national)



Source: TERM 2007

Graph 3f: Evolution of air pollutants (Navigation- international)

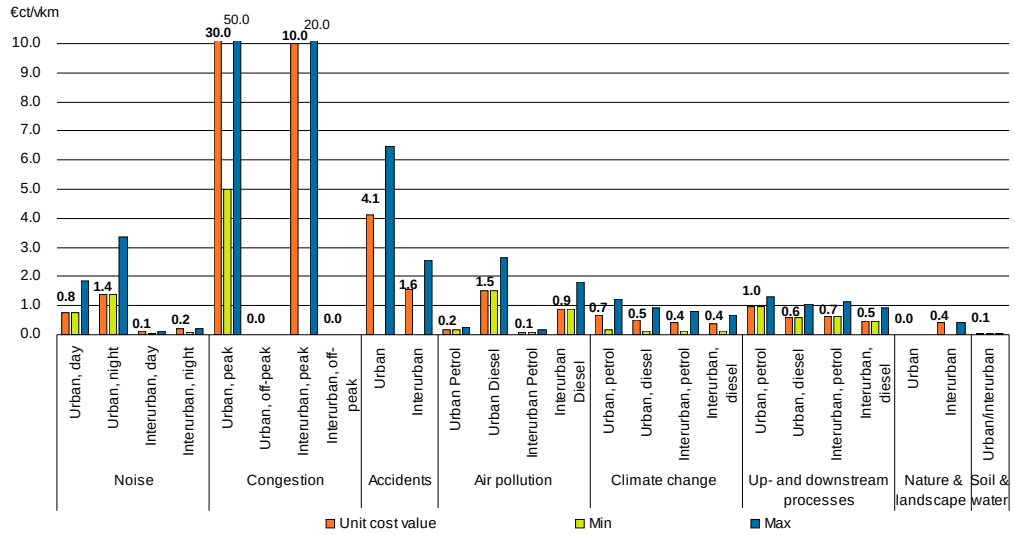


Source: TERM 2007

Annex 3: Unit External Costs per cost categories and per traffic situation

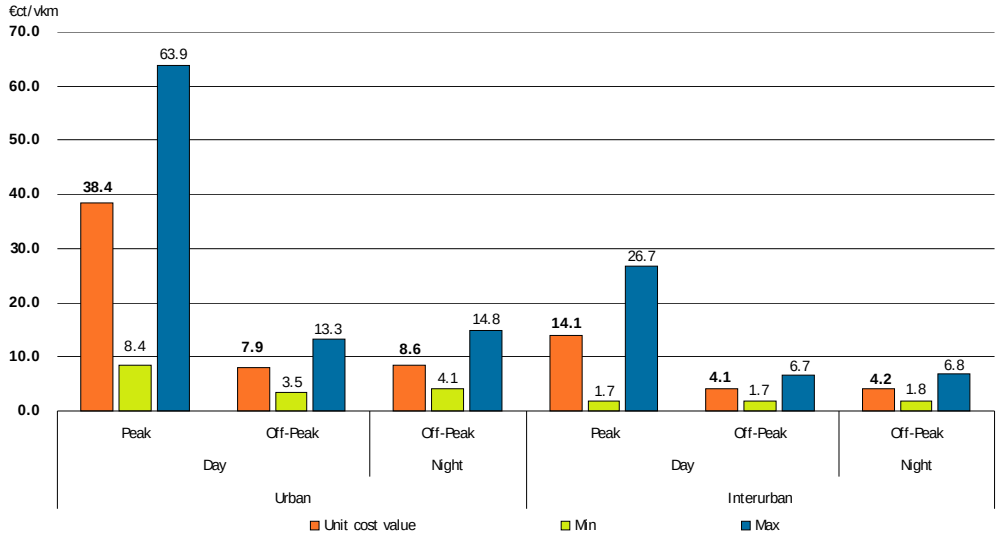
- ROAD TRANSPORT

Graph 1: Passenger cars: Unit Values per cost category in €ct/vkm (in €2000) based on unit values for all cost components from Table 47 of the Handbook.



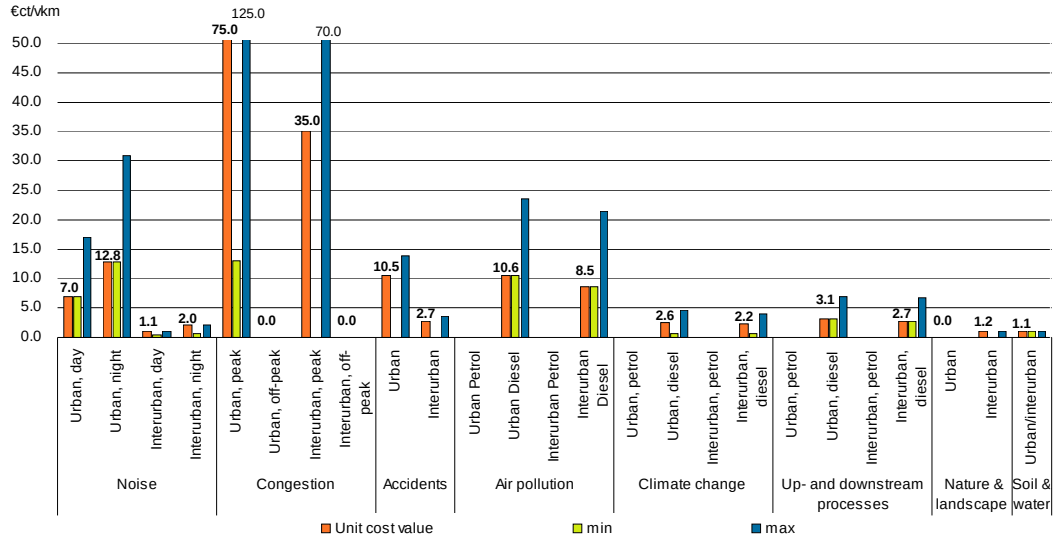
Notes: Unit cost value in **bold**. Source: Handbook (IMPACT)

Graph 2: Passenger cars (petrol): Unit Values per traffic situation in €ct/vkm (in €2000) based on unit values for all cost components from Table 47 of the Handbook



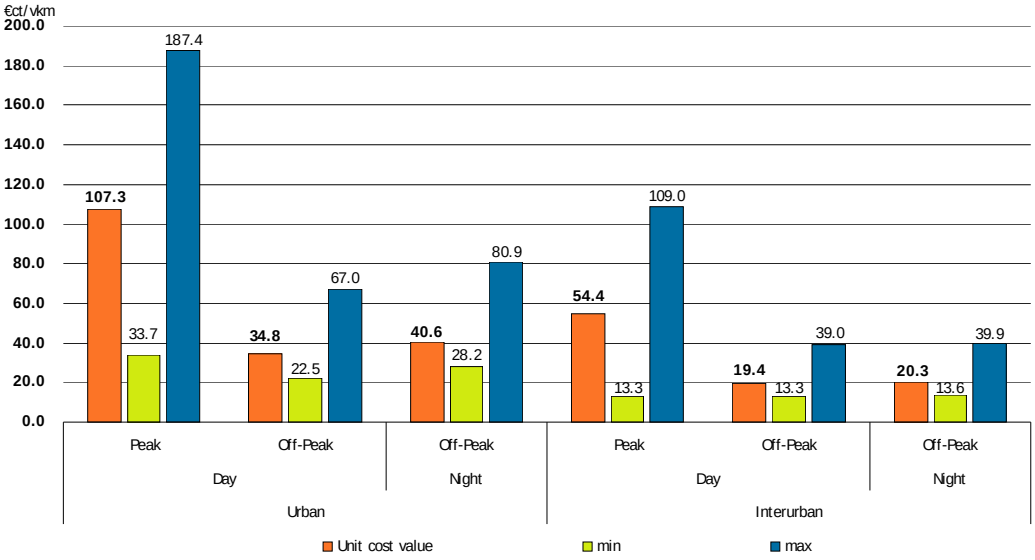
Notes: Note: for pricing purposes not all cost components might have to be considered (e.g. costs for nature and landscape). Source: Handbook (IMPACT)

Graph 3: Heavy goods vehicles: Unit cost per cost category in €ct/vkm (in €2000) based on unit values for all cost components from Table 47 of the Handbook.



Notes: Unit cost values in bold. Source: Handbook (IMPACT)

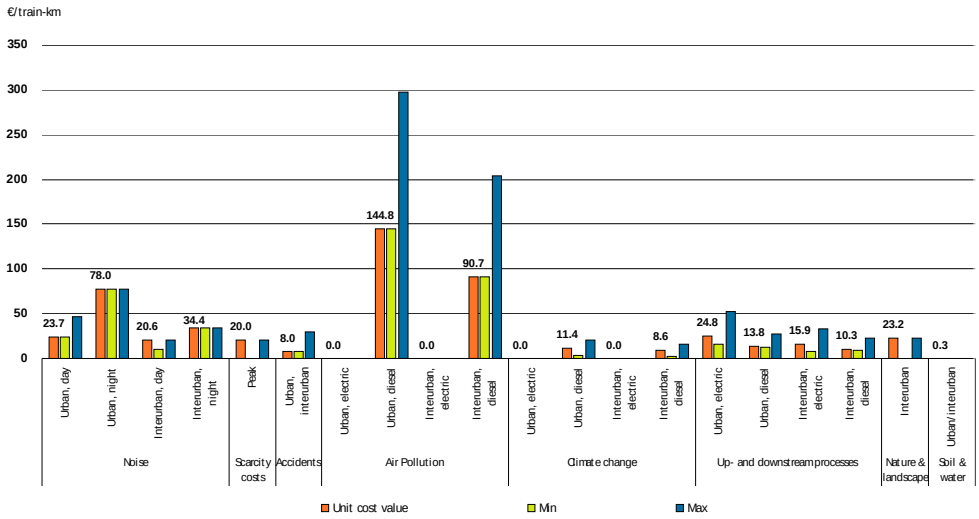
Graph 4: Heavy goods vehicles: Unit values per traffic situation in €ct/vkm (in €2000) based on unit values for all cost components from Table 47 of the Handbook.



Notes: Note: for pricing purposes not all cost components might have to be considered (e.g. costs for nature and landscape). Source: Handbook (IMPACT)

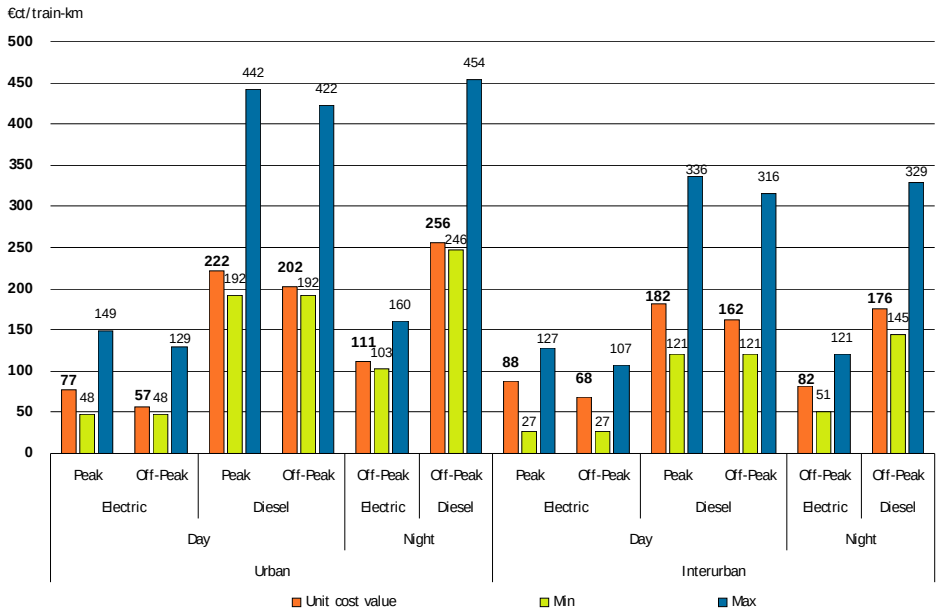
- RAIL TRANSPORT

Graph 5: Rail passenger transport: Unit values per cost category in €ct/train-km (in €2000) based on unit values for all cost components from Table 48 of the Handbook.



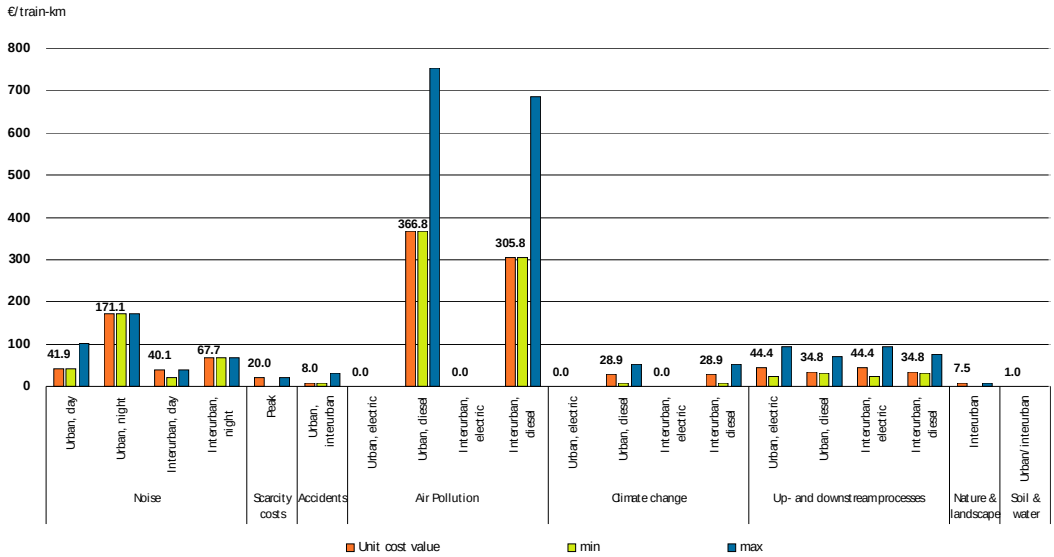
Source: Handbook (IMPACT)

Graph 6: Rail passenger transport: Unit values per traffic situation in €ct/train-km (in €2000) based on unit values for all cost components from Table 48 of the Handbook.



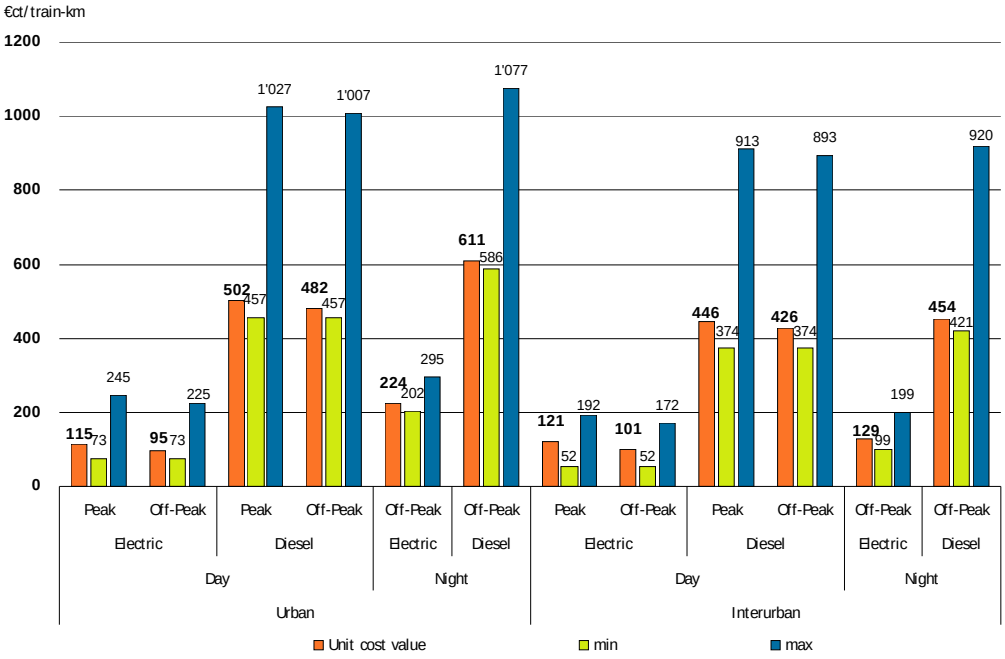
Notes: Note: for pricing purposes not all cost components might have to be considered (e.g. costs for nature and landscape). Source: Handbook (IMPACT)

Graph 7: Rail freight transport: Unit values per cost category in €ct/train-km (in €2000) based on unit values for all cost components from Table 48 of the Handbook.



Source: Handbook (IMPACT)

Graph 8: Rail freight transport: Unit values per traffic situation in €ct/train-km (in €2000) based on unit values for all cost components from Table 48 of the Handbook.



Notes: Note: for pricing purposes not all cost components might have to be considered (e.g. costs for nature and landscape). Source: Handbook (IMPACT)

- AIR TRANSPORT

Table 1: Air transport: Unit values per cost component in €/ flight in €2000

Cost component		*Air passenger*
		weighted EU-19 average values
Noise costs		228
Scarcity costs	Peak	n.a.

	Off-Peak	n.a.
Accident costs		118
Air Pollution		117
Climate change		530
Up- and downstream processes		612
Additional external costs (nature & landscape)		n.a.
Total external costs		993

Explanations by cost category:

Noise costs: Value can also be expressed in €/LTO since noise costs only occur during take-off and landing of an aircraft, Model results of TREMOVE model (EU-19 average values).

Scarcity costs: Not available.

Accident costs: Model results of TREMOVE model (EU-19 average values).

Air pollution: Distance class 1.000-1.500 km, Model results of TREMOVE model (valuation factors for Germany used).

Climate change: Distance class 1.000-1.500 km, costs correspond to the costs of a whole flight (from origin to destination), costs are without climate impacts of non-CO2 emissions, Model results of TREMOVE model (EU-19 average values).

Up- and downstream: Distance class 1.000-1.500 km, costs correspond to the costs of a whole flight (from origin to destination), Model results of TREMOVE model., valuation of air pollutants with valuation factors for Germany.

Nature&Landscape: Not available.

- WATERWAYS TRANSPORT

Table 2: Inland waterways: unit values per cost component in €ct/ship-km (only comprehensive data for air pollution and climate change costs available) in €2000

Cost component	*Waterborne freight transport*
	weighted EU-19 average values
Noise	(–)
Scarcity	(–)
Accidents	(–)
Air pollution	89-1260
Climate change	8-114
Up- and downstream processes	8-108
Nature & landscape	(–)
Soil & water pollution	(–)
Total external costs	105-1482

Explanations by cost category:

Air pollution: Ranges correspond to costs of different ship types acc. to **Error! Reference source not found.** (*Model results of TREMOVE model (valuation factors for Germany).*

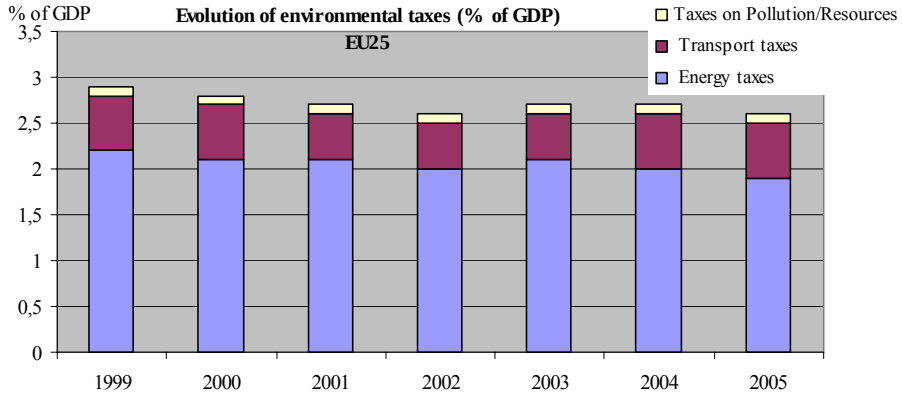
Climate change: Ranges correspond to costs of different ship types acc. to Table 30, using the central value for climate change costs from Table 26, *Model results of TREMOVE model (EU-19 average values).*

Up- and downstream: Ranges correspond to costs of different ship types acc. to Table 40 (p. 95), Model results of TREMOVE model, valuation of air pollutants with valuation factors for Germany.

Total Total bandwidths are calculated by adding up bandwidths of all categories.

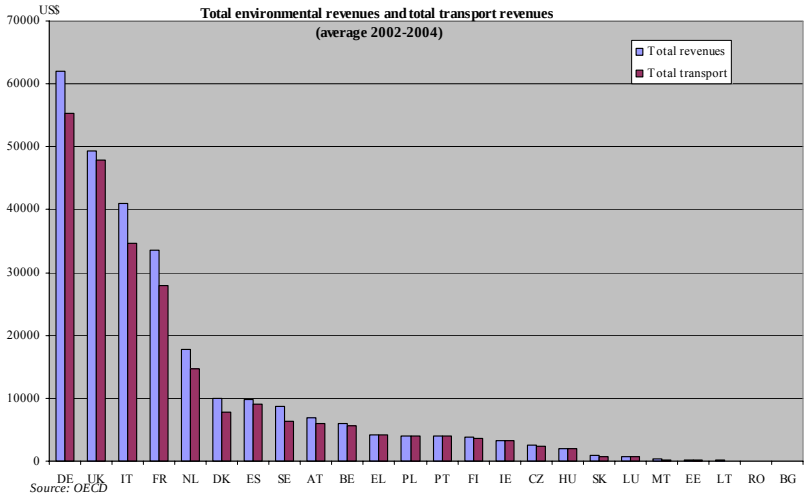
Annex 4: Overview of taxes and subsidies in transport

Graph 1: Evolution of environmental tax



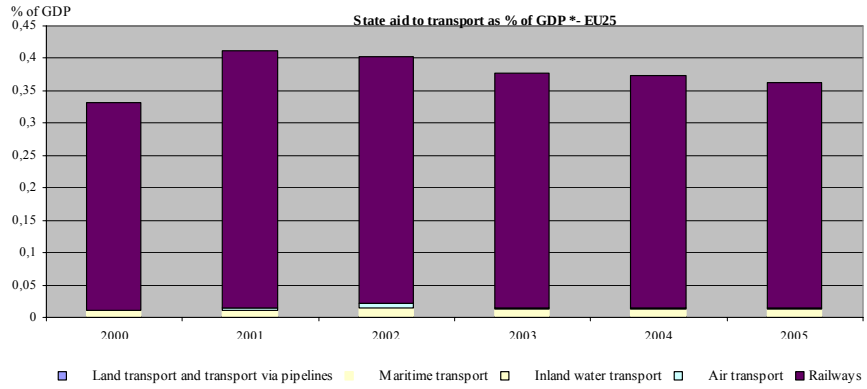
Source: Eurostat/TAXUD

Graph 2: Total environmental revenues and total transport revenues



Source: OECD

Graph 3: State aid to transport as a % of GDP



* Source: DG COMP scoreboard. For railways, COM(2006)761. Subsidies to railways includes all public subsidies that have been communicated to the Commission as well as subsidies that have been notified and authorised by the Commission under relevant State aid rules. However the figures exclude compensation for services of general economic interest.

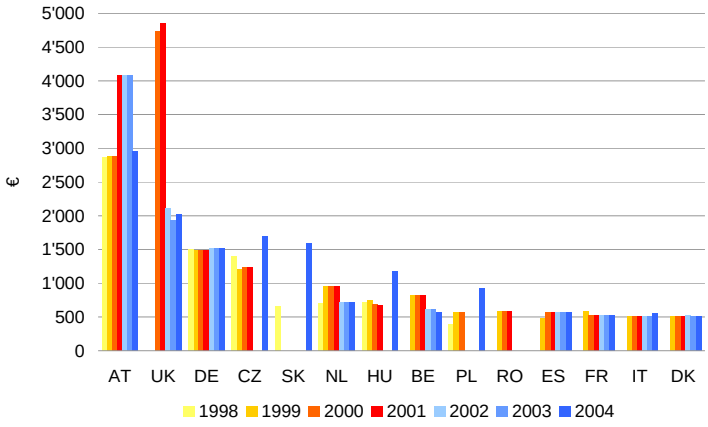
Annex 5: Overview of taxes and subsidies in each mode of transport

Table 1: Summary table on existing charges and taxes in road transport

Road Transport		
Existing charges and taxes	**EU Framework**	**Member States**
Fuel tax	Directive 2003/96/EC on energy taxation	All Member States 1.9% of EU25 GDP
Vehicle tax		0.5 % of EU25 GDP
Infrastructure Charge	Directive 1999/62/CE as amended by Directive 2006/38/CE on the charging of heavy goods vehicles for the use of certain infrastructures	
No tolls, no vignette		CY, EE, FI, LV, MT
Traditional Tolled Motorway for passengers and HGV		EL, ES, IE, FR, IT, PT, SL
Time based vignette for passenger and HGV		HU, CZ, LT, SK
Distance-based electronic road charging system for HGV		AT, DE, CZ
Time based fee charging (Eurovignette) for HGV		BE, DK, LU, NL, SE.
Time base vignette for HGV		BG, PL, RO
Urban congestion: urban tolls		IT (Parma, Firenze, Ferrara, Reggio Emilia, Cesena, Bologna) MT (La Valette) SE SL (Maribor) UK (London)

Based on DIFFERENT, OECD Database, Eurostat data base.

Graph 1: Vehicle taxes in Member States (for HGV)



Source: Road Transport Report n°1

Table 2: Summary table on existing charges and taxes in rail transport

Rail Transport		
Existing charges and taxes	**EU Framework**	**Member States**
Fuel tax	Directive 2003/96/EC on energy taxation	
Infrastructure Charge	Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification.	
Maintenance		AT, CZ, DK, EE, FI, FR, DE, HU, LT, NL, PL, PT, RO, SL, SE, UK
Renewals		EE, FI, FR, DE, HU, LT, PL, SL, UK
Train planning and operations		CZ, EE, FR, DE, HU, IT, LT, NL, PL, PT, RO, SL
Congestion and Scarcity		AT, DK, FR, DE, IT, UK
Accidents		SE
Environment		FI, SE

Based on ECMT (2005), DIFFERENT.

Table 3: Summary table on existing charges and taxes in air transport

Air Transport		
Existing charges and taxes	**EU Framework**	**Member States**
Fuel tax	Directive 2003/96/EC on energy taxation. Article 14, 1.c.: exemption for "energy products supplied for use as fuel for the purpose of air navigation other than in private pleasure-flying".	Directive 2003/96/EC on energy taxation gives the possibility to tax fuel used on domestic and, under certain conditions, intra-EC flights. NL (Kerosene tax since 2005 for domestic flights)
Route Charge	Guidelines provided by Eurocontrol	
Infrastructure Charge and restrictions		
Landing charge according to maximum take-off weight		AT, BE, CY, CZ, DE, DK, FI, FR, DE, HU, EL, IE, IT, LV, LT, LU, MT, PT, NL, ES, SK, SL, UK
Noise	Directive 2002/30/EC on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports	BE, CZ, FR, HU, NL, SE, UK, DE (Berlin, Munich, Stuttgart) (not based on social cost of noise, but on cost recovery of alleviation measures). Night noise charge: DK, (Kastrup), FI, DE (Frankfurt, Munich, Berlin),
Congestion and Scarcity	Work on a proposal to develop a secondary market for slots at airports.	Peak/off-peak AT (Vienna), FI, PT, ES, UK
Night time surcharge		BE (Brussels), CY, FR, IT, LV, (Riga), LT (Vilnius), LU, MT, NL
Accidents		-

Air pollution		CZ, HU, IT, ES, SK, SE
Emission Trading Scheme	Proposal for a Directive amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community. COM(2006) 818 final	

Based on DIFFERENT. OECD data base, IMPRINT-Net.

Table 4: Summary table on existing charges and taxes in maritime transport

Maritime Transport		
Existing charges and taxes	**EU Framework**	**Member States**
Fuel tax	Directive 2003/96/EC on energy taxation. Article 14, 1.b.: exemption for "energy products supplied for use as fuel for the purposes of navigation within Community waters (including fishing), other than private pleasure craft, and electricity produced on board a craft ".	
Infrastructure Charge		
Ports dues: ship gross tonnage/cargo type		AT, BE, CY, CZ, DK, EE, FI, FR, DE; EL, HU, IE, IT, LV, NL, PL, PT, SK, SL, ES, SE, UK
Cargo dues		CY, FR, IT, LV, LU, MT, PT
Environment		SE

Based on DIFFERENT, IMPRINT-Net

Table 5: Summary table on existing charges and taxes in inland waterways transport

Inland Waterways Transport		
Existing charges and taxes	**EU Framework**	**Member States**
Charge exemption	Directive 2003/96/EC on energy taxation: Art. 15(1)(f) *possibility* to exempt fuel used for the purpose of navigation on inland waterways (incl. fishing) other then in private pleasure craft, and electricity produced on board of a craft.	Rhine, Danube, Elbe Oder (Mannheim Convention). 70% of inland waterway transport.
Shipping rights		BE,
Differentiated charge		FR, DE (Mosel convention)
Port use		NL, HU

Based on study of Ecorys .Charging and pricing in the area of inland waterways (2005)

Annex 6: Eurovignette in Europe

Insert picture

Annex 7: Equity Approach of the level of internalisation (REFIT approach)

1. METHOLODOGY

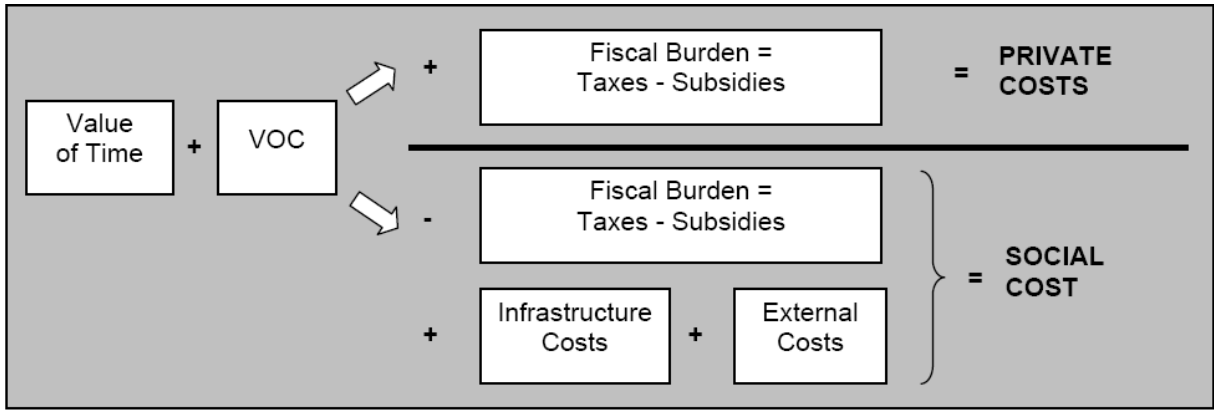
REFIT is a Research project aiming at providing a set of sustainability indicators for assessing the effect of various policies. This project is developing a "modelling tools-based" methodology that produces data on a set of identified indicators and that enables ex-ante evaluation of the European Common Transport Policy considering the economic, environmental and social dimensions of sustainability.

The level of internalisation (LoI) is the degree, to which external costs have been internalised according to the polluter pays principle. The LoI is designed to assess how much policies contribute to the objective of fair pricing. According to theory, pricing and taxation is justified if markets are imperfect and distorted.

For the REFIT calculations the Equity Approach is eligible. It takes into account total and average costs.

The aim of the Equity Approach (or Full Cost Approach) is to identify the total costs they cause and compare these costs with the total charges paid by the category in question. Thus, the Equity Approach defines the Level of Internalisation as follows:

Figure 1: Basic cost elements of the LoI



The basic cost elements of the LoI are

Vehicle operation costs (VOC) reflect the costs derived from the generation of transport services. They comprise i.e. driver wages, fuel cost , insurance, etc
Value of Time is a mode specific value of the time of the passenger (or goods) spent in the vehicle.

These are added to both nominator and denominator

PRIVATE COSTS

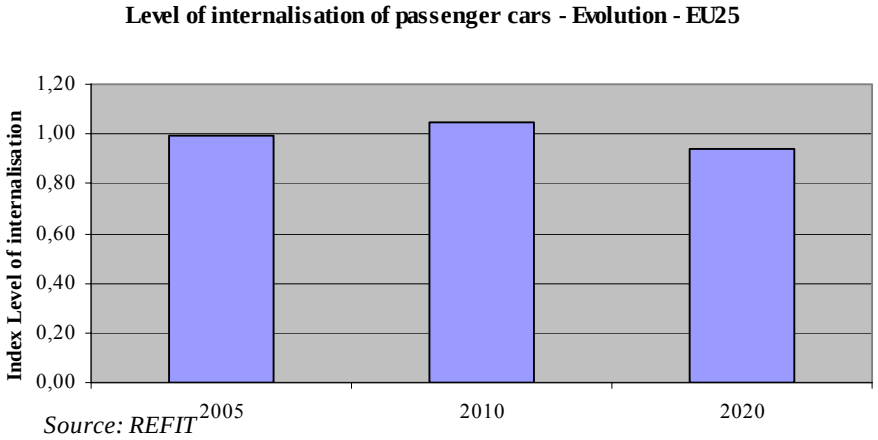
The consumer has to pay taxes, fees and charges for the service, such as fuel levy, road user fees, airport charges, etc. Since the consumer profits as well from state subsidies to the transport sector, these have to be deducted.

SOCIAL COSTS

Infrastructure Costs are costs related to implementation and maintenance of transport infrastructures. These costs are borne by the state and are a part of the social costs.
The sum of taxes and subsidies is deducted from the denominator, as it is assumed that taxes are used to pay the social costs caused by the transport activity.
External Costs are generated through the transport activities and comprise the costs for airborne emissions, global warming, noise and accidents. Only the cost components that are not internalised according to the polluter pays principle are external.

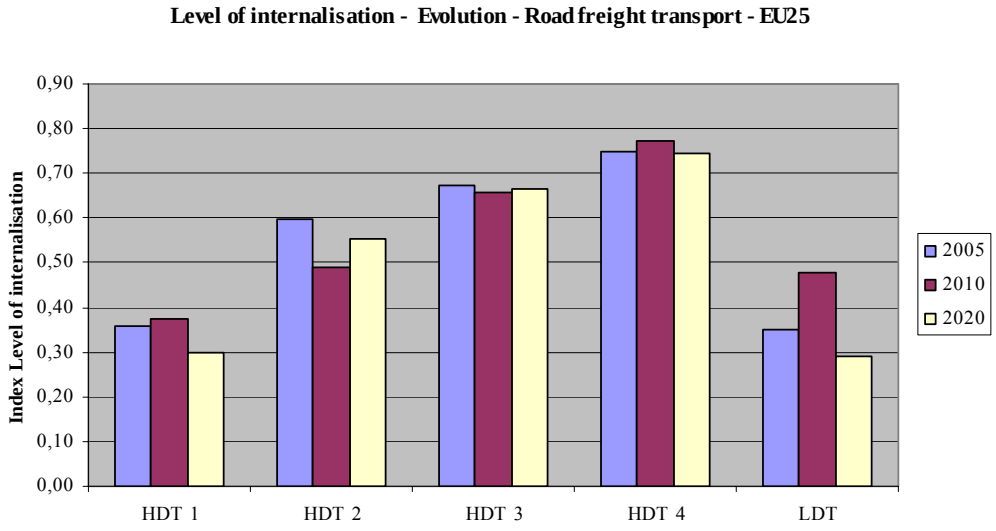
2. INDICATORS

Graph 1

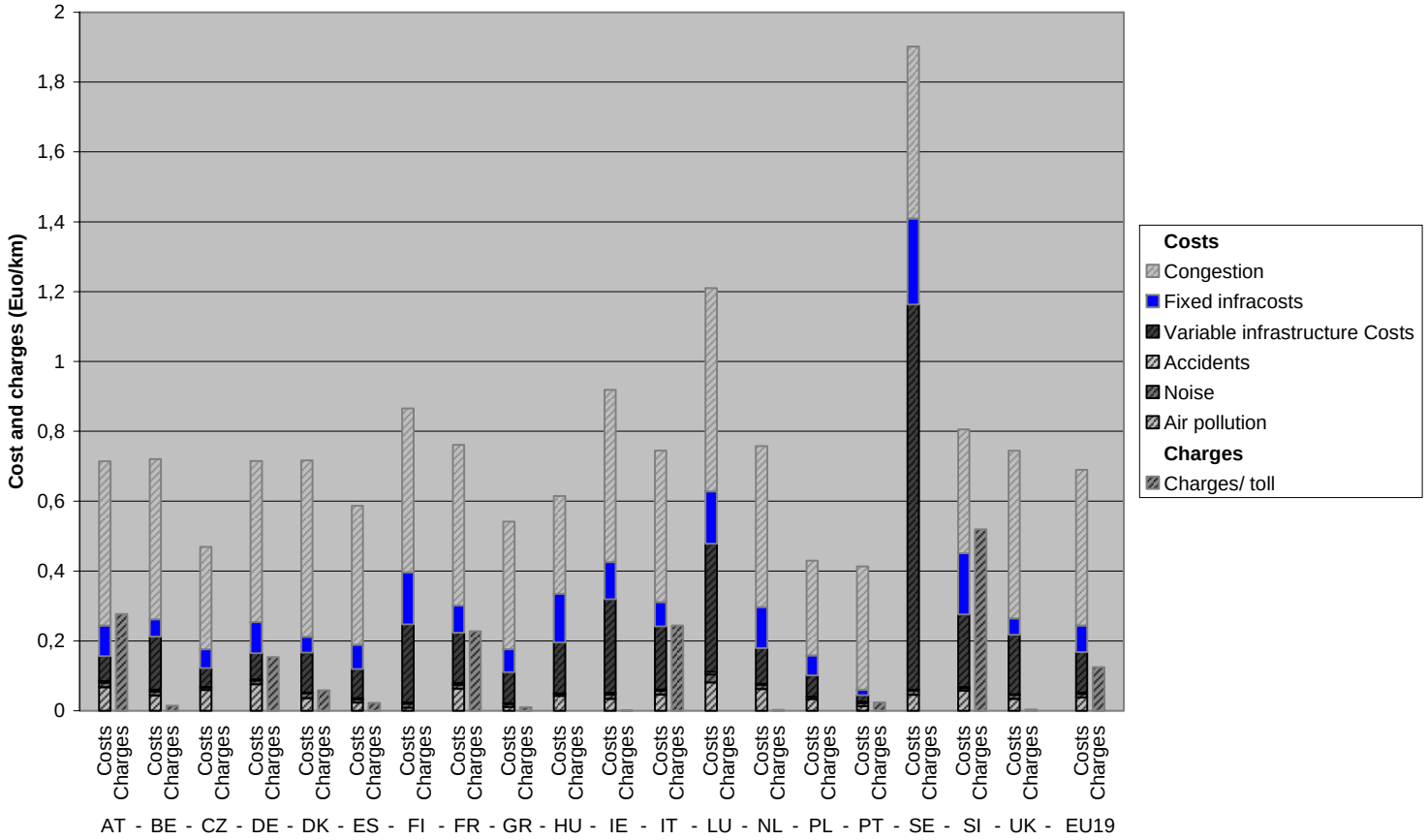


Source: REFIT

Graph 2



Annex 8: Efficiency approach: Level of internalisation (IMPACT)



Source: IMPACT Study (Deliverable 3). The study also provides similar calculations for other vehicles.

Annex 9: Screening of policy options

Table 1: Summary of policy options (without BAU option)

	Charge	Tax	Tradable permit	Electronic charging
Congestion				
Road	Policy option for freight, passenger, freight + passenger		Policy option	Policy option for freight, passenger, freight + passenger
Rail	Policy options			
Air	Policy option			
Maritime	Policy option			
Inland Navigation	Policy option			
Accident				
Road	Policy option	Policy option		Policy option
Rail				
Air				
Maritime				
Inland Navigation				
Noise				
Road	Policy option	Policy option		Policy option
Rail	Policy option	Policy option		
Air	Policy option	Policy option		
Maritime				
Inland Navigation				
Air pollution				
Road	Policy option	Policy option		Policy option
Rail	Policy option	Policy option		
Air	Policy option	Policy option		
Maritime	Policy option	Policy option		
Inland Navigation	Policy option	Policy option		
Climate Change				
Road		Policy option	Policy option	
Rail		Policy option	Policy option	
Air		Policy option	Policy option	
Maritime		Policy option	Policy option	
Inland Navigation		Policy option	Policy option	

Source: Consultation Paper on the Internalisation of external costs. Published in October 2007.

Table 2: Confronting policy choices with Stakeholders views and the need of European action (subsidiary test)

	Stakeholders views on external costs	Stakeholders views on policy options	Stakeholders views on the need for European actions	Subsidiarity test	Policy options proposed in the Impact Assessment
Congestion in road	Congestion is seen as an important nuisance/	The majority of people favour the option of charging for freight and passenger.	The majority of people think that the EU should do something in the field of congestion. But they stress that congestion is a local problem and the EU should pay attention to this characteristic.	Subsidiarity should be respected as long as the principle of free circulation in the EU is respected. EU directive 2006/38/EC (Eurovignette) provides a common approach on interurban road (modulation) More complex in urban areas.	Congestion charge for passenger cars: EU common framework. Congestion charge for freight road transport: revision of EU directive. Policy option 2.
Congestion in rail	The majority of people consider congestion is not an important nuisance.	The majority favour "no new action"		Scarcity charge is foreseen in EU directive 2001/14/EC.	No option for rail.
Congestion in aviation	The majority of people consider congestion is not an important nuisance.	The majority favour "scarcity charge".		Communication on infrastructure charge. Common framework.	No option for air
Congestion in maritime	The majority of people consider congestion is not an important nuisance.	The majority favour "no new action"			No option for maritime
Congestion in IWW*	The majority of people consider congestion is not an important nuisance.	The majority favour "no new action"			No option for IWW
Accident in road	Accident is not seen as the most important nuisance	The majority thinks that accident should be internalised in road. The majority favour liability insurance	The majority of people think that the EU should do something in the field of accident.	In the field of insurance, need to respect the subsidiarity principle.	No option.
Accident in rail	Accident is not seen as the most	The majority thinks that			No option..

	Stakeholders views on external costs	Stakeholders views on policy options	Stakeholders views on the need for European actions	Subsidiarity test	Policy options proposed in the Impact Assessment
	important nuisance	accident should be internalised in rail.			
Accident in aviation	Accident is not seen as the most important nuisance	The majority thinks that accident should be internalised in aviation.			No option..
Accident in maritime	Accident comes after air pollution and climate change. (but interpreted as accidents implying water pollution)	The majority thinks that accident should be internalised in maritime.			No option.
Accident in IWW*	Accident is not seen as the most important nuisance	The majority thinks that accident should be internalised in IWW.			No option.
Noise in road	Noise is not seen as an important nuisance.	The majority favour differentiated charge.	The majority of people think that the EU should do something in the field of noise. The EU is already harmonising data collection (noise map). Initiatives in railways and aviation.	The EU is already harmonising data collection (noise map). Initiatives in railways: abatement measures in retrofitting. Directive 2002 on noise in airports: report published.	Noise is charged in all modes of transport in policy option 2 and 3.
Noise in rail	Noise is considered as the most important nuisance	The majority favour differentiated charge.			Noise is charged in all modes of transport in policy option 2 and 3.
Noise in aviation	Noise ranks after air pollution and climate change.	The majority favour differentiated charge.			Noise is charged in all modes of transport in policy option 2 and 3.
Noise in maritime	Noise is not considered as the most important nuisance.				Noise is charged in all modes of transport in policy option 2 and 3.
Noise in IWW	Noise is not seen as an important nuisance.				Noise is charged in all modes of transport in policy option 2 and 3.
Air pollution in road	Air pollution is seen as the most	The majority favour	The majority of people think	In the field of regulation and	Air pollution charge in all

	Stakeholders views on external costs	Stakeholders views on policy options	Stakeholders views on the need for European actions	Subsidiarity test	Policy options proposed in the Impact Assessment
	important nuisance	differentiated charge.	that the EU should do something in the field of air pollution.	standardisation, EU can act to ensure fair competition.	modes of transport in policy option 2 and 3.
Air pollution in rail	Air pollution ranks second after noise.	Half favour differentiated charge. Half favour "no new action". .			Air pollution charge in all modes of transport in policy option 2 and 3.
Air pollution in aviation	Air pollution second after climate change.	The majority favour differentiated charge.			Air pollution charge in all modes of transport in policy option 2 and 3.
Air pollution in maritime	Air pollution ranks first.	The majority favour differentiated charge.			Air pollution charge in all modes of transport in policy option 2 and 3.
Air pollution in IWW	Air pollution ranks first.	The majority favour differentiated charge.			Air pollution charge in all modes of transport in policy option 2 and 3.
Climate change in road	Climate Change is not considered as the most important nuisance	The majority favour taxation.	The majority of people think that the EU should do something in the field of climate change. Global approach. EU is entitled to act. There is also the need to take into account existing international agreements in maritime and IWW sectors. The proposal to put air transport into ETS should also be taken into account.	Climate change is a global problem. EU is entitled to act. As regards fuel taxation, rule of unanimity of Member States.	Climate change tax or ETS is considered in policy option 2 and 3.
Climate change in rail	Climate Change is considered as a nuisance after congestion and air pollution.	Half favour "no new action" and half of respondents ETS.			Climate change tax or ETS is considered in policy option 2 and 3.
Climate change in air transport	Climate Change is considered as the most important nuisance.	ETS and tax are the most favoured instruments.			Climate change tax or ETS is considered in policy option 2 and 3.
Climate change in maritime	Climate change is considered as an important nuisance and ranks second after air pollution.	The majority favour ETS			Climate change tax or ETS is considered in policy option 2 and 3.
Climate change in IWW	Climate change is considered as an important nuisance and ranks second after air pollution.	No new action and ETS are favoured.			Climate change tax or ETS is considered in policy option 2 and 3.

Annex 10: Description of policy options 2 and 3

1. POLICY OPTION 2

Policy Options 2 concerns the revision of the Eurovignette, leaving all other modes of transport unchanged. Within each variant 2a, 2b, some further analysis has been made in order to test the impact of different assumptions on fuel tax, estimates of external costs.

The starting point would be take into account the existing infrastructure costs (assumed to be implemented through existing tolls) as it is foreseen in the current directive.

Policy option 2 envisages charging in all roads in order to avoid traffic diversion. The current directive allows Member States to charge on motorways (TENs). The IMPACT study proposed a scenario (5B) charging only motorways and detour of traffic appeared to be important. Therefore, charging in all roads will be analysed.

2.A. Charging for air pollution and noise costs while climate change tackled through fuel taxes

Road user charge for air pollution and noise would be allowed. Basically, Member States would add to the current permissible road tolls (infrastructure cost) an environmental mark-up. The mark-up would reflect the air pollution and noise costs generated by lorries and would vary according to the vehicle characteristics, the location and to the time. The differentiation at constant revenue according to time (peak, off-peak) would contribute to reduce congestion. Existing fuel taxes are considered to cover climate change (e.g. by labelling a CO2 component).

Policy option 2A will be analysed with different assumptions.

- The first one would be to take the central value of external costs as proposed by the Handbook. This option is part of the analysis proposed section 4 and 5.

- A second option would be to take the high estimates of external costs as proposed by the Handbook. This option allows analysing the impact of taking higher values of external costs. The charges would also vary according to the EURO class of vehicle and the location (urban/interurban). Existing fuel taxes are considered to cover climate change.

- Finally, a third option will be tested assuming that only Member States having already tolls charge external costs. This option would envisage optional charging by Member States. Therefore, in the modelling exercise, Ireland, Finland, Sweden, Denmark, Estonia, Latvia, Lithuania, Luxembourg, Malta, Cyprus and United Kingdom have been excluded from the scope of the analysis. An EU coordination including a cap system would ensure that the charges are not set above the median values of external costs of air pollution and noise generated by lorries. The charges would also vary according to the EURO class of vehicle, and the location (urban/interurban). Existing fuel taxes are considered to cover climate change.

2.B Charging for air pollution, noise and climate change

A similar system would be applied, except that in addition a CO2 charge would be added on top of the air pollution and noise charge. Member States may choose to add this CO2 charge

in their fuel tax or in the tolls. Those above the EU average fuel tax level could be inclined to opt for an increase of tolls.

Two possibilities could be explored:

- Member States add a CO2 charge on top of the infrastructure charge whatever their current level of fuel duties (above or at Community minimum level).

- Member States add to the tolls a CO2 mark-up with a lowering of fuel tax.

2. C. Charging for air pollution, noise and congestion

On top of air pollution and noise costs, a congestion mark-up would be applied on some sections/links (basically, when marginal infrastructure costs are higher than average infrastructure costs, reflecting the pressure on the use of infrastructure).

As regards congestion charging, two possibilities would be explored:

- Charging for congestion HGV

- Charging for congestion HGV and private cars. The rationale behind would be to charge HGV only if passenger cars are also charged.

Table 1: Description of modelling options for the Policy options 2

Modes **Scope External costs**	**Road freight transport** **Modelling of Policy Option 2**
Air pollution Noise CO2	**Variant 2a** External costs on top of existing infrastructure cost (as they are currently charged). Charges on air pollution, noise. CO2 already internalised through fuel taxes. ***2a High estimates*** In this sub-variant, high estimates of external costs are applied. **2a Central estimates** Here, central estimates of external costs are applied. ***2a Some Member States*** Only Member States with tolls (excluding IE, FI, SW, DK, EE, LV, LT, LU, MT, CY, UK)
Air pollution Noise CO2	**Variant 2b**. Same as variant 2a Central estimates All Member States CO2 mark-up. ***2b High fuel tax*** ***2b Lower fuel tax***
Air pollution Noise Congestion	**Variant 2c**. Same as variant 2a Central estimates All Member States. Congestion mark-up on some sections. 2C freight Congestion charge would be limited to freight transport. 2C all road Congestion charge would be extended to freight and passenger cars.

2. POLICY OPTION 3

Policy option 3 includes all modes of transport. Charging for road freight transport is similar to charging in policy option 2. Variant 3A allows charging for air pollution and noise and add a fuel tax to non road transport.

Table 2: Description of modelling options for the Policy options 2

Modes **Economic Instruments** **Scope External costs**	**All modes of transport** **(PO3)**
Air pollution Noise CO2	**Variant 3a** External costs on top of existing infrastructure costs cost (as they are currently charged). Air pollution and noise charging in all modes of transport. CO2 assumed to be internalised in road fuel taxes. CO2 charge (fuel tax) in maritime and IWW added. Air pollution and noise are reflected in an increase of circulation tax in cars (converted in flat km-charge in Transtools).
Air pollution Noise CO2	**Variant 3b** Same as variant 3a. Mark-up for CO2 in road transport (freight and passenger)
Air pollution Noise Congestion	*No variant. Road congestion cannot be internalised through circulation tax. Congestion can not be modelled in other modes of transport.*
All external costs, i.e. accidents, congestion, air pollution, climate change, noise.	-

4. SCENARIO OF THE IMPACT STUDY AND THE LINK WITH THE POLICY OPTIONS OF THE IMPACT ASSESSMENT

The IMPACT study comprises other set of scenario that has been also useful to build the policy options.

From the IMPACT study (deliverable 3), the reference scenario has been used to assess the impacts of other policy options.

The other scenarios provide illustration on alternative ways of internalisation. Scenario 2 assumes internalisation through fuel tax. This scenario has been discarded as fuel tax cannot capture the local dimension of some external costs.

Scenario 3 assumes an increase of charges and has not been used.

Scenario 4a assumes a lowering of fuel tax in road transport and has not been used. Scenario 4b is the same as 4a, but keeps existing level of fuel tax. Scenario 4c is the same as 4a, but keeps existing level of fuel tax in freight transport.

Finally, scenario 5a and 5b are close to policy option 3. The difference is that these scenarios apply marginal infrastructure costs and charge for all external costs. Scenario 5b is interesting because it only charges freight road transport on motorways. It results a detour traffic which has been assessed when deciding the scope of policy option 2.

Annex 11: Description of models

TRANSTOOLS

TRANSTOOLS is a European transport network model covering passenger and freight, as well as intermodal transport. The following innovations are obtained from TRANSTOOLS:

- New set up of a supply and demand model with respect to existing models.

- Intermodality for passenger/freight (as National and European transport policies seek to promote intermodality through different measures).

- Inclusion of intercontinental flows (mainly for freight), as some models do not cover this segment.

- Full coverage of Central and Eastern Europe (Accession Countries and the countries at the borders of the enlarged European Union).

- Integration of the new Member States at a level similar to those of EU-15.

- Feedback infrastructure development economy (as the question of indirect effects in the economy and on network level is important, especially where investment has a substantial influence - notably for Accession Countries).

- Logistics/freight chain explicitly included.

- Coupling method between local traffic and long-distance traffic in order to address the effect of congestion on the later.

- A software approach is chosen which results in a software modelling tool on network level.

The TRANSTOOLS model, which reference data comes from the ETIS database, is made of different modules. These model components exchange information according to a sequential approach (i.e. the origin/destination matrix produced by the passenger model is transferred to the modal split model, etc.) although feed back effects are taken into account (i.e. transport costs and times produced by the assignment model are fed back to the modal split model). In brief, the model works in the following way (using a modelling step of 1 year):

- The freight/logistics model (based on NEAC and SLAM principles) produces the freight unimodal transport modal matrices for the 10 NST/R commodity groups on the basis of the NUTS2 zoning system.

- The passenger model (based on ASTRA and VACLAV principles) simulates the generation and distribution of trips and produces origin/destination matrices by trip purpose and by mode at regional level (NUTS3 zoning system).

- Main inputs for these two models are the transport network, the socio-economic data and the transport Level of Service (cost and times); the latter is produced by the TRANSTOOLS assignment model.

- The freight and passenger trip matrixes enter in the assignment stage. Freight matrixes have to be brought on the level of NUTS III, a level which is appropriate to describe congestion.

- From the assignment module the transport costs will enter (in logsum) into the SCGE model, which is based on CG Europe principles. The change in transport costs/accessibility is a driving force for indicating the indirect effects (change in regional GDP), which are then fed in the freight and passenger model.

TREMOVE

TREMOVE is a policy assessment model to study the effects of different transport and environment policies on the emissions of the transport sector. The model estimates the transport demand, the modal shifts, the vehicle stock renewal, the emissions of air pollutants and the welfare level. The model can be applied for environmental and economic analysis of different policies as road pricing, public transport pricing, emission standards, subsidies for cleaner cars, etc.

TREMOVE models both passenger and freight transport, and covers the period 1995-2020.

TREMOVE includes in fact 2 models: a land transport model, and a maritime model. The maritime model has not been used for IMPACT since it is not able to model the impacts of pricing policies. The land transport model has been set up to model all transport within one country. The TREMOVE modelling used for IMPACT covers 19 countries: the EU-15 plus Czechoslovakia, Hungary, Poland and Slovenia.

The TREMOVE model has been developed by Transport & Mobility Leuven and the K.U. Leuven, for the European Commission, DG Environment.

The first version of the model dates 1997-1998. At that time, the model covered nine countries and focussed on road transport. The K.U. Leuven and DRI developed the first model as an analytical underpinning for the European Auto-Oil II programme.

TREMOVE consist of twenty-one parallel country models. Each country model consists of three inter-linked core modules: a transport demand module, a vehicle turnover module and an emission and fuel consumption module, to which a welfare cost module and a well-to-tank emissions module has been added.

The transport demand module describes transport flows and the user's decision making process when it comes to making their modal choice. Starting from the baseline level of demand for passenger and freight transport per mode, period, region, etc., the module describes how the implementation of a policy measure will affect the users and companies choice between these 240 different transport types. The key assumption here is that the transport users will select the volume of transport and their preferred mode, period, region etc. based on the generalized price for each mode: cost, tax or subsidy and time cost per km travelled. The output of the demand module consists of passenger kilometres (pkm) and ton kilometres (tkm) that are demanded per transport type for a given policy environment. The pkm and tkm are then converted into vehicle kilometres.

The vehicle stock turnover module describes how changes in demand for transport or changes in vehicle price structure influence the share of age and type of vehicles in the stock. The

output of the vehicle stock module is twofold: both the total fleet and the number of km for each year according to vehicle type and age.

The fuel consumption and emissions module is used to calculate fuel consumption and emissions, based on the structure of the vehicle stock, the number of kilometres driven by each vehicle type and the driving conditions.

Outputs from the vehicle stock and fuel consumptions and emissions modules are fed back into the demand module. As fuel consumption, stock structure and usage influence usage costs, they are important determinants of transport demand and modal split.

In addition to the three core modules, the TREMOVE model includes a well-to-tank emissions and a welfare cost module.

The well-to-tank emissions module enables to calculate emissions during production of fuels and electricity.

The welfare cost module has been developed to compute the cost to society associated with emission reduction scenarios in European urban and non-urban areas. The welfare effect of a policy change is calculated as the discounted sum of changes in utility of households, production costs, external costs of congestion and pollution and benefits of tax recycling. These benefits of tax recycling represent the welfare effect of avoiding public funds to be collected from other sectors, when the transport sector generates more revenues.

ASTRA

The ASTRA model is an integrated simulation model which consists of eight modules. The modules are linked by a series of feedback loops and the model can be run over the appraisal period required for a cost benefit analysis (CBA). For example, trade flows, private consumption decisions, investments, production relationships modelled by input-output tables, government revenues and technical progress are influenced by transport behaviour and transport policies.

The 8 modules describe the structure and development of population, the macro-economy, the regional economy, foreign trade, transport, vehicle fleet composition, the environment and add a welfare module for aggregating results by means of welfare indicators. While the first idea for ASTRA development was to bring together transport, the economy and the environment on a common platform of analysis the recently presented advanced version ASTRA-D includes covers now all 25 EU countries plus Bulgaria, Romania, Switzerland and Norway, and 25 economic sectors.

(1) The population module (POP) provides the population development for all modelled 29 European countries with one-year age cohorts. Demographic trends, which result from the population module, strongly affect the outcomes of the other modules. This is particularly true for ageing societies with shrinking populations but also holds for intra EU and rural-urban migration, which is of prior importance with regard to social integration.

The model depends on exogenous country-specific factors like fertility, death and infant mortality rates as well as migration into the 29 modelled European countries. Based on the age structure given by the one-year-age cohorts important information is provided for other modules like the number of persons in working age or the number of persons in age classes

that permit to acquire a driving licence. The population in ASTRA is calibrated to fit the EUROSTAT baseline population predictions until 2050 (Ponti et al., 2002).

(2) The national economic framework in which the other modules are embedded is provided by the macro-economic module (MAC). The MAC cannot be categorised explicitly into only one economic category of models, for instance a neo-classic model. Instead it incorporates neo-classical elements, like production functions, but also Keynesian elements as the dependency of investments on consumption. These have been extended according to the requirements of the ASTRA objectives e.g. such that investments are also made dependent on exports.

The macro-economic module provides several important outputs to other modules. The most important one is, obviously, gross domestic product acting as one of the major drivers for exports. Labour productivity is another element among factors that drive the foreign trade module. Finally, disposable income per adult affects car purchasing in the vehicle fleet module. The following five major elements constitute the functionality of the macroeconomics module.

The sectoral interchange model reflects the economic interactions between 25 economic sectors of the national economies by an Input-Output table structure. The structure of 25 economic sectors is based on the NACE-CLIO system established by EUROSTAT for input-output data. The input-output tables are driven by changes of final demand. The structure of the tables can either change due to shifts between sectors of final demand and due to changes in transport and energy costs that are part of the intermediate inputs in the input-output table. The main output taken from the input-output model are the sectoral production value (total output) and the sectoral gross value added. The sectoral production value is the major driver for the generation of domestic freight.

The second element, the demand side model depicts the four major components of final demand: consumption, investments, exports-imports (which is modelled in detail in the foreign trade module) and the government consumption. All indicators of the demand side are modelled on the basis of 25 economic sectors, including 10 service sectors.

The basic element of the supply side is a production function of Cobb-Douglas type calculating potential output that incorporates the three major production factors labour supply, capital stock and natural resources as well as technical progress referred to as total factor productivity (TFP) Total factor productivity is endogenised depending on sectoral investments, freight transport time-savings and labour productivity changes.

The fourth element of MAC consists in the employment model that is based on value-added as output from input-output table calculations and labour productivity. Employment is differentiated into full-time equivalent employment and total employment in order to capture the growing importance of part-time employment. In combination with the population module, unemployment can be estimated via regulation of activity rate of labour force.

The fifth element of MAC describes government behaviour. Government revenues are differentiated into revenues from social contributions, direct, indirect and other taxes and additionally transport pricing revenues. Transfers to households, subsidies, government consumption and investments form expenditures. Categories that are endogenised comprise VAT and fuel tax revenues, direct taxes, import taxes, social contributions and revenues of transport charges on the revenue side as well as transport investments, interest payments for

government debt, government consumption, unemployment payments, transfers to retired and children, on the expenditure side.

(3) The regional economics module (REM) mainly provides the generation of passenger trips and freight transport volume representing the first of four stages of the classical four-stage transport modelling approach. The number of passenger trips is driven by the number of people belonging to different age classes, their employment and car-ownership situation. Passenger trip generation is performed individually for each of the 75 functional zones implemented in the ASTRA model. Each of the modelled 29 European countries is subdivided into up to four zones composed of groups of homogenous NUTS-II zones. The functional zones were identified by analysis of settlement patterns and GDP per capita.

Domestic freight transport depends on sectoral production values that are translated into flows for the fifteen sectors, which produce goods by means of value-to-volume ratios. International freight transport is generated by sectoral trade, output of the foreign trade module, and value-to-volume ratios are used again to compute the correspondent traffic volume. ASTRA uses a development trend of value-to-volume ratios as experts project higher growth of exported values than amount of goods, which implies an appreciation of exported goods. For freight distribution and the further calculations in the transport module the demand volumes of the fifteen sectors are aggregated into three goods categories: bulk goods, general cargo goods and unitised goods.

(4) The foreign trade module (FOT) is subdivided into an INTRA-Europe and a Europe to rest-of-the-world (RoW) countries model. The rest-of-the-world countries were aggregated into nine regions, consisting of: NAFTA, Latin and Middle America, Japan, China, India (e.g. India, Pakistan), East Asian Tigers (e.g. South Korea, Thailand, and Malaysia), Oceania (e.g. Australia, New Zealand), Turkey and Rest-of-the-world countries. Both, INTRA-Europe and Europe-RoW models are mainly driven by the development of relative productivity between the 29 European countries or between the 29 European countries and rest-of-the-world countries, GDP growth of importing country and world GDP growth as external factors to trade. Additionally the INTRA-Europe trade flows depend on the development of averaged generalized cost of transport between each of the country pairs. The resulting export-import flows of these two trade models then are fed back into the macroeconomics module as part of the final demand. Secondly, the INTRA-Europe trade model provides monetary flows between countries that were transformed via value-to-volume ratios into international freight demand within the REM module.

(5) The major input of the Transport Module (TRA) is the link based transport demand for passenger and freight transport. Using individual transport costs for each transport mode in Euro per km and individual transport time matrices per mode the transport module calculates the modal split based on a classical Logit functions depending on generalised costs (Ortuzar/Willumsen, 1998). The development of passenger transport costs per mode is modelled similar for all modes and starts from exogenously calculated initial costs per km for each passenger mode, differentiated into countries and the three trip purposes business, personal and holiday. An exogenous trend for the cost development is constituted for each mode. Furthermore the development of costs per km for the usage of cars is influenced by the endogenous calculated fuel price development and by the introduction of road pricing in several countries. Similar to the calculation of costs per km for each passenger mode the transport times per mode and km are generated based on initial time matrices for each mode. For national transport the generation and distribution steps of a classical 4-stage transport model are ruled by the REM module, while for the international freight transport, generation

and distribution are replaced by input from the foreign trade model. In the final stage all flows are assigned to domestic networks to model capacity limitations and time reactions of the various modes.

As the assignment stage and the resulting congestion effects on transport times and therefore transport behaviour can only be modelled by a highly detailed transport network model, the transport module in ASTRA can be combined through an interface with the transport network model VACLAV. VACLAV uses a regional classification on the NUTS3 level, i.e. with about 1,300 regions for West Europe and the accession countries to the European Union.

(6) The major input for the Environment module (ENV) are the vehicle-kilometres-travelled generated by the TRA module per transport mode and distance band respectively. Based on these traffic flows and the information from the vehicle fleet model on the drives, car categories and emission standards, the environmental module calculates the most important transport emissions - CO2, NOx, CO, VOC and soot particles - for each distance band. Emission generation is differentiated according its source in: emissions from vehicle and fuel production, emissions caused by cold starts and the hot emissions. Other than the emissions also fuel consumption and fuel tax revenues from transport are computed by this module. Traffic flows and accident rates for each mode form the input to calculate the number of accidents in the European countries. The expenditures for fuel, the revenues from fuel taxes and value-added-tax (VAT) on fuel consumption are transferred to the macro-economic module and provide input to the economic sectors covering fuel products and the government revenues.

(7) The Vehicle Fleet Module (VFT) calculates the vehicle fleet composition for all road modes for the modelled 29 European countries. Vehicle fleets are differentiated into different age classes based on one-year-age cohorts and into different emission standard categories. Additionally, the car vehicle fleet is differentiated into gasoline and diesel powered cars with different cubic capacity categories. The car vehicle fleet develops according to the income changes, the development of population and the development of the fuel prices. The vehicle fleet composition of bus, light-duty vehicles and heavy-duty vehicles mainly depends on the driven kilometres and the development of average annual mileages per vehicle of these modes. The purchase of vehicles is translated into value terms and forms an input of the economic sectors in the MAC that covers the vehicle production. The vehicle fleet model considers also scrapping of a certain share of vehicles during the average lifetime.

(8) Finally in the Welfare Measurement Module (WEM) major macro-economic, environmental and social indicators can be compared and analysed. Also different assessment schemes that combine indicators into aggregated welfare indicators for instance an investment multiplier are provided in the WEM. In some cases, e.g. to undertake a CBA, the functionality is separated into further tools to avoid excessive growth of the core ASTRA model by including the assessment framework directly within the model.

HOW THE MODELS COMPLEMENT

The analysis of impacts relies on different models. All these models have been used in a complementary ways. TRANSTOOLS results have been used in Astra modelling. TREMOVE and TRANSTOOLS have also been used to support the REFIT indicators.

Table 1: Use of models for the analysis of impact

Analysis of Impact	**Model**
Transport Cost Traffic Modal shift	TRANSTOOLS
Economic Macroeconomic evolutions (GDP, investment, exports, consumption, TFP, employment)	ASTRA
Level of internalisation	REFIT, based on TREMOVE
Environment	
Environmental costs	TRANSTOOLS
Noise	REFIT (based on TREMOVE and TRANSTOOLS)
Social	
Safety	TRANSTOOLS REFIT (based on TRANSTOOLS)
Equity	REFIT (based on EDIP)
Regional welfare	TRANSTOOLS

Annex 12: Description of the reference scenario

The development of the reference scenario (No New Actions) considers the policy framework set by already taken decisions as well as European strategy documents. The reference scenario is built on the current situation. So for all modes all currently existing taxes, charges and regulation remain. This includes existing infrastructure charges, fuel taxes, harbour dues, etc. In addition to the current situation, the reference scenario assumes that all policy proposals that are in the pipeline are implemented as well as the options offered by 2006/38/EC are used by all Member States (see part 4 of the impact assessment).

1. TRANSPORT EVOLUTIONS

Table 1: Evolution of freight transport

EU-25, 2020, billion ton*kms

	Short-Sea	Rail	Road	IWW	All modes
Reference 2000	1363	465	1800	224	3851
Reference 2020	2350	864	2853	325	6392
Growth 2000-2020	72,5%	85,8%	58,5%	45,0%	66,0%

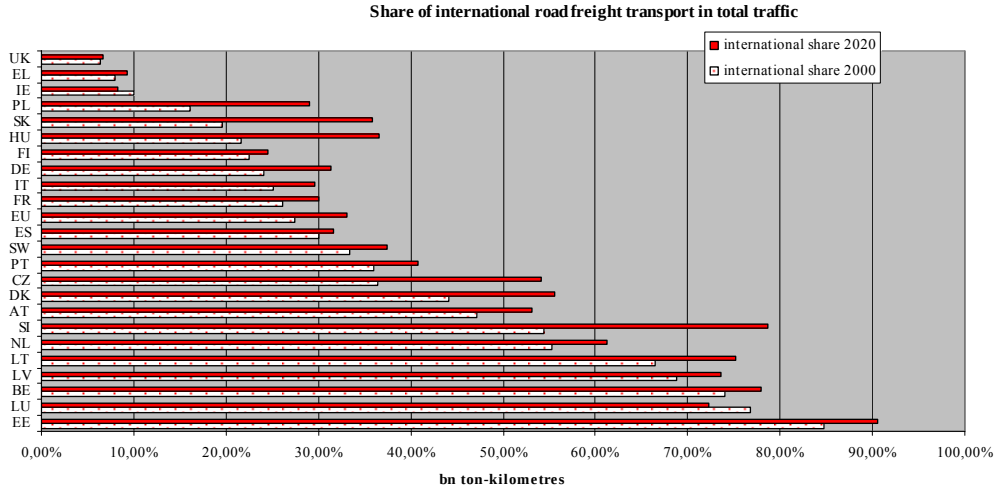
Table 2: Evolution of passenger transport

EU-25, 2020, billion pass*km*

	Air	Rail	Road	Total
Reference 2000	440	423	4197	5060
Reference 2020	795,8322962	550,9763	5512,47	6859,279
Growth 2000-2020	80,9%	30,3%	31,3%	35,6%

* Combined TRANSTOOLS-TREMOVE results. As TRANSTOOLS does not include intra-NUTS 3 traffic, a combination with TREMOVE has been made. Reference 2000 is using the Pocket book figures.

Graph 1: Evolution of the share of international road freight transport in total traffic



Source: IMPACT/TRANSTOOLS

2. THE BRIDGE BETWEEN ASTRA AND TRANSTOOLS

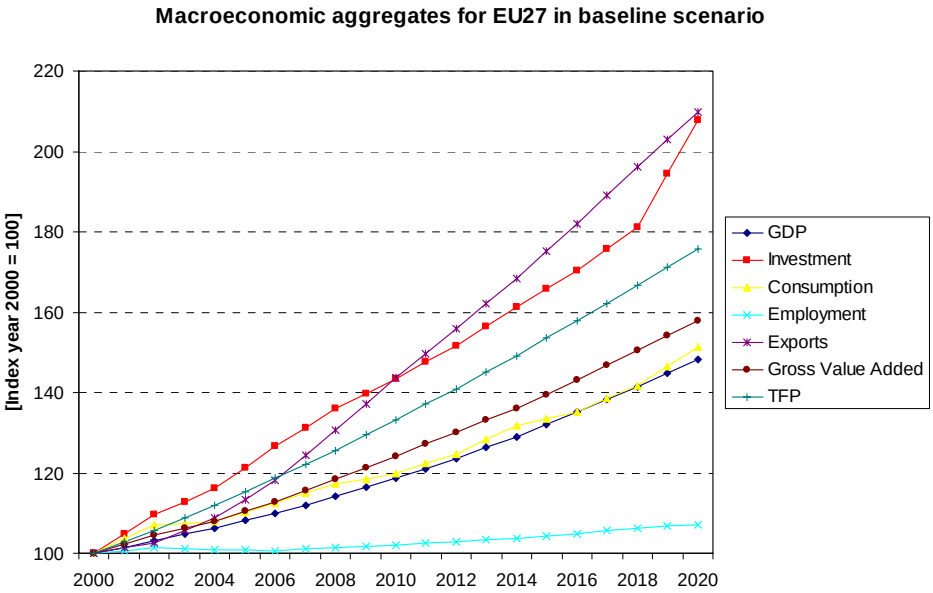
The Trans-Tools model is based on traffic network and simulates interzonal traffic between NUTS3 regions for passenger (respective NUTS2 regions for freight) transport. Due to computation constraints ASTRA is not able to simulate on a similar spatial level and therefore uses functional zones instead of real NUTS regions. Thus in ASTRA every country is subdivided in up to four functional zones (cluster of NUTS II regions according similar population density and other variables). All NUTS zone based trip and time data coming from the Trans-Tools model is transformed to the functional zone based structure of ASTRA. After this transformation ASTRA uses passenger trips respective freight volumes and travel times from the Trans-Tools model for the base year 2000 and for the final year 2020 for the reference scenario and for policy option. In comparison to static models like Trans-Tools, ASTRA as a dynamic model requires inputs for all simulation years in between. Hence, the inputs from Trans-Tools are linear interpolated to derive the input for the whole simulation period from 2000 to 2020. Thus no significant break is expected for the reference scenario (where no policy is implemented); but for policy option 4, where kilometre charges (and at the same time revenues) are changed according the marginal cost pricing principle. These changes were implemented for 2009 and the following years.

Passenger trips, freight volumes and infrastructure user charges are implemented in the ASTRA transport module. In order to provide feedbacks to the economy ASTRA uses micro-macro bridges to simulate the impacts of transport cost, time and finally behaviour changes. Passenger transport performance is used to calculate the share of consumption for transport products and services. Furthermore, ASTRA simulates the impacts on import and export flows between the European countries by analysing the changes in transport times and costs. Technological improvements and hence increasing total factor productivity are induced by reductions in total freight transport time.

Additionally, ASTRA is able to take the use of toll revenues into account. Revenues from road charges can be fed back into the system in terms of balancing the national budget and reducing the government debts or in terms of improving the national competitiveness via refunding the revenues for direct tax reductions. In the latter the expenditures are given back to all private households balancing the total disposable income of private households.

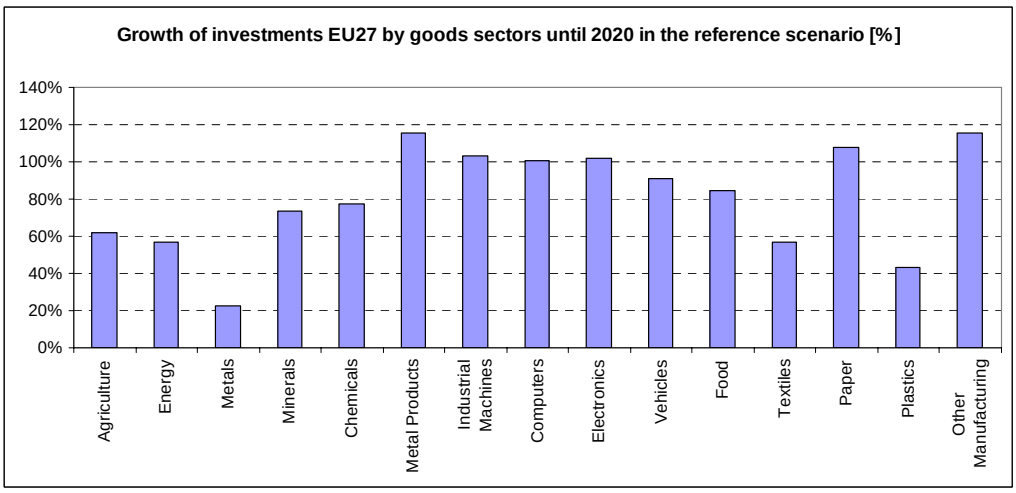
3. MACROECONOMIC TRENDS

Graph 2: Macroeconomic trends of Reference Scenario



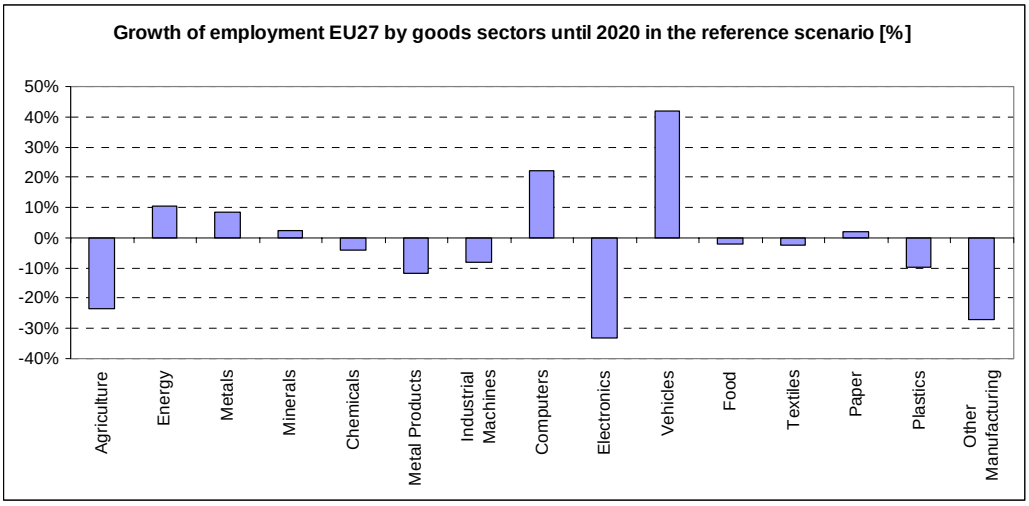
Source: IMPACT/ASTRA

Graph 3: Average annual investment growth rate investments in the goods sectors of EU-27 (in € 2000)



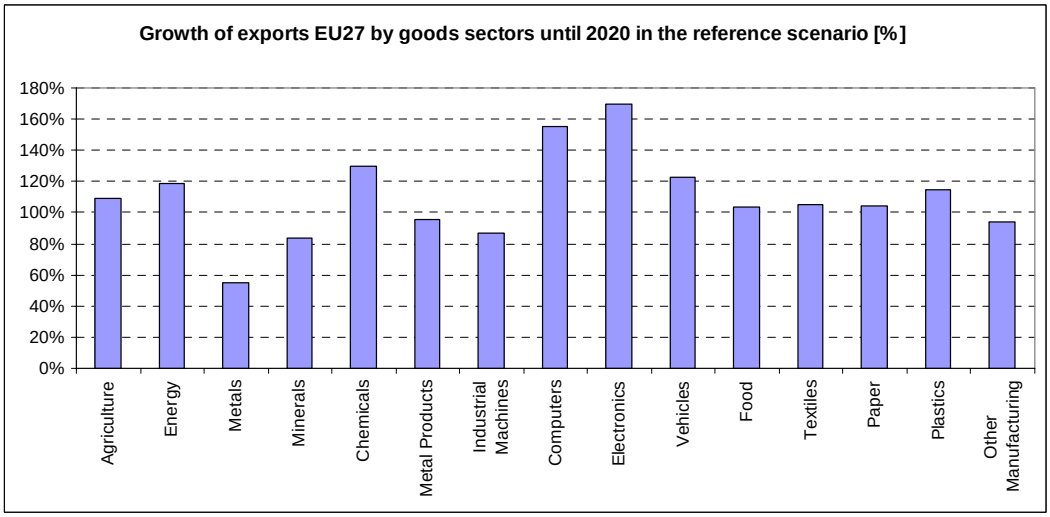
Source: IMPACT/ASTRA

Graph 4: Average annual growth rate of employment in the goods sectors of EU-27 (in € 2000)

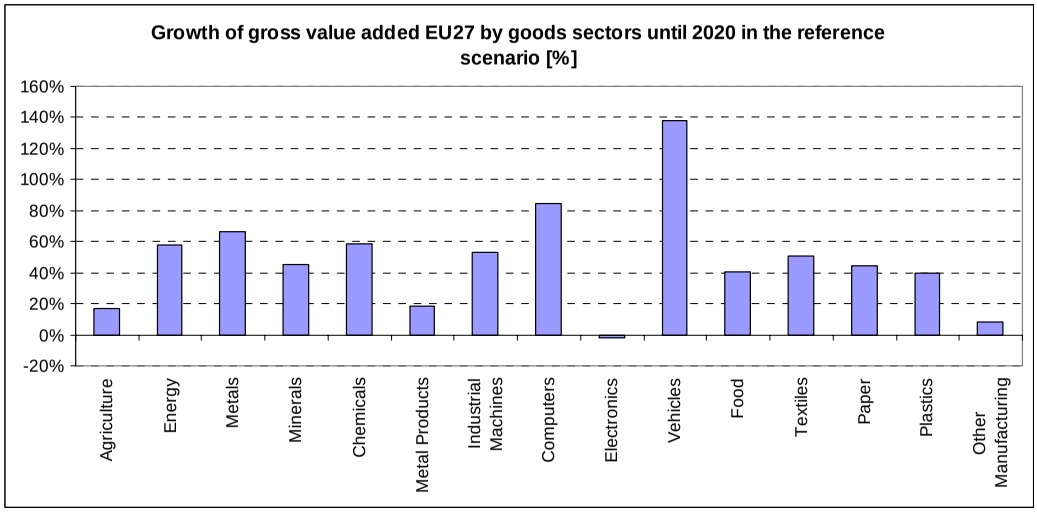


Source: IMPACT/ASTRA

Graph 5: Average annual growth rate of exports in the goods sectors of EU-27 (in € 2000)



Graph 6: Average annual growth rate of gross value added in the goods sectors of EU-27 (in € 2000).



Source: IMPACT/ASTRA

Annex 13: Analysis of Impact of Policy options 2 and 3

1. CHANGES IN TAXES AND CHARGES IN POLICY OPTIONS

Table 1: Summarized changes in total taxes and charges per scenario, per mode (2020)

Total increase in charges/taxes in 2020 (billion €$_{2000}$)	Freight				Passenger			
Scenario	Road	Rail	IWW	Total freight	Road	Rail	Aviation	Total passenger
PO 2A (central estimates)	12	0	0	12	0	0	0	0
PO 2A- only MS with tools	11	0	0	11	0	0	0	0
PO 2A (high estimates)	24	0	0	24	0	0	0	0
PO 2B (existing fuel tax)	22	0	0	22	0	0	0	0
PO 2B (lowering fuel tax)	17	0	0	17	0	0	0	0
PO 2C	24	0	0	24	0	0	0	0
PO 3A	12	1	1	14	0	1	2	3
PO 3B	22	1	1	24	0	1	2	3

Source: summarized modelling input data (based on TREMOVE 2.44 fleet and mileage data for 2020, EU-19).

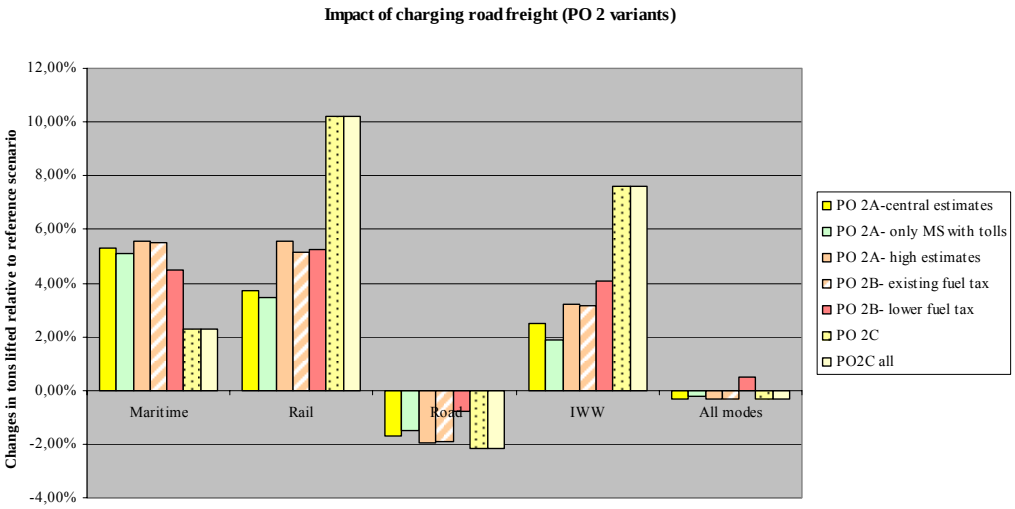
[1] Including LDT.

Remark: These data do not show changes in overall revenues, since they are based on traffic volumes in the baseline from TREMOVE. TRANSTOOLS runs are limited to inter-NUTS-3 traffic.

Source: IMPACT Study

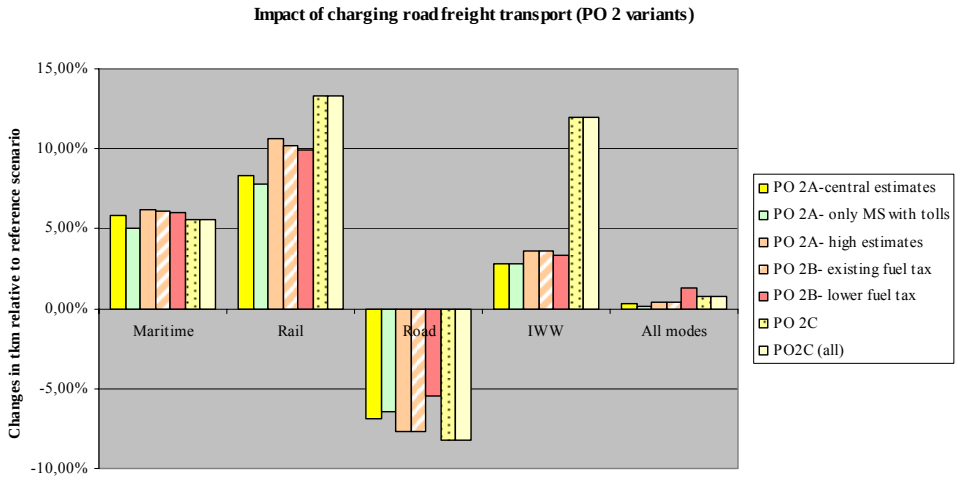
2. ANALYSIS OF IMPACT OF VARIANTS OF POLICY OPTION 2 ON MOBILITY

Graph 1: Analysis of impact on freight transport (ton lifted)



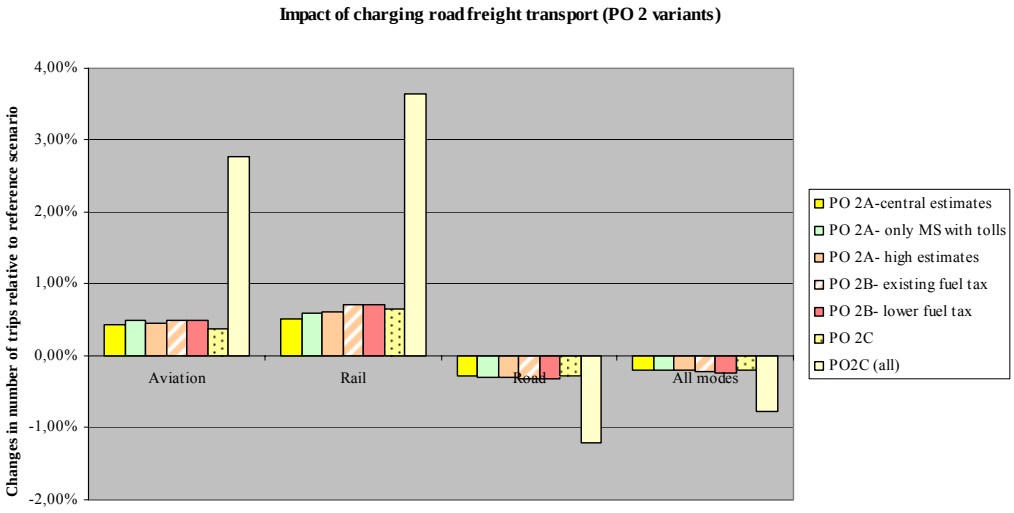
Source: IMPACT/TRANSTOOLS

Graph 2: Analysis of impact on freight transport (ton km)



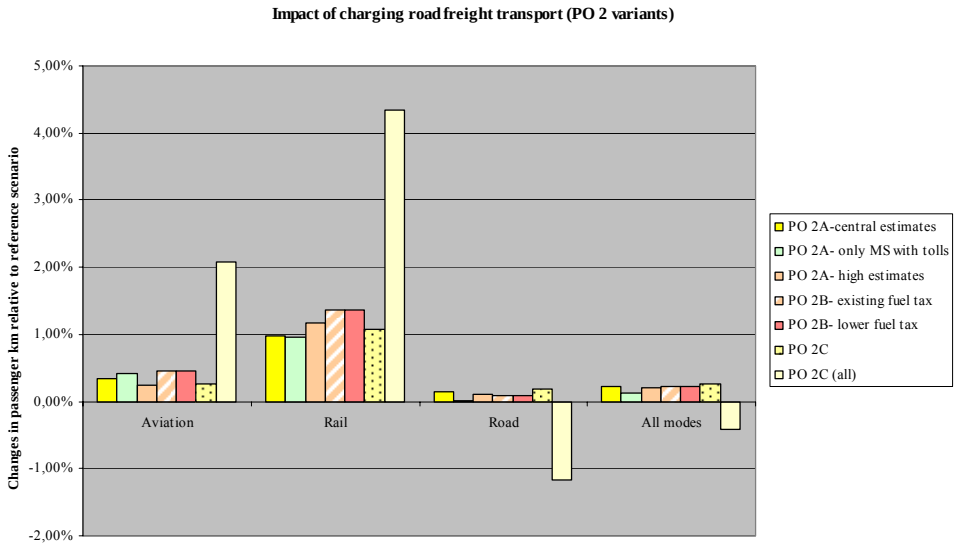
Source: IMPACT/TRANSTOOLS

Graph 3: Analysis of impact on passenger transport (number of trips)



Source: IMPACT/TRANSTOOLS

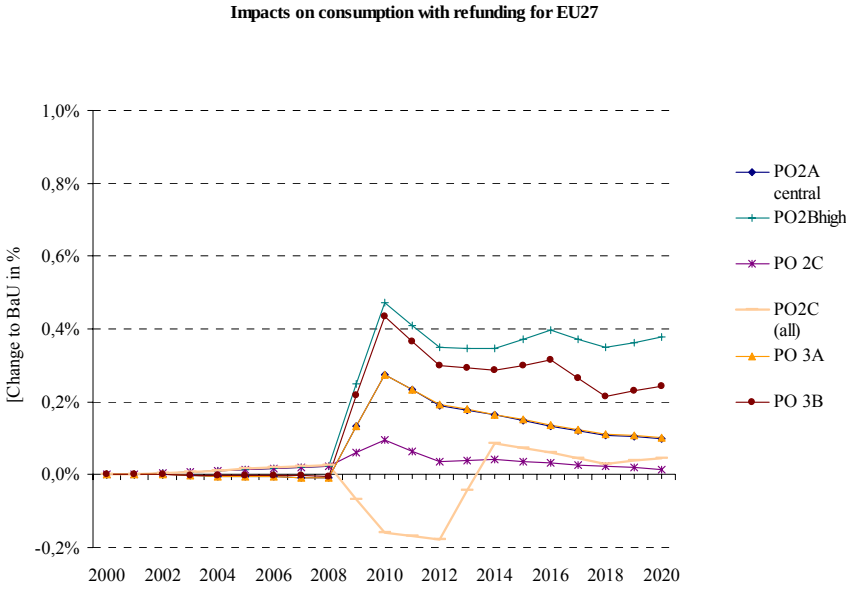
Graph 4: Analysis of impact on passenger transport (passenger-km)



Source: IMPACT/TRANSTOOLS

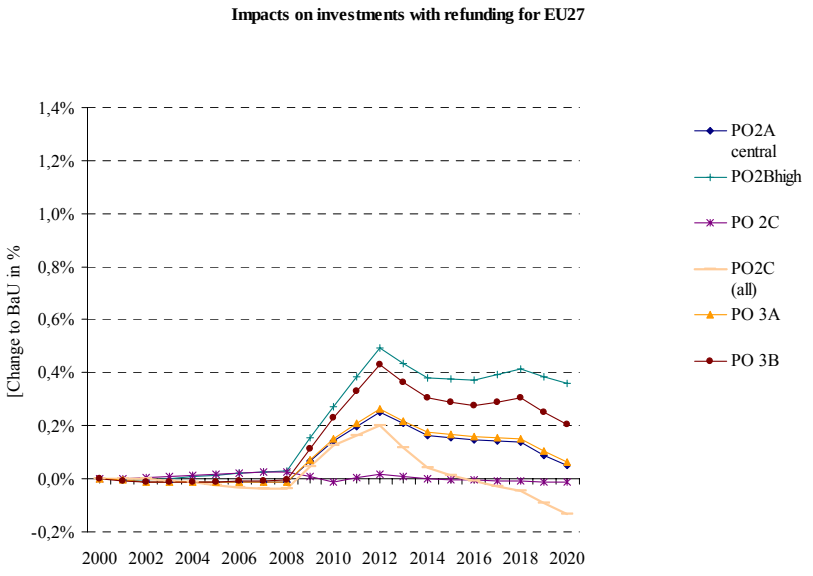
3. MACROECONOMIC IMPACT: COMPARISON OF OPTIONS WITH REFUNDING

Graph 5: Analysis of impact on consumption with refunding



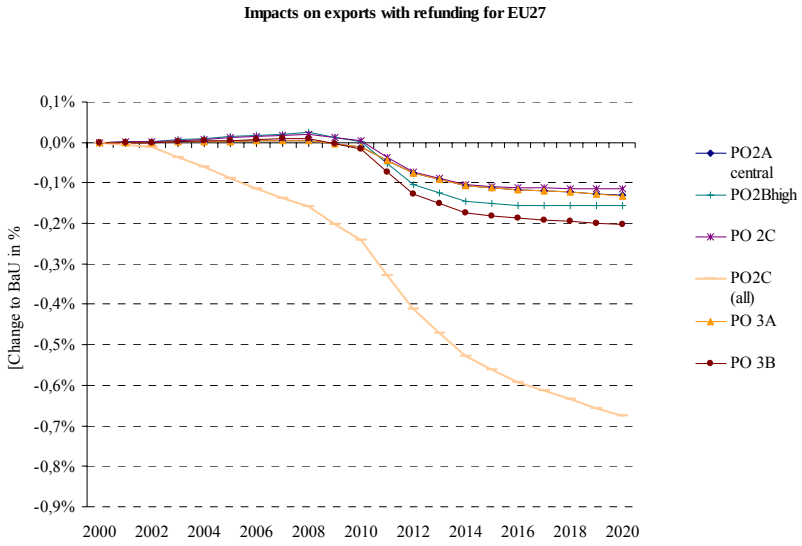
Source: IMPACT/ASTRA

Graph 6: Analysis of impact on investment with refunding



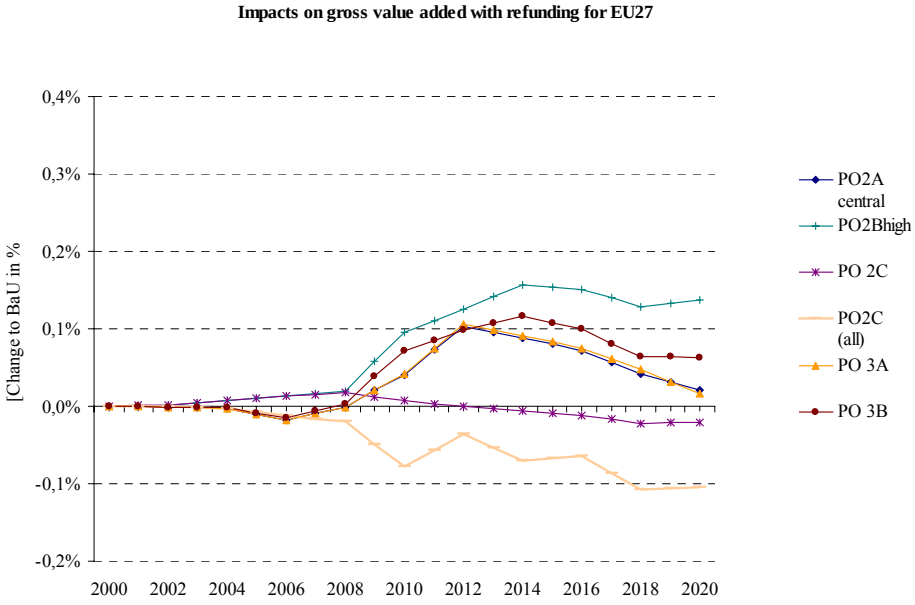
Source: IMPACT/ASTRA

Graph 7: Analysis of impact on exports with refunding



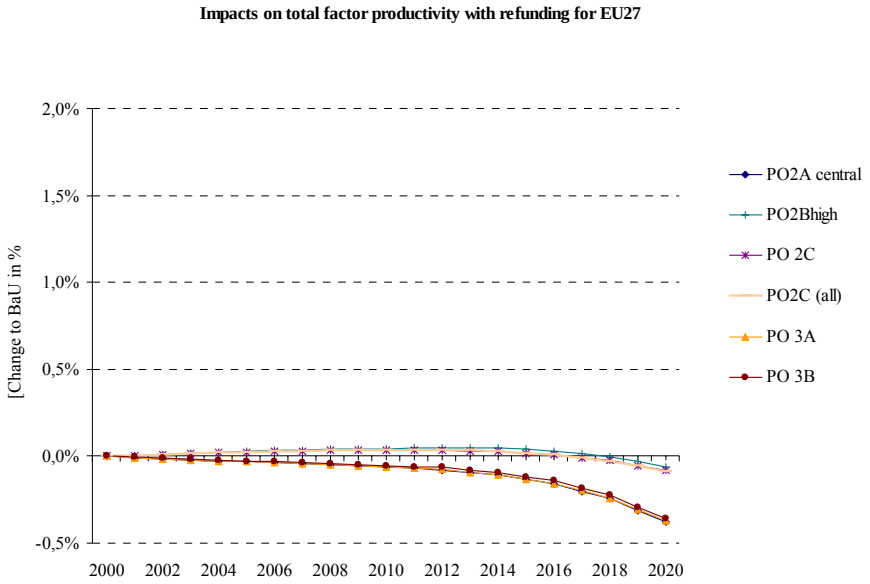
Source: IMPACT/ASTRA

Graph 8: Analysis of impact on GVA with refunding



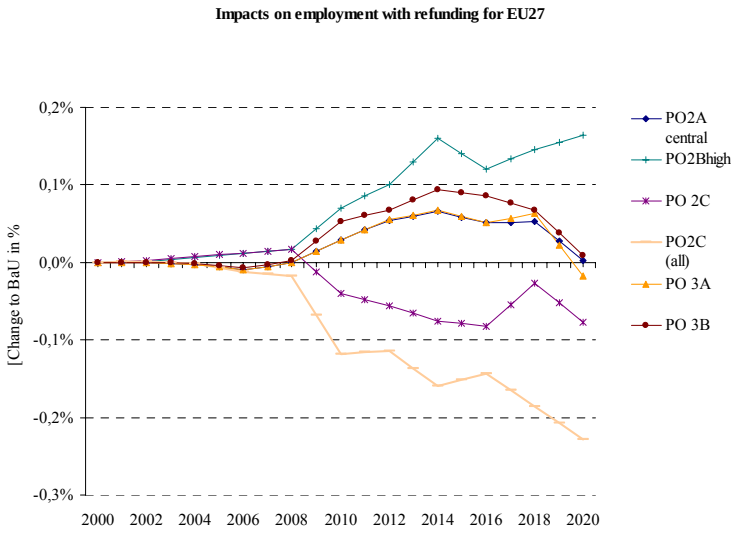
Source: IMPACT/ASTRA

Graph 9: Analysis of impact on TFP with refunding



Source: IMPACT/ASTRA

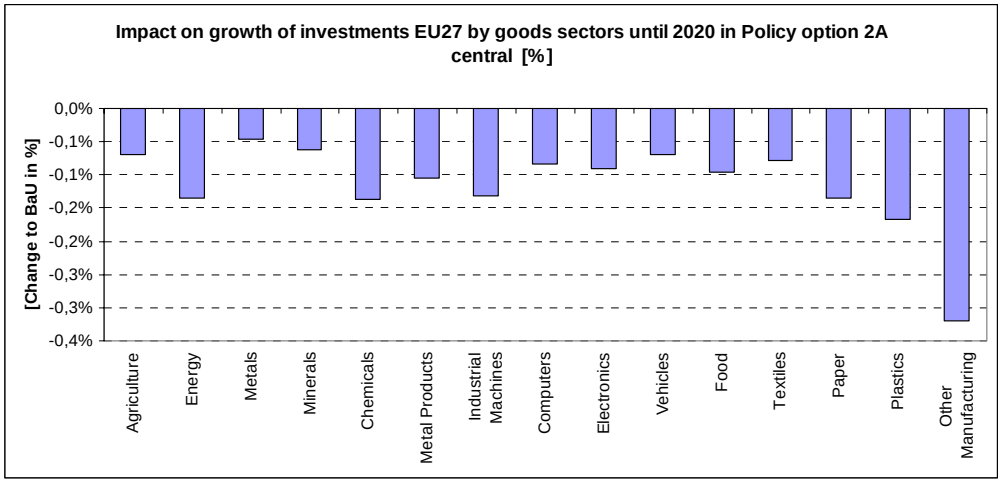
Graph 10: Analysis of impact on employment with refunding



Source: IMPACT/ASTRA

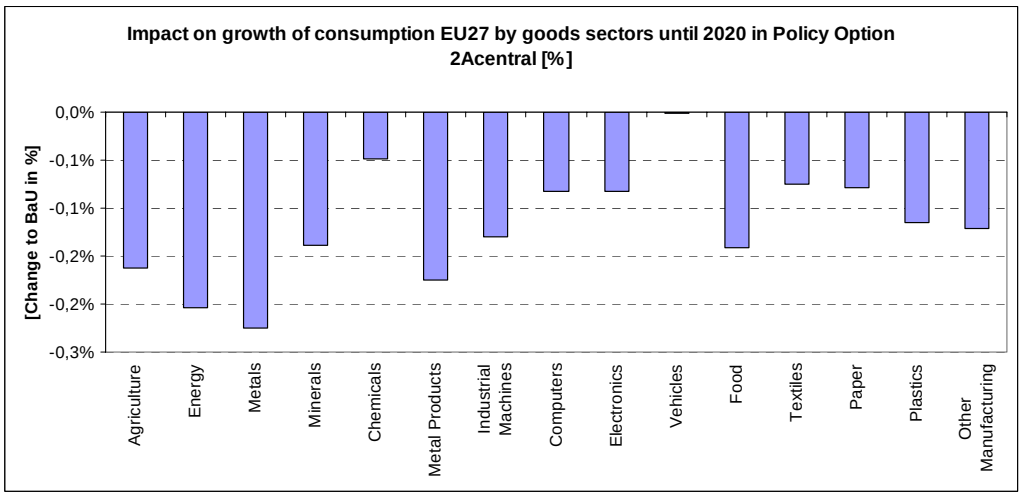
4. SECTORAL IMPACTS OF *POLICY OPTION 2A*

Graph 11: Impact on growth of investment in the goods sectors of EU-27 – PO 2A



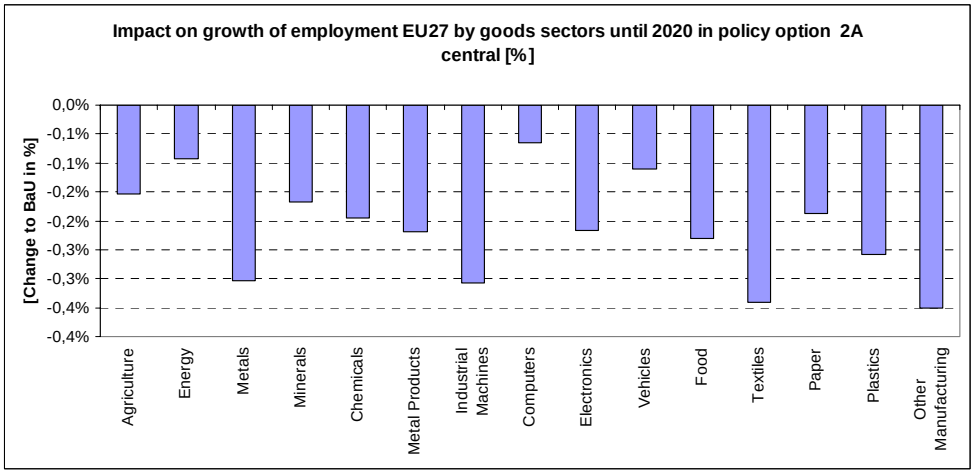
Source: IMPACT/ASTRA

Graph 12: Impact on growth of consumption in the goods sectors of EU-27 – PO 2A



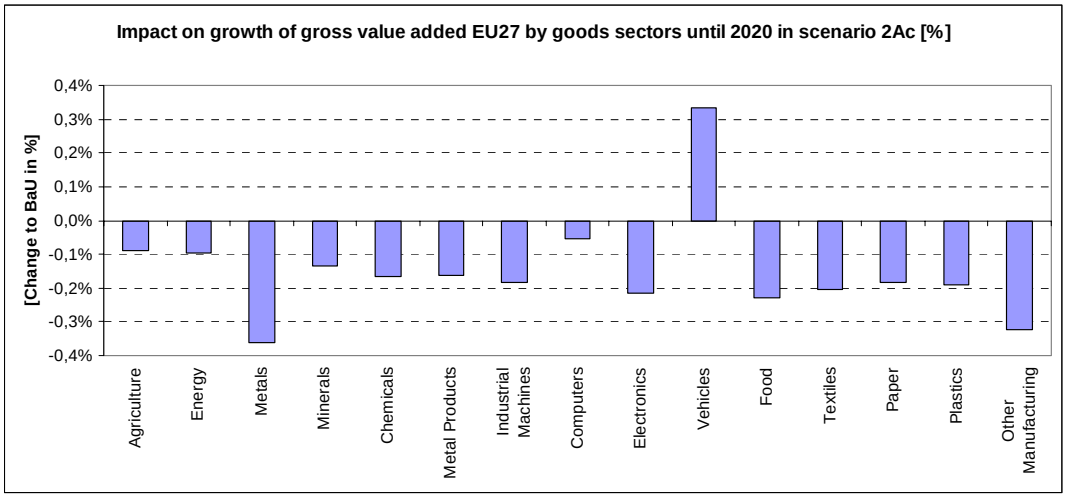
Source: IMPACT/ASTRA

Graph 13: Impact on growth of employment in the goods sectors of EU-27 – PO 2A



Source: IMPACT/ASTRA

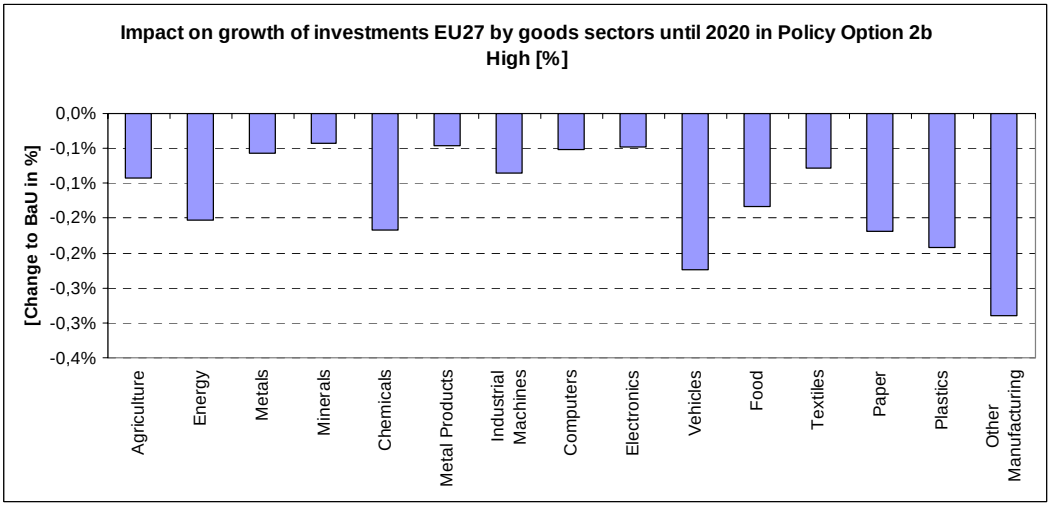
Graph 14: Impact on growth of gross value added in the goods sectors of EU-27 – PO 2A



Source: IMPACT/ASTRA

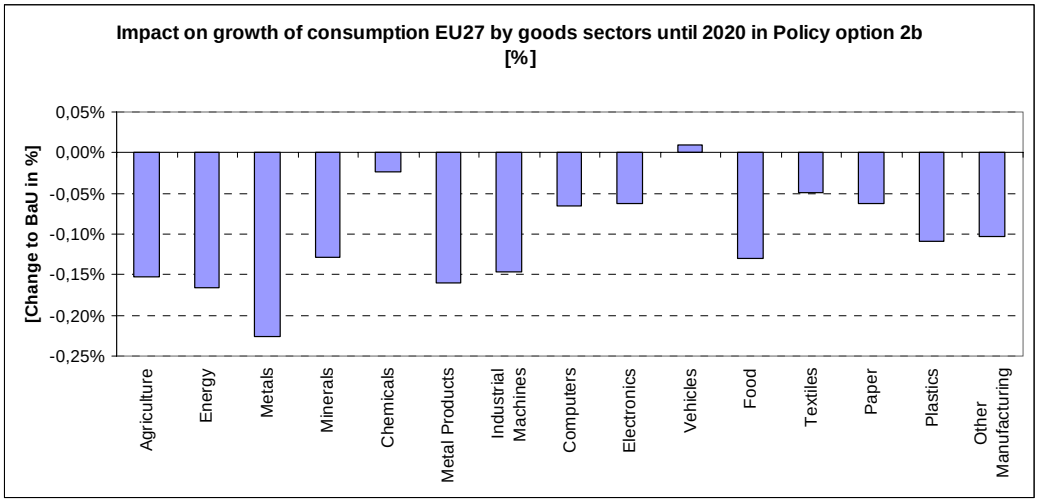
POLICY OPTION 2B

Graph 15: Impact on growth of investment in the goods sectors of EU-27 – PO 2B



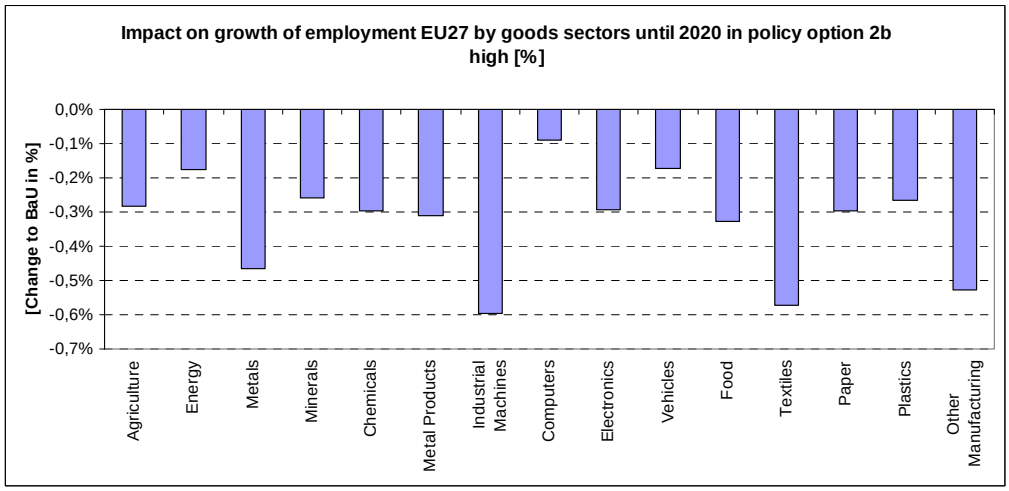
Source: IMPACT/ASTRA

Graph 16: Impact on growth of consumption in the goods sectors of EU-27 – PO 2B



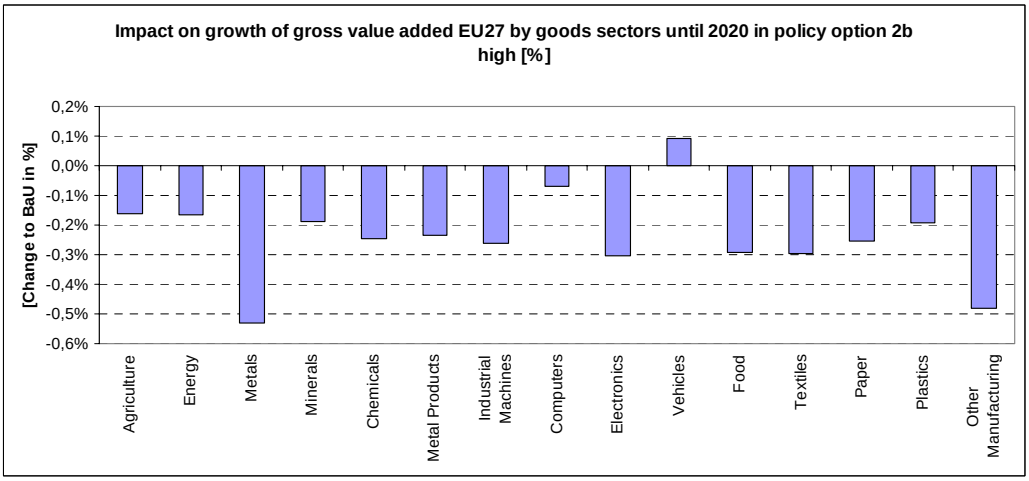
Source: IMPACT/ASTRA

Graph 17: Impact on growth of employment in the goods sectors of EU-27 – PO 2B



Source: IMPACT/ASTRA

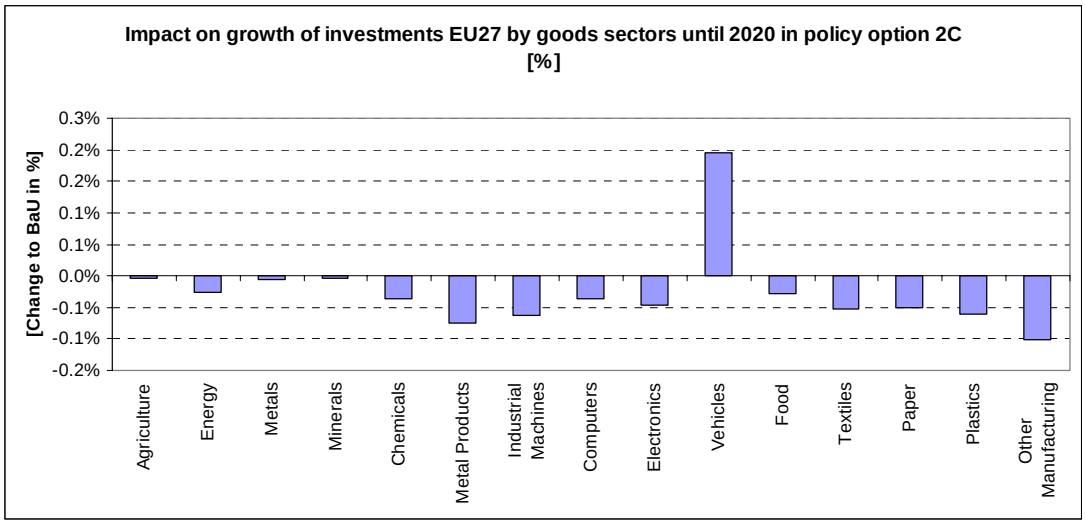
Graph 18: Impact on growth of gross value added in the goods sectors of EU-27 – PO 2B



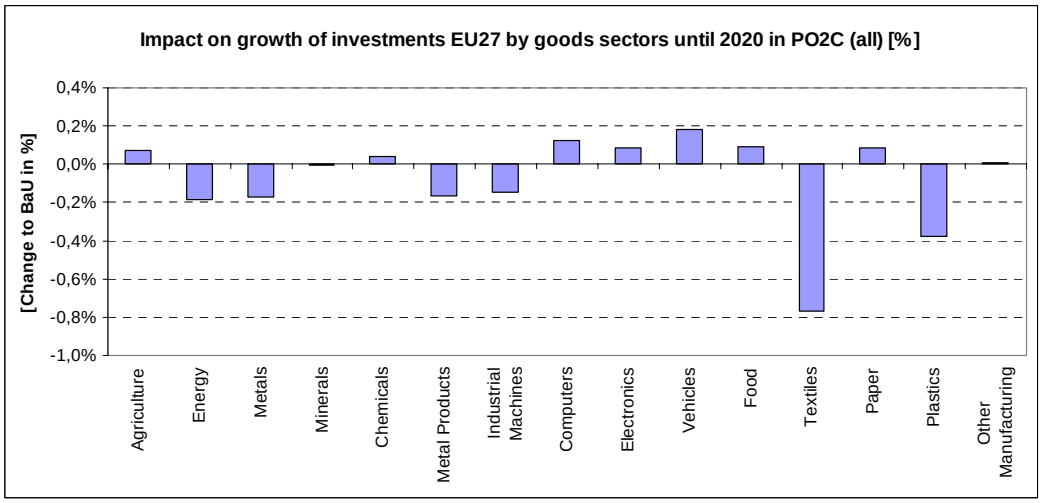
Source: IMPACT/ASTRA

POLICY OPTION 2C and 2C (all)

Graph 19: Impact on growth of investment in the goods sectors of EU-27 – PO 2C

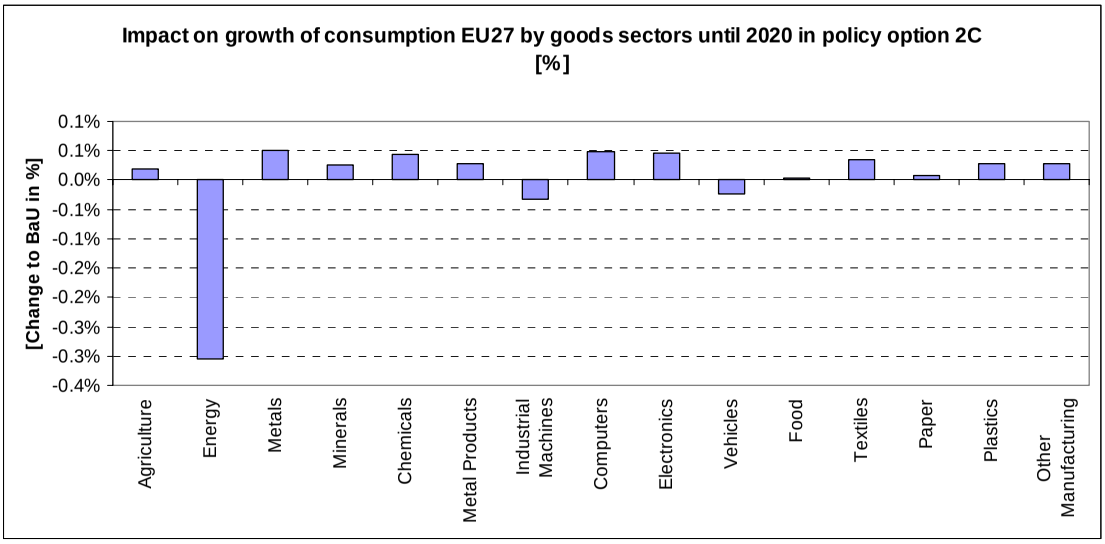


Source: IMPACT/ASTRA

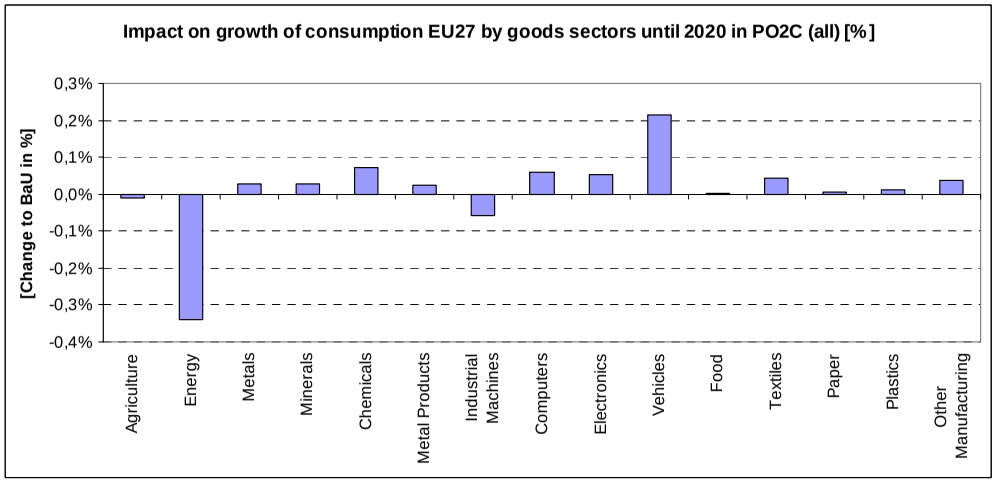


Source: IMPACT/ASTRA

Graph 20: Impact on growth of consumption in the goods sectors of EU-27 – PO 2C

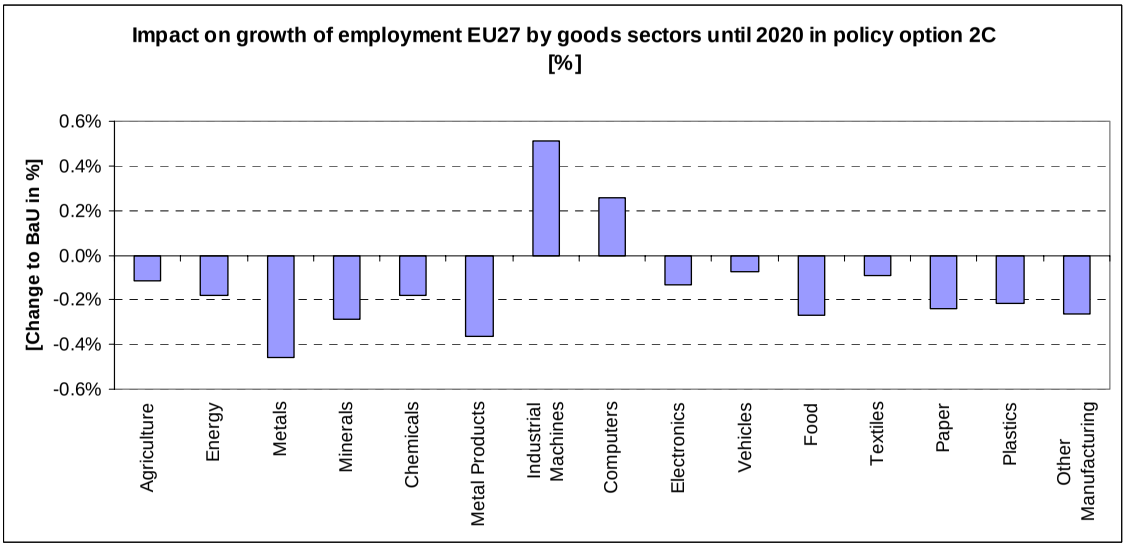


Source: IMPACT/ASTRA

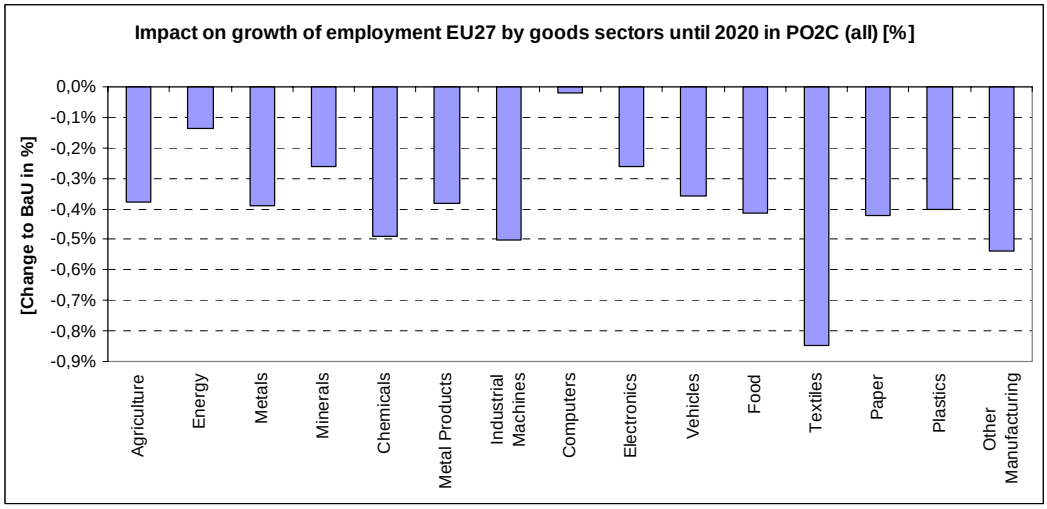


Source: IMPACT/ASTRA

Graph 21: Impact on growth of employment in the goods sectors of EU-27 – PO 2C

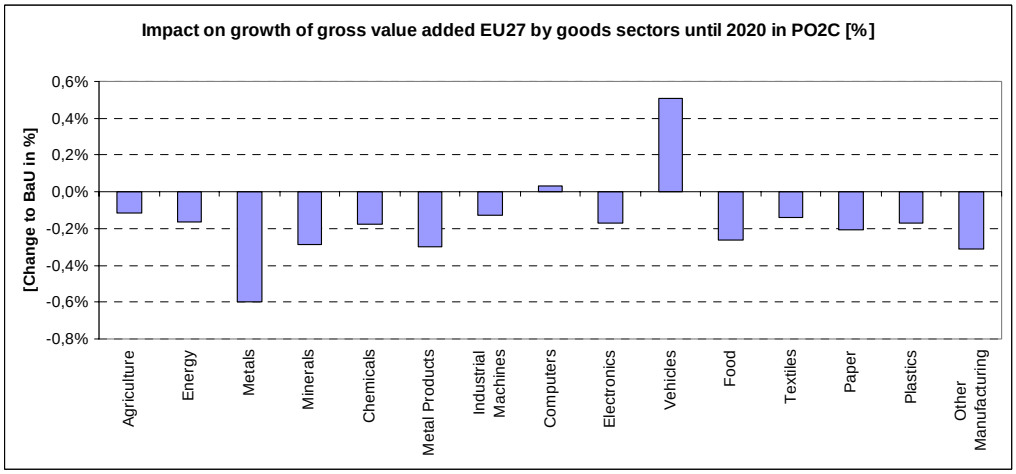


Source: IMPACT/ASTRA

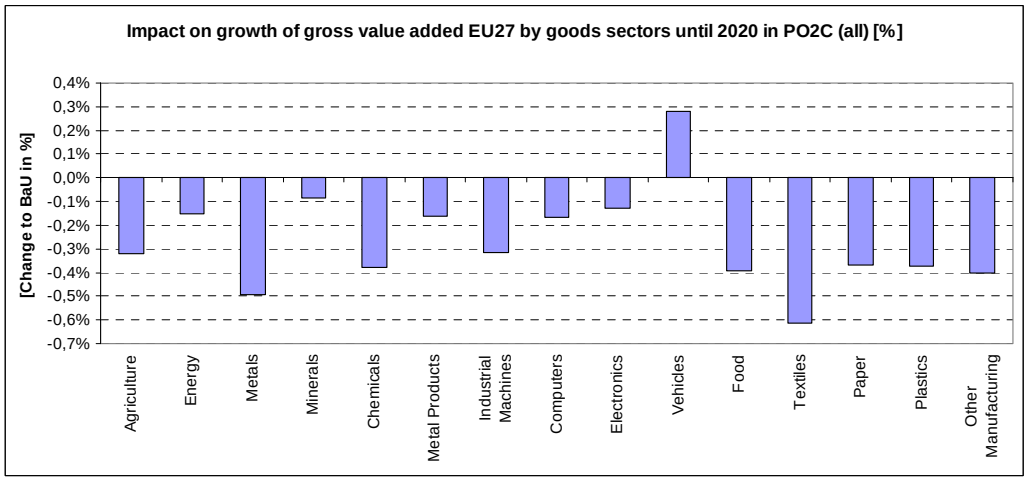


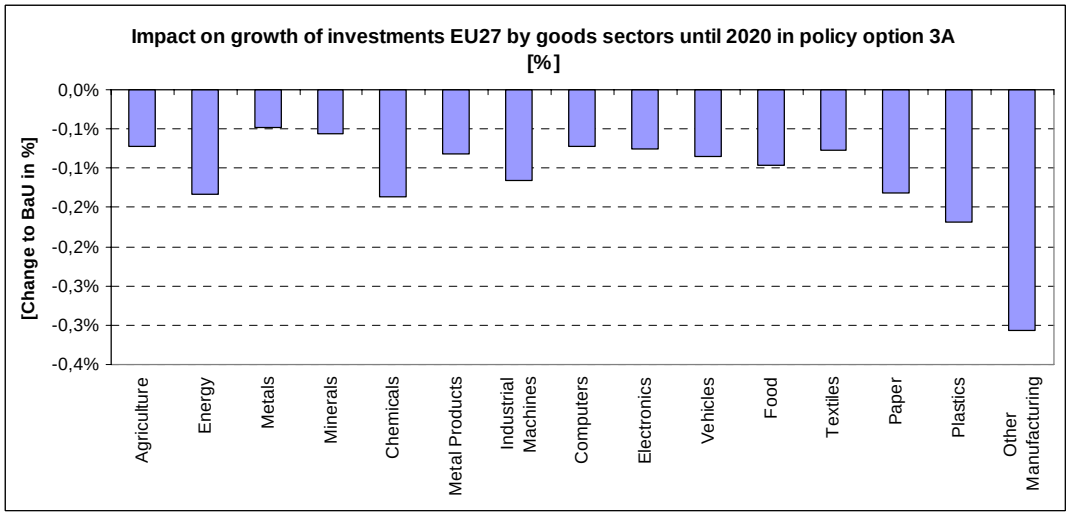
Source: IMPACT/ASTRA

Graph 22: Impact on growth of gross value added in the goods sectors of EU-27 – PO 2C



Source: IMPACT/ASTRA

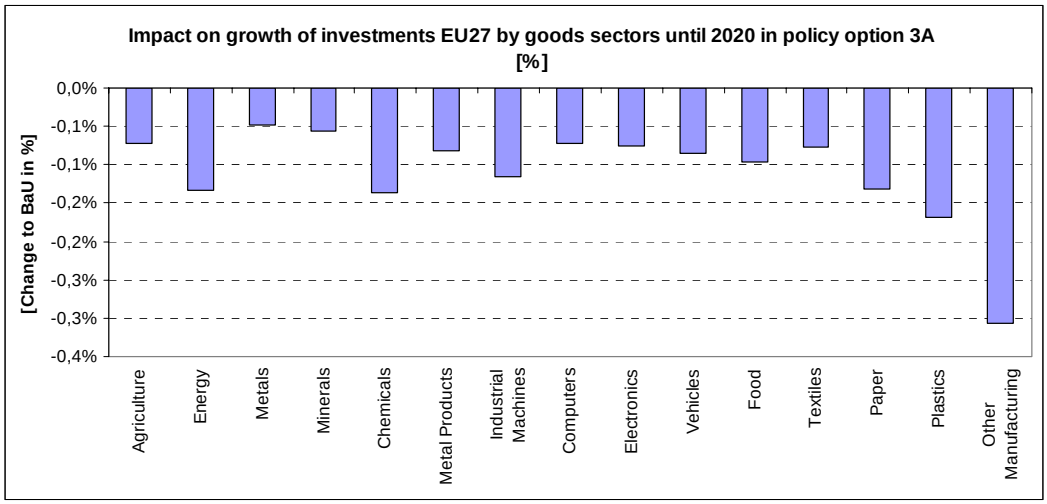




Source: IMPACT/ASTRA

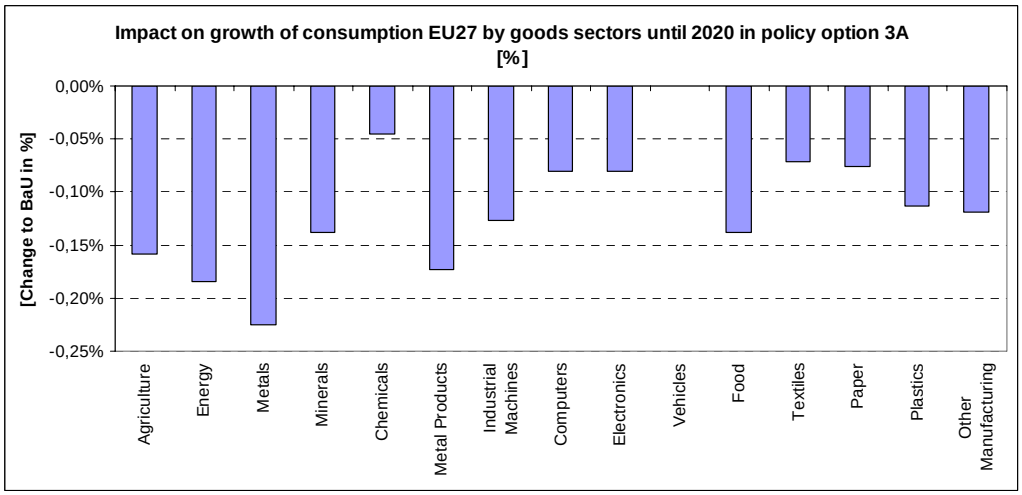
POLICY OPTION 3A

Graph 23: Impact on growth of investment in the goods sectors of EU-27 – PO 3A



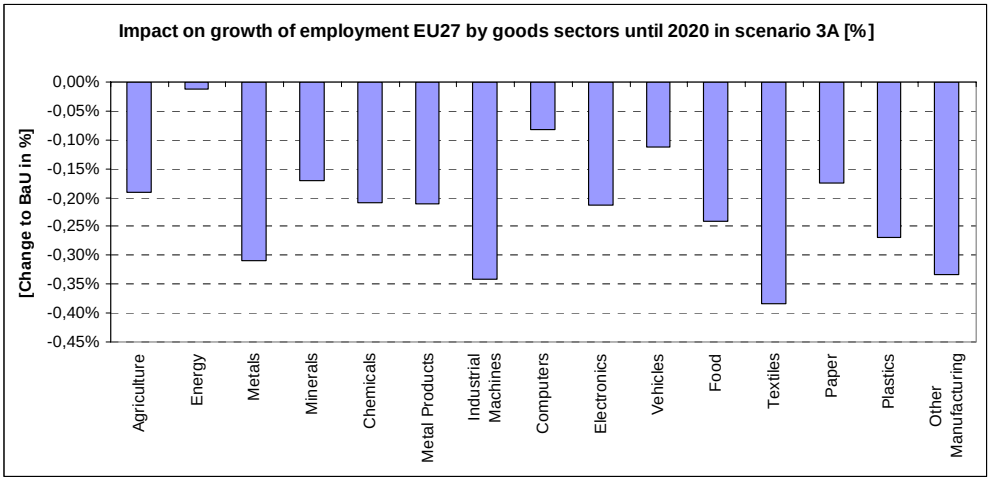
Source: IMPACT/ASTRA

Graph 24: Impact on growth of consumption in the goods sectors of EU-27 – PO 3A



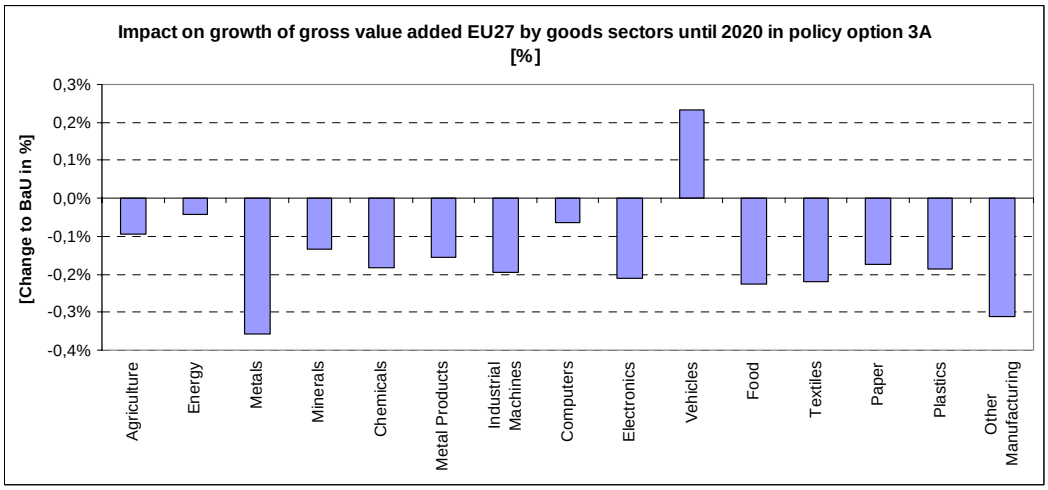
Source: IMPACT/ASTRA

Graph 25: Impact on growth of employment in the goods sectors of EU-27 – PO 3A



Source: IMPACT/ASTRA

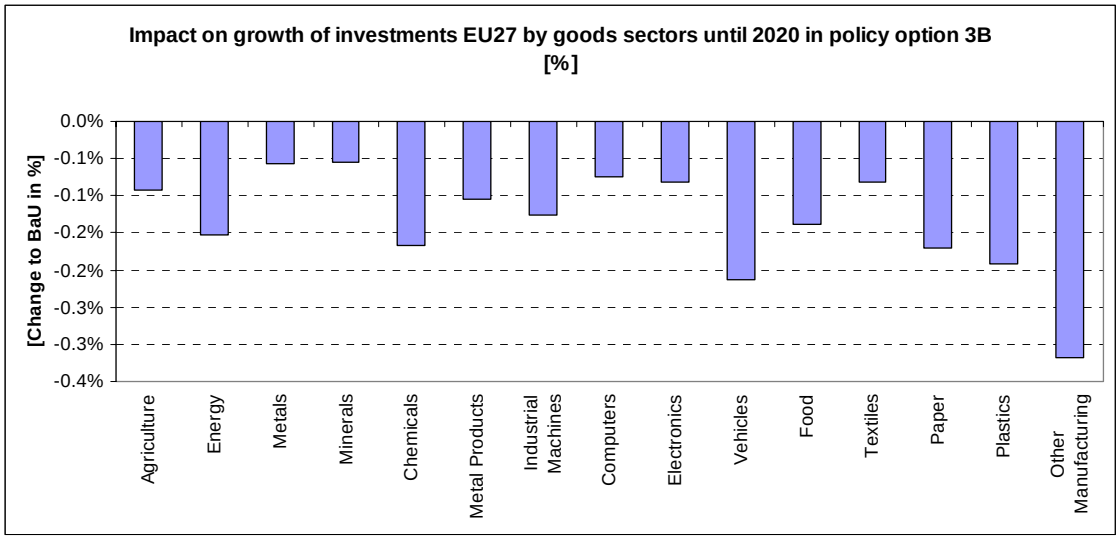
Graph 26: Impact on growth of gross value added in the goods sectors of EU-27 – PO 3A



Source: IMPACT/ASTRA

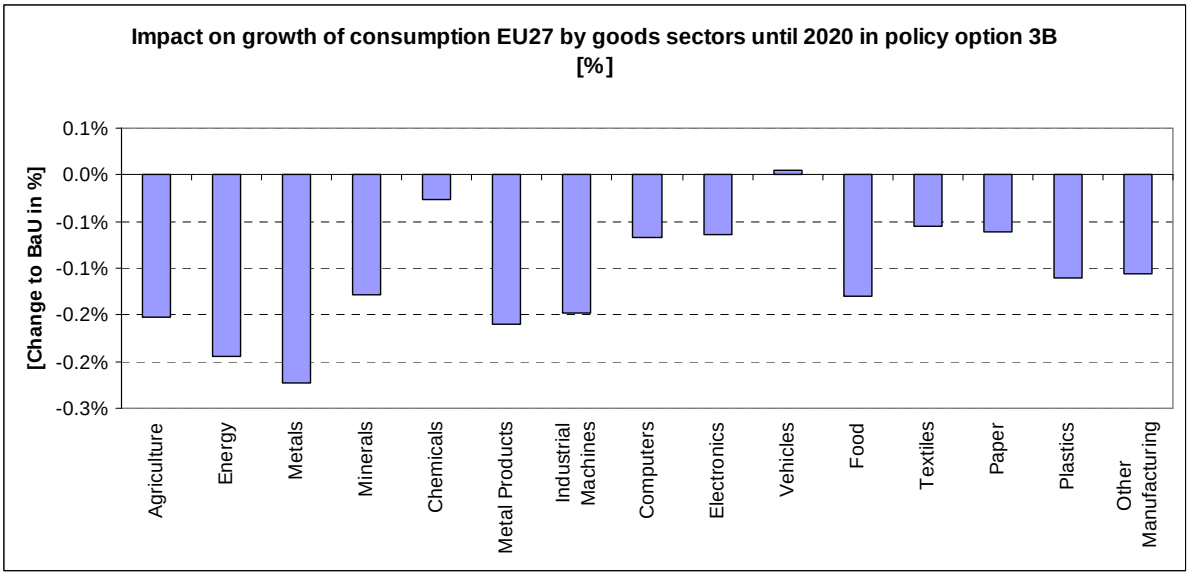
POLICY OPTION 3B

Graph 27: Impact on growth of investment in the goods sectors of EU-27 – PO 3B



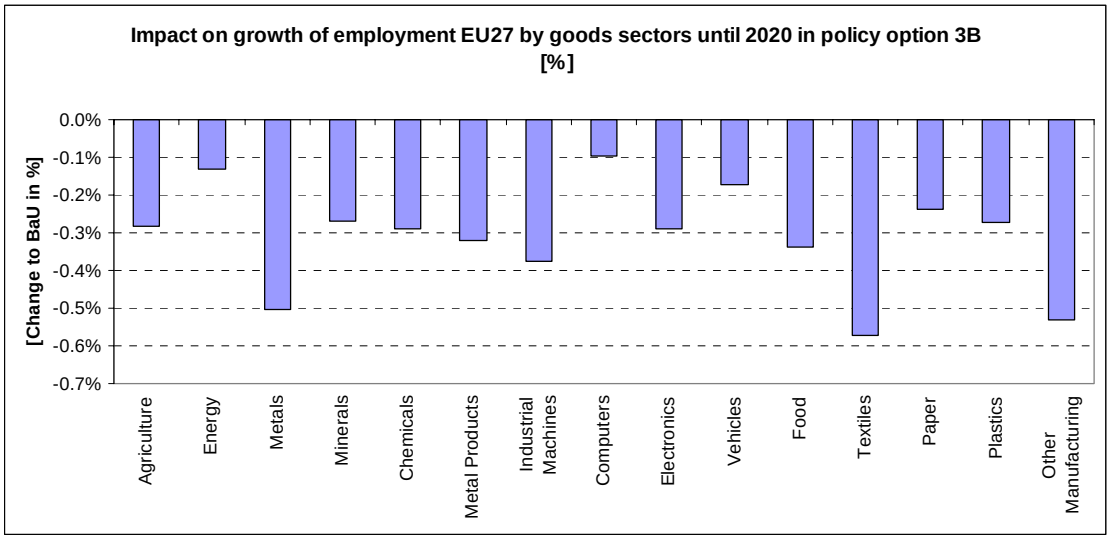
Source: IMPACT/ASTRA

Graph 28: Impact on growth of consumption in the goods sectors of EU-27 – PO 3B



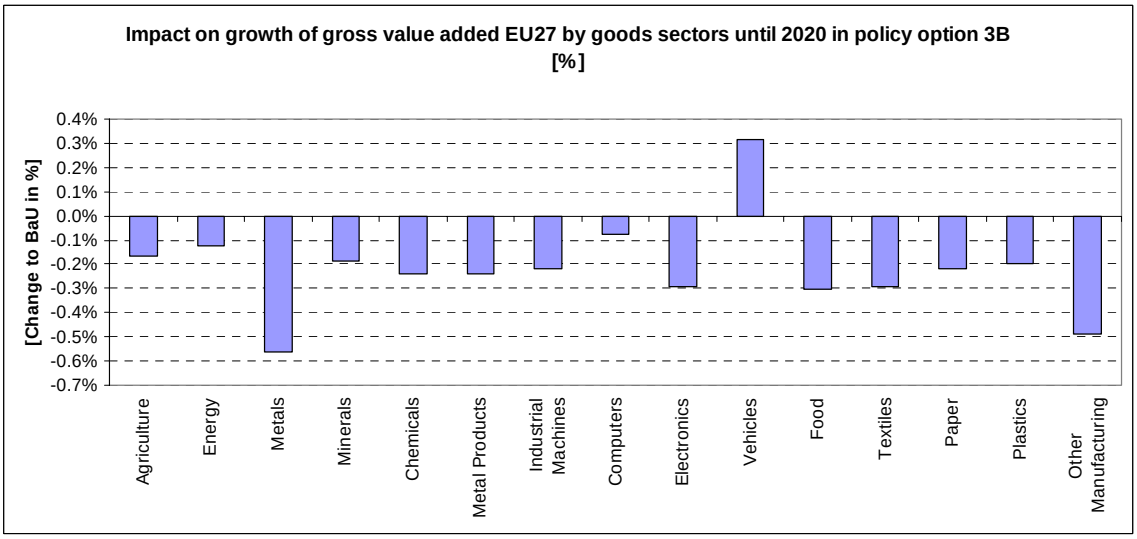
Source: IMPACT/ASTRA

Graph 29: Impact on growth of employment in the goods sectors of EU-27 – PO 3B



Source: IMPACT/ASTRA

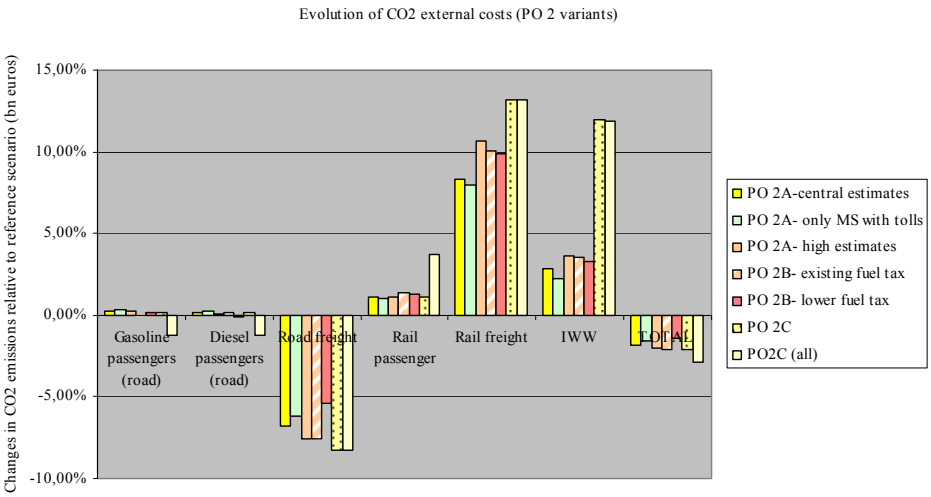
Graph 30: Impact on growth of gross value added in the goods sectors of EU-27 – PO 3B



Source: IMPACT/ASTRA

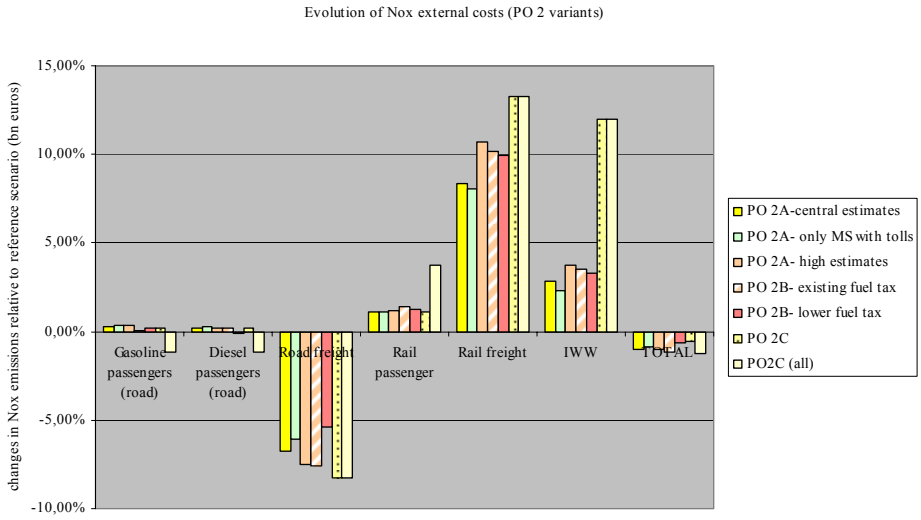
4. IMPACT ON EXTERNAL COSTS OF VARIANTS OF POLICY OPTIONS 2

Graph 31: Evolution of CO2 external costs (PO2 variants)



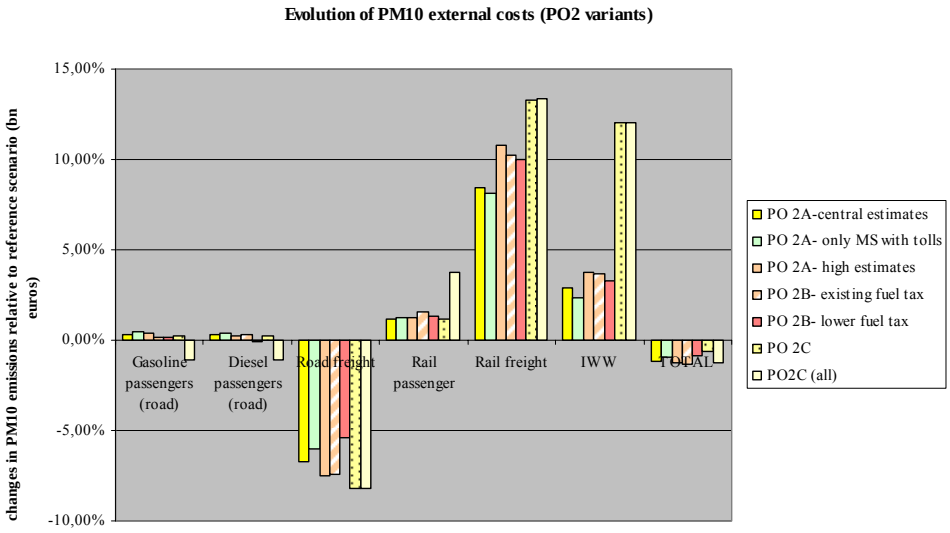
Source: IMPACT/TRANSTOOLS

Graph 32: Evolution of Nox external costs (PO2 variants)



Source: IMPACT/TRANSTOOLS

Graph 33: Evolution of PM10 external costs (PO2 variants)



Source: IMPACT/TRANSTOOLS

5. IMPACT ON CONGESTION OF VARIANTS OF POLICY OPTIONS 2

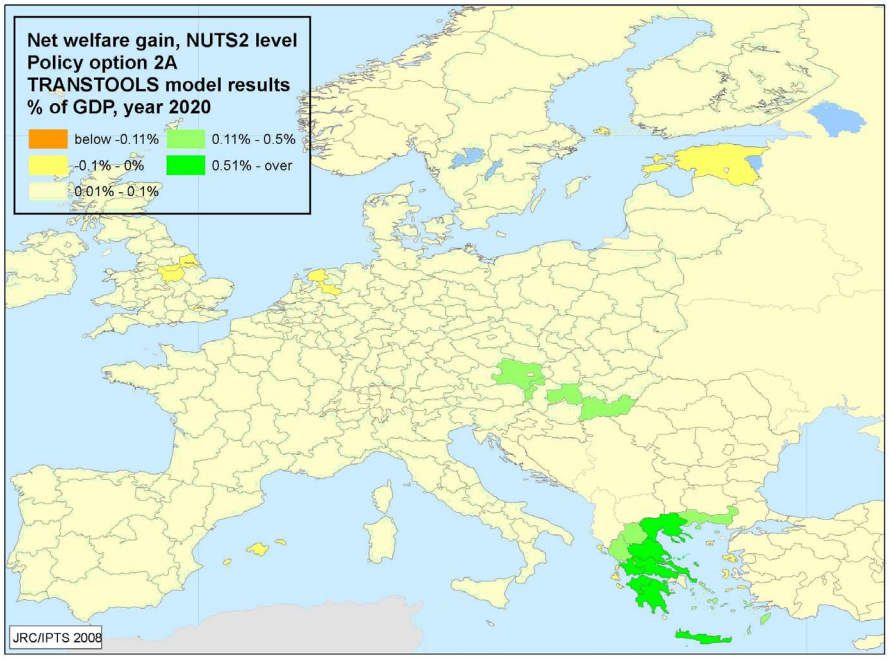
Table 2: Congestion indicator (whole road network)

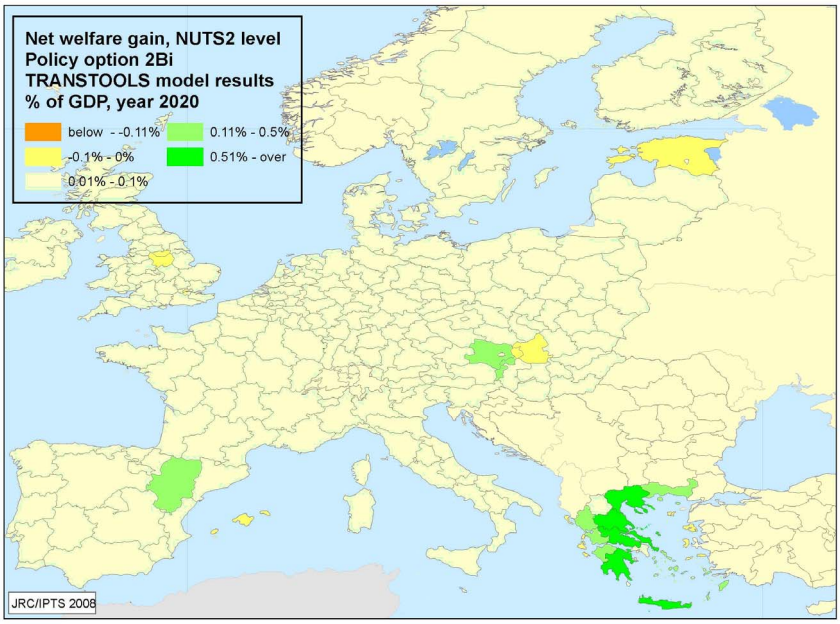
Note: differences are computed with respect to Impact1

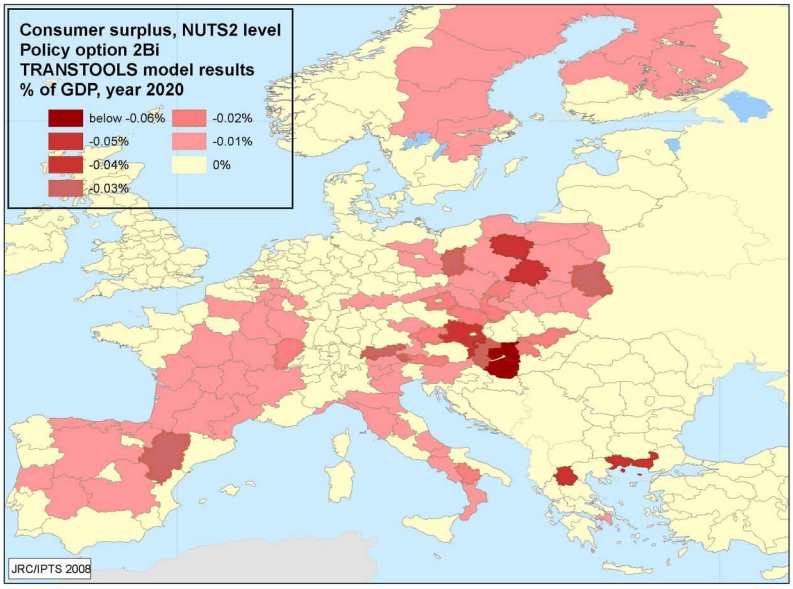
Scenario	congestion_network	Difference
Impact1	28,62%	
PO 2A (central)	28,35%	**-0,27%**
PO 2 Only Member States charging	28,58%	**-0,04%**
PO 2 (high values)	28,23%	**-0,39%**
PO 2B (same fuel taxes)	28,39%	**-0,23%**
PO 2B (min fuel taxes)	28,87%	**0,25%**
PO 2C	27,38%	**-1,25%**
PO2C (all)	26,56%	**-2.06%**
PO 3A	28,43%	**-0,19%**
PO 3B	28,40%	**-0,22%**

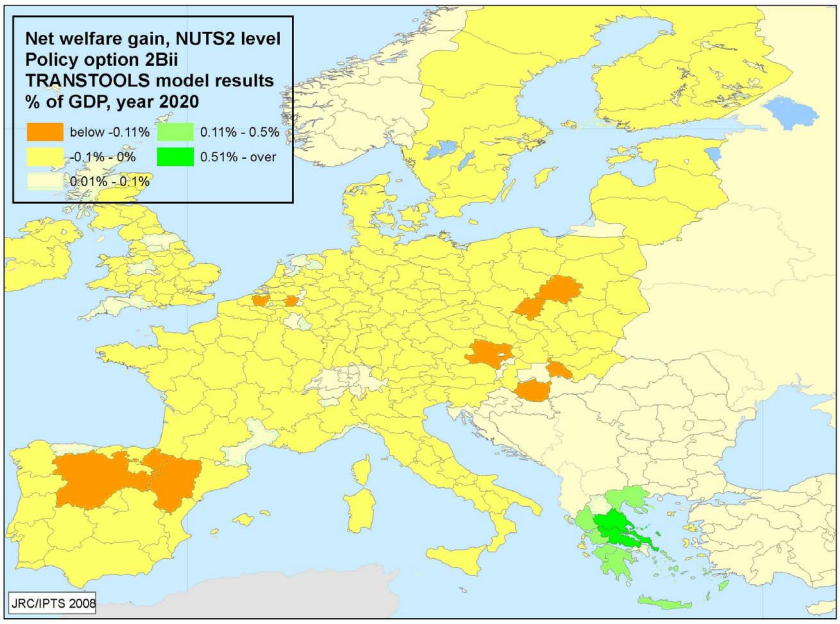
Source: TRANSTOOLS

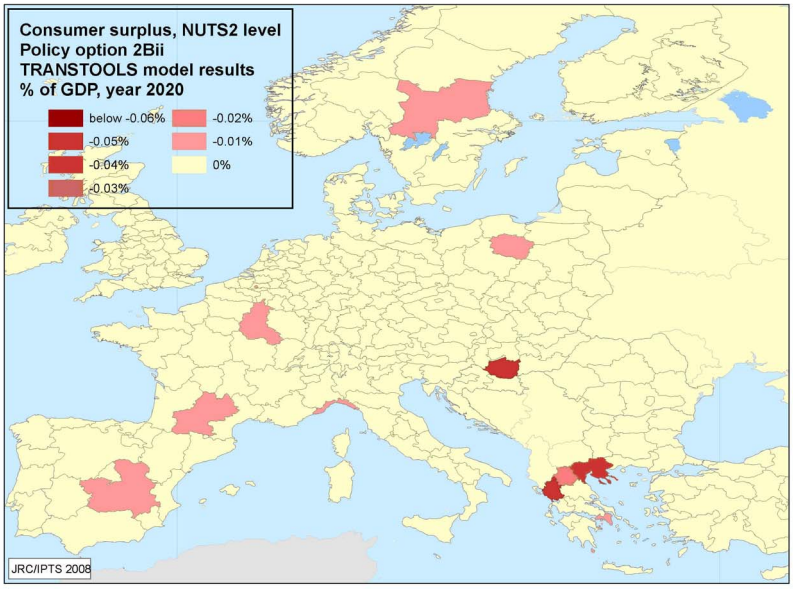
6. REGIONAL WELFARE IMPACTS

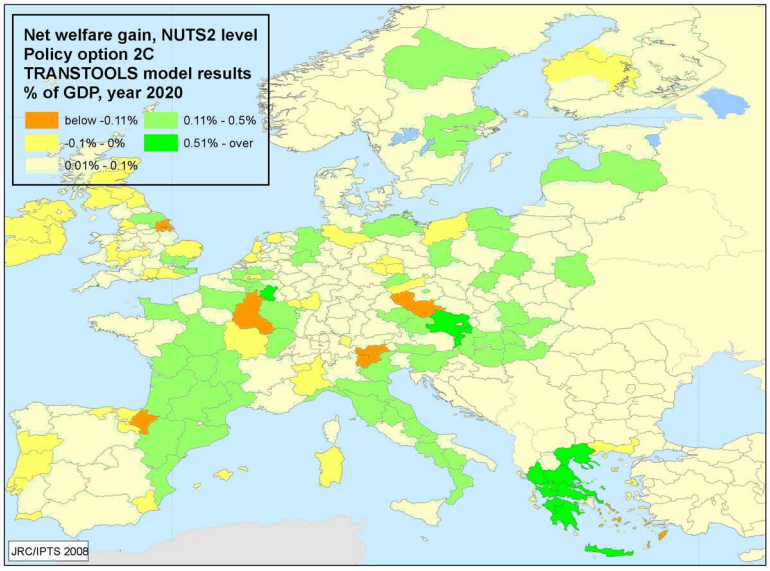

Net welfare gain, NUTS2 level
Policy option 2A
TRANSTOOLS model results
% of GDP, year 2020
below -0.11%
0.11% - 0.5%
-0.1% - 0%
0.51% - over
0.01% - 0.1%
JRC/IPTS 2008

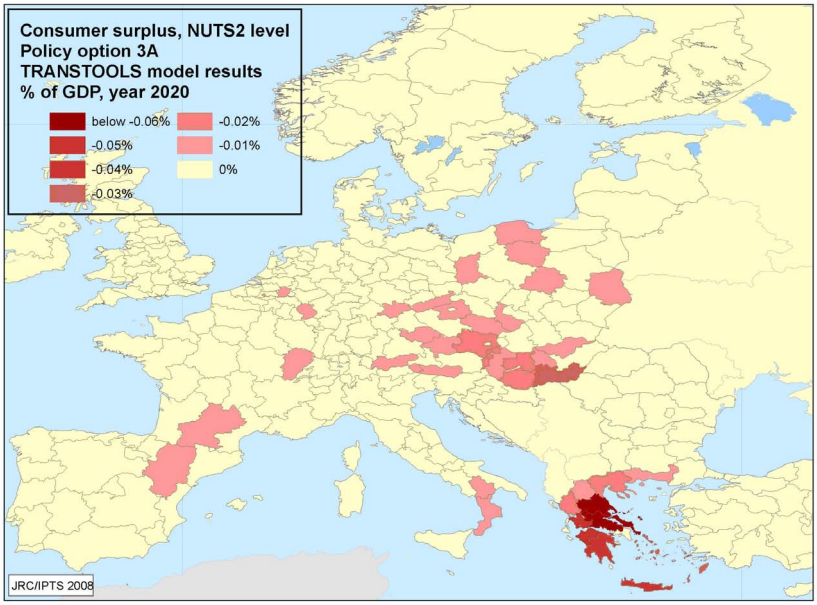

Net welfare gain, NUTS2 level
Policy option 2Bi
TRANSTOOLS model results
% of GDP, year 2020
below - -0.11%
0.11% - 0.5%
-0.1% - 0%
0.51% - over
0.01% - 0.1%
JRC/IPTS 2008

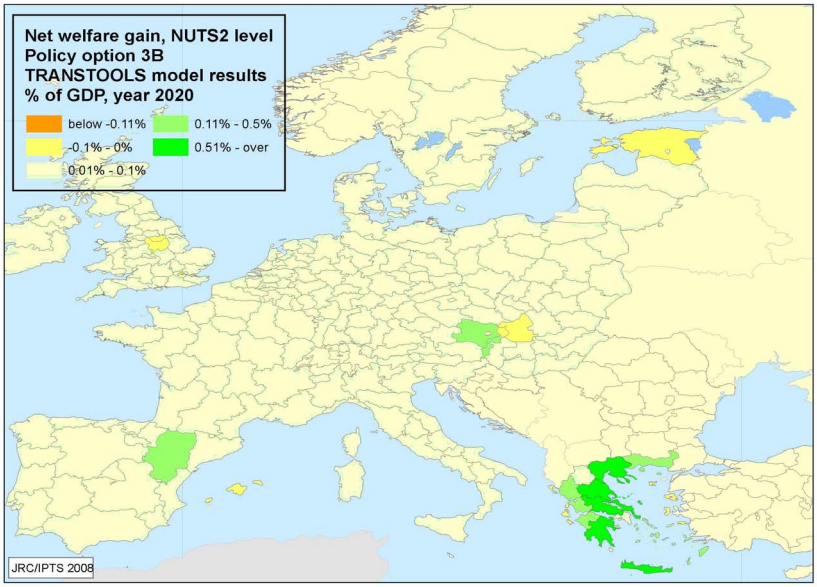

Consumer surplus, NUTS2 level
Policy option 2Bi
TRANSTOOLS model results
% of GDP, year 2020
below -0.06%
-0.05%
-0.04%
-0.03%
-0.02%
-0.01%
0%
JRC/IPTS 2008

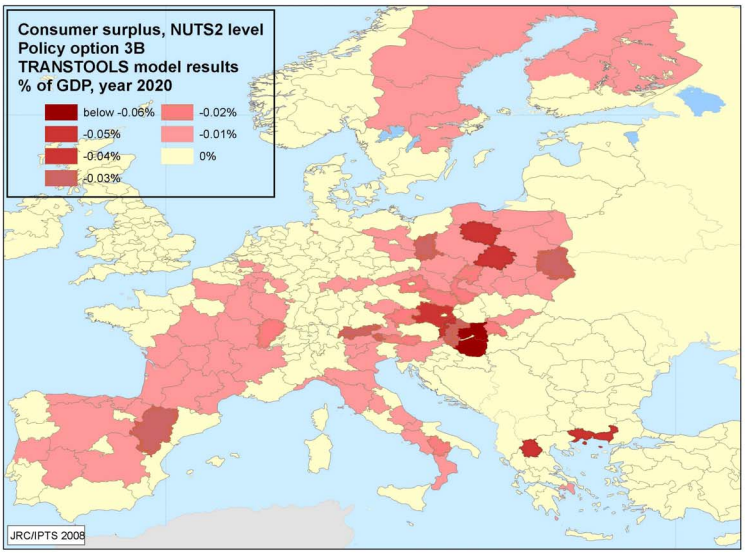

Net welfare gain, NUTS2 level
Policy option 2Bii
TRANSTOOLS model results
% of GDP, year 2020
below -0.11%
-0.1% - 0%
0.01% - 0.1%
0.11% - 0.5%
0.51% - over
JRC/IPTS 2008


Consumer surplus, NUTS2 level
Policy option 2Bii
TRANSTOOLS model results
% of GDP, year 2020
below -0.06%
-0.05%
-0.04%
-0.03%
-0.02%
-0.01%
0%
JRC/IPTS 2008


Net welfare gain, NUTS2 level
Policy option 2C
TRANSTOOLS model results
% of GDP, year 2020
below -0.11%
-0.1% - 0%
0.01% - 0.1%
0.11% - 0.5%
0.51% - over
JRC/IPTS 2008


Consumer surplus, NUTS2 level
Policy option 3A
TRANSTOOLS model results
% of GDP, year 2020
below -0.06%
-0.05%
-0.04%
-0.03%
-0.02%
-0.01%
0%
JRC/IPTS 2008


Net welfare gain, NUTS2 level
Policy option 3B
TRANSTOOLS model results
% of GDP, year 2020
below -0.11%
-0.1% - 0%
0.01% - 0.1%
0.11% - 0.5%
0.51% - over
JRC/IPTS 2008



7. METHODOLOGY USED TO ESTIMATE WELFARE

The analysis below has been provided by JRC who modelled transport evolutions.

It is based on the estimation of consumers welfare gain/loss and of the change in the total external cost of transport. The original theoretical analysis suggested that these should be estimated on a link basis for all transport modes. There is however a strong limitation in doing so in a multi-modal network model, since modal shift and route choice changes would lead to demand curves of unknown shape for each link.

In order to solve that problem, the analysis focuses on larger geographic areas (NUTS 2 or country level) for which the aggregate transport demand curves have a more orthodox shape. At that geographic level, the influence of modal split and route choice is less distorting and the demand curve is linear and downwards sloped. With this level of aggregation, the customers behaviour is orthodox, with the demand decreasing when charges increase, and vice versa. This also simplifies the welfare analysis, thus constituting a logical assertion, given that the changes in traffic volumes are assumed to be small and therefore the area below the demand curve can be calculated as a triangle in first approximation. Finally, since the represented curve yields the demand as a function of generalized cost, it is important to remark what cost stands for. As a matter of fact, the cost is in turn a function of several variables.

More concisely, the generalized cost is defined as follows:

$$C(T, C_{ext}, G, L) = k_1 T + (k_2 + C_{ext} + G)L \quad (€/veh)$$

where:

T and L are time to cross the link (in hours) and link length (in km) respectively.

k_1 is the value of time (€/h*veh).

k_2 is the driving cost (€/km)..

C_{ext} is the toll price (€/km).

G is the generic cost (€/km).

This definition of generalized cost is based on the parameters of the TRANSTOOLS model that affect demand and route choice. There are of course several other factors that affect user behaviour, but since they remain constant in all scenarios compared they would not influence the result.

The change in the level of external cost is a function of the change in transport volumes and the external cost factor for each mode and link. This external cost factor, C_{ext} (measured in €/veh*km), was estimated on the basis of the charges calculated in the IMPACT study, which in turn correspond to external cost of transport using the marginal social cost pricing approach.

The algorithm for the estimation of welfare gains differs in the two main cases of user reaction:

Case 1:

If an increase in average charges takes place in a certain region, the traffic volume in this region will decrease. This fact yields a welfare loss represented by the red triangle. On the other hand, this traffic reduction improves the external cost in this region, since less traffic means less congestion, less fuel consumption, etc, as shown in the blue square.

Comparing one scenario with the reference scenario 1, the colored areas equal:

$$\text{Welfare}: \frac{1}{2}(V_2 - V_1)(C_2 - C_1)$$

$$\text{External cost}: -C_{ext}(V_2 - V_1)$$

Where C_1, V_1 are the generalized costs and traffic volumes in scenario 1 and C_2, V_2 are the generalized costs and traffic volumes in the scenario we want to estimate welfare gains for.

From the IMPACT study, we have defined that $(C_2\text{-}C_1) \approx C_{ext}$. If differences in times and other costs are small, one can also assume that $T_1 \approx T_2$ and $G_1 \approx G_2$, Consequently, the red area would roughly equal half the blue area and the net effect in this region would be positive.

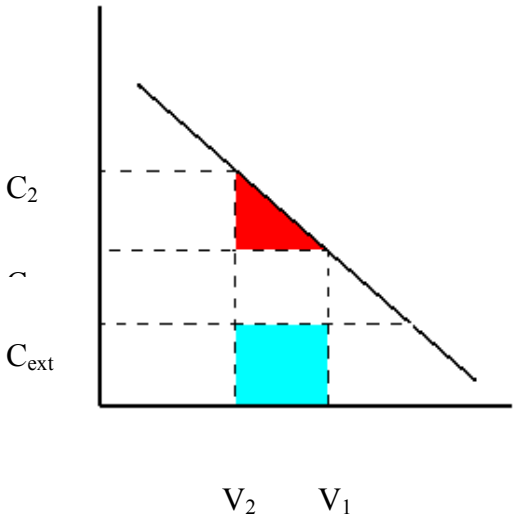


Figure 1.Case 1.

In practice there are some differences between T_1 and T_2 due to the change in travel times as a result of changes in congestion levels. In most cases however the difference is not large enough to change the order of magnitude of the two areas. Consequently, the welfare gain from the reduction of externalities is higher than the loss in consumer surplus.

Case 2:

If a decrease in charges takes place in a certain region, the traffic volume in this region will increase. In this case, there would be a welfare gain represented by the blue triangle. On the other hand, this traffic increase leads to an increase in external cost, as shown in the red square. Therefore, the colored areas equal:

$$\text{Welfare}: -\frac{1}{2}(V_2 - V_1)(C_2 - C_1)$$

$$\text{External cost}: -C_{ext}(V_2 - V_1)$$

As stated in the previous case, if $T_1 \approx T_2$ and $G_1 \approx G_2$, we have that $(C_2\text{-}C_1) \approx C_{ext}$ and the blue area would equal half the red area. As a result, the net effect would be negative.

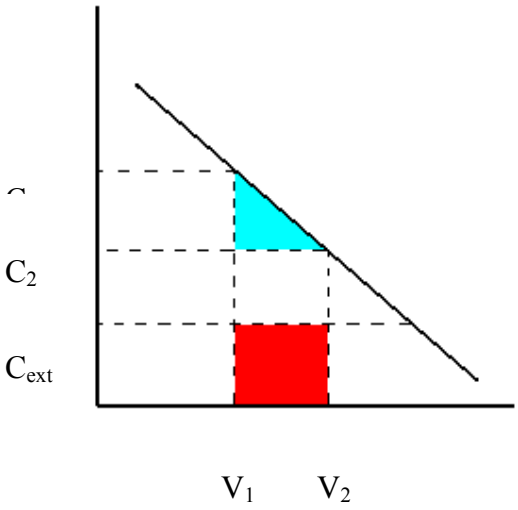


Figure 2. Case 2.

8. TOTAL WELFARE

Table 4: Total net welfare gain

	Total net welfare gain TRANSTOOLS road transport network Billion €, year 2020
PO 2A	**0.87**
PO 2Bi	**0.84**
PO 2Bii	**0.03**
PO 2C	**1.83**
PO2Call	**2.30**
PO 3A	**0.90**
PO 3B	**0.85**

Source: TRANSTOOLS

Annex 14: Implementation Costs and Administrative costs

Table 1: Overview of implementation costs of road pricing schemes

Data source	Study or real figures?	Technology involved	Investments per user (€)	Operational costs per user (€ p.a.)
Road pricing for all vehicles on all roads				
Ministry of Transport, 2005 (km charging)	Study	GPS	280 – 507	53 – 147
Ministry of Transport, 2005 (km charging + congestion charging)	Study	GPS	275 – 513	63 – 138
Ministry of Transport, 2006 (km charging)	Study	GPS	163 – 338	31 – 119
DfT (2004)	Study	GPS	662 – 4,925	128 – 433
Road pricing for HGVs only				
Ministry of Transport, 2005 (GPS)	Study	GPS	818 – 1,660	156 – 409
Ministry of Transport, 2005(DSRC)	Study	DSRC	1,250 – 1,500	250 – 667
Austria	Real	DSRC	417 – 617	58
Germany	Real	GPS	500 – 1,000	393- 508
Switzerland	Real	DSRC	450 – 565	100

Source: CE Delft, 2005; DfT (2004); Ministry of Transport, 2005; 2006; Oehry, 2006.

Note: The gray labelled data has been used for the implementation cost estimates in this report.

Table 2: Assessment of administrative Costs

Amendment of Directive 1999/62/EC on charging heavy goods vehicles						**Tariff (€ per hour)**		**Time (hour)**		**Price (per action or equip)**	**Freq (per year)**	**Nbr of entities**	**Total nbr of actions**	**Total cost**	**Regulatory origin (%)**			
The main administrative cost will stem from the obligation for Member States who decides to charge external costs to report to the EC every year the total revenue of the charge																		
No.	Ass. Art.	Orig. Art.	Type of obligation	Description of required action(s)	Target group	i	e	i	e			10 MS can be expected to opt for an external cost charge			Int	EU	Nat	Reg
1	1§1	12	Notification of (specific) activities	Familiarising with the information obligation	National administration	27,4*		10,00		274,0	1,00	10	10	2.740		100%		
2			Submission of (recurring) reports	Retrieving relevant information from existing data	National administration	27,4		20,00		548,0	1,00	10	10	5.480		100%		
3			Submission of (recurring) reports	Producing new data	National administration	27,4		10,00		274,0	1,00	10	10	2.740		100%		
4			Submission of (recurring) reports	Filling forms and tables	National administration	27,4		2,00		54,8	1,00	10	10	548		100%		
5			Other	Producing new data	National administration	27.4		500		13700	1.00	10	10	137000				
TOTAL										0,0			0	148508				

* German national public administration hourly labour costs. Eurostat.

Annex 15: Glossary

Average cost	Average cost consists of total cost divided by a measure of output. In the case on infrastructure, it would correspond to total cost of infrastructure (fixed and variable) divided by vehicle-km.
Charge	A charge is a proportional payment required in exchange for a clearly defined service. For example, a toll charge will give access to the use of a specific infrastructure (bridge, motorway, etc…).
CO2	Carbon dioxide is a major greenhouse gas. It contributes to climate change.
Efficiency	Refers to the efficient allocation of scarce resources. In this case, marginal social cost equals marginal social benefit.
Elasticity	Proportional change in demand in response to a price increase or decrease (price elasticity).
External cost	External costs are costs which the user of a good or service does not pay for.
Fixed cost	Cost which are not dependent on the traffic volume.
HGV	Heavy duty vehicles above 3.5 tonne gross weight
Internal cost	Internal costs are costs which are directly paid by the user
LDV	Light Duty vehicles (vans up to 3.5 tonnes gross weight)
LTO	Landing take off
Marginal cost	Marginal costs reflect the additional cost of an additional vehicle.
MOC	Motorcycles
MOPED	Low powered motorized vehicles, in general two-wheeled (scooters, motorized bicycles, small motorcycles).
pkm	Passenger kilometre
Permit system	A tradable permit scheme is a mechanism by which the authorities set a maximum level of pollution or use of an infrastructure and assign to individuals/operators a quantity of permits that corresponds to this level. The individuals/operators can then trade permits, improving the efficiency in the distribution of efforts or in the use of the infrastructure.
Social cost	Social cost is the sum of external and private cost
Tax	A tax is a required payment of money to governments that are used to provide public

	goods and services for the benefit of the community as a whole. Examples are fuel tax, circulation tax, registration tax.
Tkm	Ton-kilometres
Vkm	Vehicle-kilometre. One kilometre travelled by a single vehicle.