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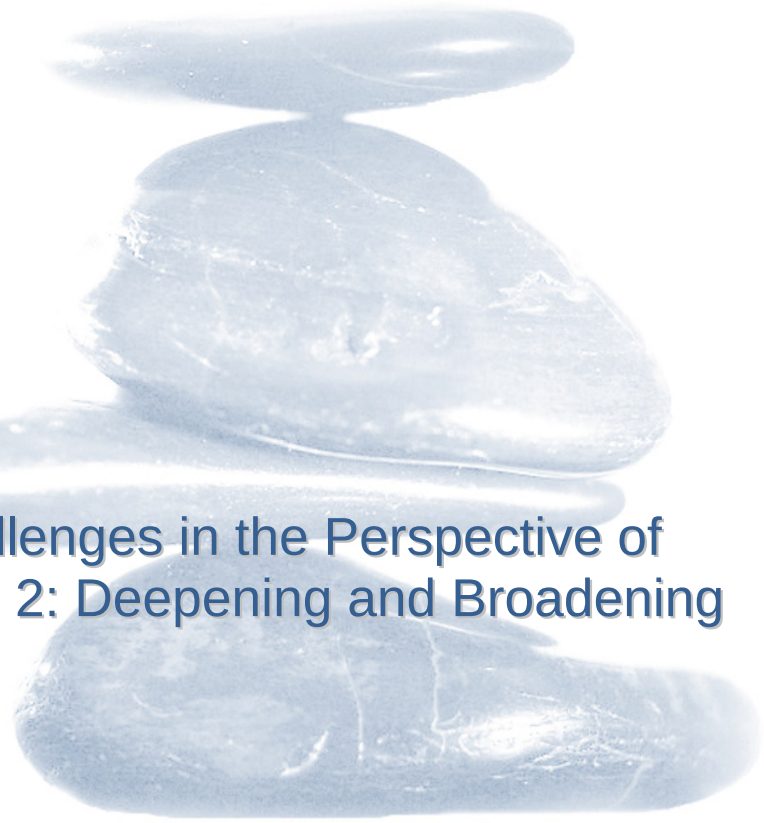

Contract Study

Regional Challenges in the Perspective of 2020 – Phase 2: Deepening and Broadening the Analysis

Final report

Commissioned by
European Commission
Directorate General for Regional Policy
Unit C1 Conception, forward studies, impact assessment

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Executive Summary

The present study *Regional Challenges in the Perspective of 2020 – Phase 2: Deepening and Broadening* expands the analysis presented in the European Commission publication *Regions 2020 – An Assessment of Future Challenges for EU Regions* from November 2008. The Europe 2020 strategy is Europe's answer to the impacts of the financial and economic crisis and other ongoing global challenges that Europe has been facing in recent years and decades. Globalisation, demographic change, climate change, secure, sustainable and competitive energy, and social polarisation, in addition to the economic and financial crisis, are the major challenges confronting Europe today, challenges of a medium and long-term perspective. In the decade up to 2020, three major scenarios are forecasted regarding how Europe will overcome the economic crisis. These scenarios will have an important influence on the impact of these challenges and the adaption towards them. In the *sustainable recovery* scenario, Europe is able to make a full return to the earlier growth path and raise its potential to go beyond. In the *sluggish recovery* scenario, Europe will have suffered a permanent loss in wealth and start growing again from this eroded basis. In the most pessimistic of the scenarios, the *lost decade*, Europe will have suffered a permanent loss in wealth and potential for future growth and the pre-crisis economic growth levels cannot be reached again until 2020.

Challenges that depend on each other

While these challenges all have different regional impacts, the European regions are all faced with a specific vulnerability. To assess these regional peculiarities, the concept of regional vulnerability, which is borrowed from environmental impact assessments, is expanded to include socio-economic objects of investigation. It distinguishes between a region's measure of exposure towards an influence, the specific regional sensitivity and the capacity of a region to adapt to negative/positive impacts. As the analysed challenges exhibit a very complex nature, more than one indicator typically has to be used. In order to reduce complexity it was decided to split the challenges into topical *key vulnerabilities* based on scientific literature. This makes it possible to avoid overly aggregated indicators that are hard to interpret and allows the challenges to be broken down into a manageable number of indicators available on a regional level. Table I presents these twenty key vulnerabilities.

The study not only includes a vulnerability assessment of the 27 EU member states on a regional level, but also of the candidate countries Iceland, Turkey, Croatia and the Former Yugoslav Republic of Macedonia, the associated EFTA countries Norway, Switzerland and Liechtenstein and all countries of the European Neighbourhood Policy in the Mediterranean Basin and Eastern Europe. The Libyan Arab Jamahiriya and Russia were included where data was available.

What makes the analysis so fascinating is that the challenges cannot be seen separately from each other. They are almost all indirectly interwoven with each other by positive or negative feedback loops and many of the challenges may be regarded as both causes and effects of vulnerability in regions. For example, demographic change may be seen as a cause of social polarisation (with respect to misbalances of supporting vs. supported population) as well as an effect of social polarisation (with respect to income levels and distribution). Increasing global labour division intensifies climate change via the increasing consumption of energy through transportation. A changing climate can have strong negative effects on the economy and the quality of life in certain regions, thus adding to social polarisation. All these feedbacks have to be carefully considered in order to achieve an integrated representation.

Table I Key vulnerabilities

Challenge	Key vulnerability
Globalisation	Global players
	Mobility of persons and goods
	Accessibility
	Knowledge and know-how
Demographic change	Ageing population
	Shrinking population
	International migration and integration
Climate change	Agriculture and forestry conditions
	Natural and semi-natural ecosystems
	Natural hazards and coastal threats
	Health and heat waves
	Water dependency
	Summer tourism climate
Secure, sustainable and competitive energy	Energy capacities
	Fossil energy supply
	Peak energy demand
Social polarisation	Income distribution
	Labour market transformations
	Youth unemployment
	Access to SGEIs

Globalisation: Europe's engine and worry

Globalisation is probably the most immediate challenge Europe is facing both as a union and as individual Member States and their regions. It is a major source of regional disparity as it considerably weakens territorial cohesion between globally integrated regions and regions that are struggling to keep pace. The global economic crisis has also shown the limits of European preparedness vis-à-vis globalisation when consumer markets broke down worldwide and manufacturing production in many European regions dwindled. Without global trade flows and global financial interlinkages the crisis would not have spread as quickly and as radically across the majority of developed and emerging economies of the world. As international trade was drastically reduced, both air and sea cargo volumes dropped, thereby affecting employment and production in the trade and transport sectors. With decreasing real incomes and rising insecurity concerning future incomes, people's inclination to travel was also reduced, which in turn affected the tourism sector.

An overview of the content of the following paragraphs will be shown in Map I.

However, globalisation is both a multidimensional challenge and an opportunity for Europe's regions. What globalisation actually means for a region depends largely on its function within the European territory and the profile of its economy. First, larger agglomerations are generally favoured by globalisation developments as they possess the mass necessary to integrate into global economic processes. Especially the EU-12's major cities include some of the main areas of knowledge production and some of the most important trade hubs in the world – Europe's global players. The Eastern and South-Eastern metropolitan regions are still lagging in this respect, although they are in a process of catching up. In the EU 12 many more semi-rural and rural regions, especially those specialising in high-tech and innovation activities, also seem to have found the right answers to globalised production. Particularly the Central European 'pentagon' (the regions enclosed by the metropolitan areas of London, Amsterdam, Berlin, Milano and Paris) regions and the Nordic countries are very well prepared in this respect. In the southern and eastern parts of the Union the majority of rural regions are still lagging in their response to globalisation.

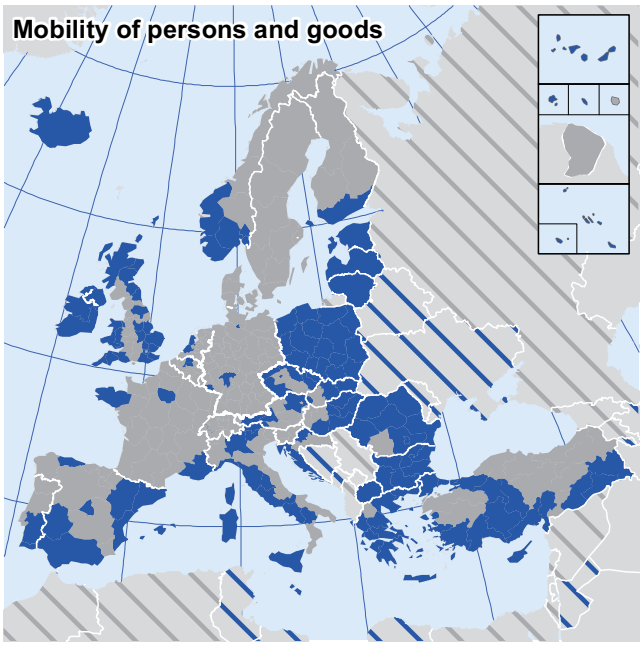
However, as the analysis of the vulnerability towards mobility shows, metropolitan regions that seem at first glance to be successful can also be very vulnerable when it comes to external shocks. For instance, the eruption of the Eyjafjallajoekull volcano and unfavourable snowfall conditions (and insufficient preparation) easily paralysed numerous air transport hubs twice in 2010. Many of the metropolitan regions were shown to be vulnerable vis-à-vis mobility issues. A positive outcome of this reduction in transport movements triggered by the crisis was that it helped Europe come closer to its CO^2 goals in that year.

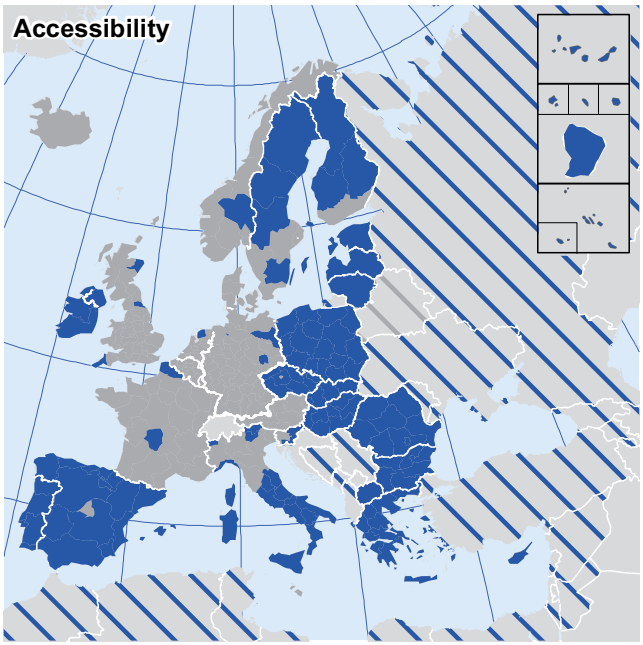
Differences in levels of accessibility largely determine the capacity of individual regions to position themselves in the mobility flows. Peripheral areas are generally understood as those areas with poorer connections to agglomerations in terms of travel times, travel costs and the diversity in the forms of transport and the routes available. This latter aspect can have a particularly significant impact on transport reliability, which is of key importance for most industrial development. As expected, the more peripheral regions (relative to the European core areas) in Northern, North-Western and Southern Europe and the New Member States, which yet are not on the same level when it comes to modern transport infrastructure,, are the most vulnerable regions in terms of accessibility. In times of public budgetary constraints, it seems unrealistic in the mid-term to enhance the costly infrastructure endowment of very peripheral regions to the extent necessary that global accessibility will notably improve. So it will become even more important to look for alternative adaptive capacities – concentration on production of knowledge, ICTs or specialisation and the filling of economic niches.

It is not a coincidence that the promotion of knowledge production and know-how remains a key strategy for Europe since the Lisbon Strategy in order to overcome global competitiveness deficits. Investment in education and research is the key for creating a knowledge-based labour force to compete globally and to enhance the necessary conditions for knowledge creation. In the vulnerability analysis that has been based on productivity and R&D personnel, the most vulnerable regions have been identified in the very southern periphery of Europe and the more rural areas in the New Member States.

Map I Globalisation vulnerability at a glance (following page)

Globalisation vulnerability at a glance





Legend

EU and recognised candidate countries, EFTA
- Most vulnerable regions and vulnerable regions
- Prepared regions

Neighbouring countries (simplified methodology)
- more vulnerable
- less vulnerable

- Not enough data

Kilometres
0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

Map developed by ÖIR
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Indicators

Global players

Exposure:
- population density
- Totel flight passengers (embarked/disembarked)
- Employment in banking and insurance

Sensitivity:
- GDP per Capita

Adaptive capacity:
- Number of transnational headquaters per 1000 jobs (Fortune)
- R&D expenditures in % of GDP

Mobility of persons and goods

Exposure:
- Total air cargo handled at airports
- Total flight passengers
- Total sea cargo

Sensitivity:
- Employment in Trade, Transport, Hotel, Restaurant (%)
- GDP in Trade, Transport, Hotel, Restaurant (%)

Adaptive capacity:
- Motorway density

Accessibility

Exposure:
- Potential road acessibility (ESPON 1.2.1)
- Potential rail acessibility (ESPON 1.2.1)
- Potential air acessibility (ESPON 1.2.1)

Sensitivity:
- Labour costs per employee in private sec.&tert. sectors
- Total nights spent in collective tourism accomodation/1000 capita

Adaptive capacity:
- Share of households with broadband access
- Patent applications per 1 mio. capita

Knowledge and know-how

Exposure:
- Share of employment in manufacturing
- Share of employment in agriculture

Sensitivity:
- Productivity in agriculture (Politecnico di Milano&DG Agri)
- Productivity in industries (Politecnico di Milano, UK Statistics Authority)

Adaptive capacity:
- Total productivity (Politecnico di Milano, UK Statistics Authority)
- R&D personnel in % of active population

Regional Challenges in the Perspective of 2020

Most of the adjacent European neighbourhood finds itself in a similar situation as large parts of the European periphery, i.e. with low productivity levels, weak service sectors and negligible knowledge production. However, a distinction must be made between the more rural areas and aspiring metropolitan agglomerations. Some of these regions, especially Turkey and Northern Africa (depending on the political developments to come), might catch up quickly and challenge the neighbouring European periphery.

From an integrated view, the rural eastern and very southern periphery is the most challenged by the globalised economy. Deficits in productivity and accessibility can not (yet) be counterbalanced by high-level service and know-how activities. In light of the development of economic profiles and specific functions, regions with activities of a more ubiquitous nature may be of importance as they can enable other regions to perform globally, for example by providing resources and environmental services. This would lead to a functional understanding of polycentricity in which the drivers of European growth are not only urban and metropolitan areas. Instead, they comprise a wide range of regions that have a role in the global division of labour.

Demographic change: population as the major resource

The challenges posed by economic globalisation developments are also challenges to demography, especially in relation to intraregional and international migration. The natural development is much more influenced by cultural and political circumstances. For instance, countries with the best child care offers usually have high birth rates. However, following the classification of the three key vulnerabilities, there are hardly any regions in Europe that do not face any demographic challenge. Regions that do not shrink often do have an ageing population. Strongly growing regions (many metropolitan regions) often owe this fact to international immigration and are therefore confronted with challenges of integration. Generally, demographic change is very closely linked to social polarisation.

An overview of the content of the following paragraphs will be shown in Map II.

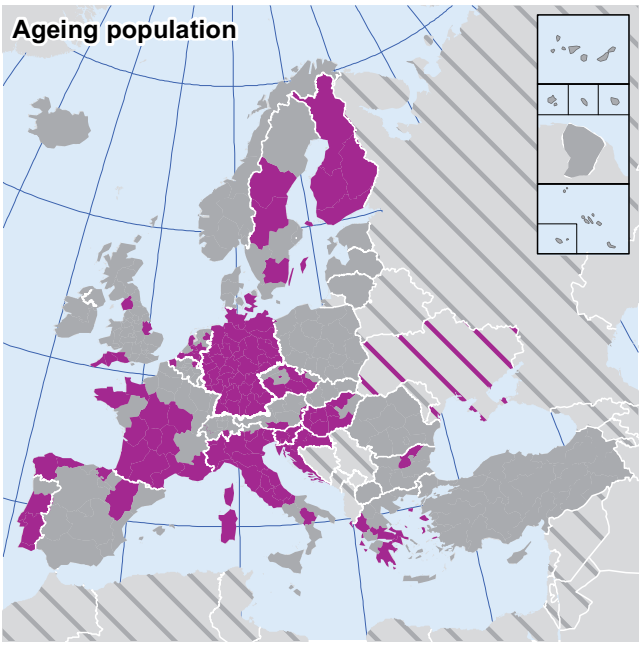
The growing share of elderly people is perhaps the most urgent component in the demographic change challenge: in other words, the ageing population. An ageing population requires different strategies to adjust specific infrastructures and has major consequences for the labour force and – supposedly – its productivity. Additionally, it poses threats to the maintenance of public pension systems. Eastern European countries are the main sources of migration flows to the EU, albeit most of the affected EU Member States are still characterised by a positive age composition. The affected regions mostly include France, Italy, Germany, Hungary and the Nordic countries.

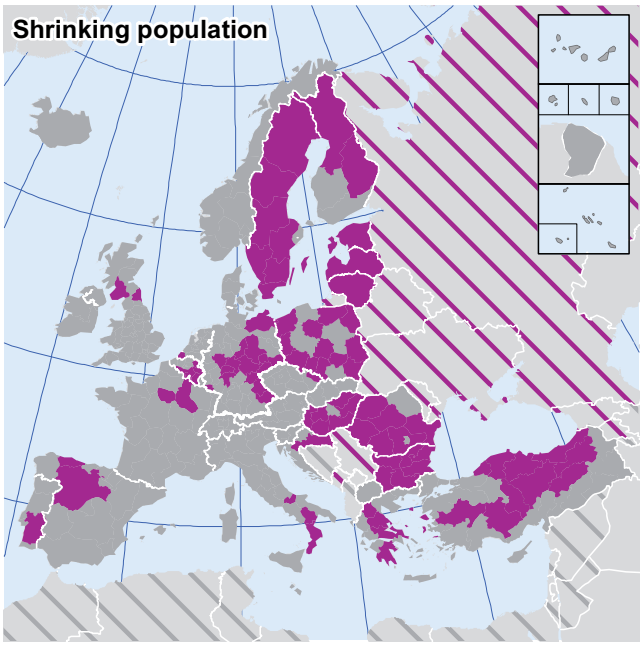
These regions are – with the exception of Sweden and Finland – less challenged by a shrinking population. Population decline more recently was caused by emigration from regions with low economic dynamics. However, a large part of Europe still experiences population growth. In fact, a number of regions have a strong growth base with both birth surpluses and migration gains, mainly due to migration flows from Eastern Europe. This already indicates which regions are the most vulnerable vis-à-vis shrinking: the rural regions in the New Member States together with the rural regions of Sweden and Finland, Turkey and East Germany as well as a couple of Southern European regions.

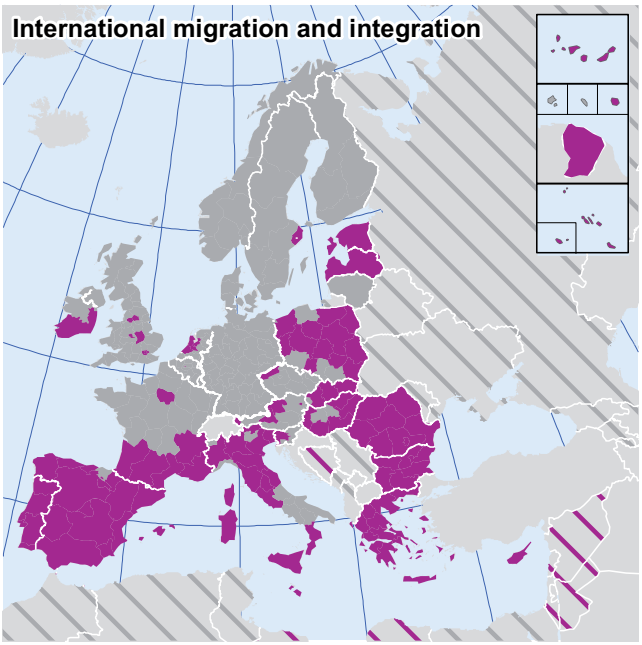
While the natural change of a population works very slowly in the long-term, migration can be influenced relatively quickly and in the short-term. In a world of massive population growth, a policy of increased immigration into the EU countries would be a feasible strategy to mitigate the demographic change. So far, a common basis has not been reached for organising international migration into the EU. There are, of course, reasons for this; one being the cultural gap between the main emigration source countries and the European destination countries. Additionally, cultural and ethnic heterogeneity often result in increased social polarisation. Thus the challenge in this key issue is not migration as such but rather the future efforts that have to be made in the field of integration. It does not come as a surprise that amongst the regions most challenged by integration are the economically flourishing metropolitan regions across Europe, as well as many regions around the Mediterranean basin that face very high immigrant rates, mainly from Africa and South America.

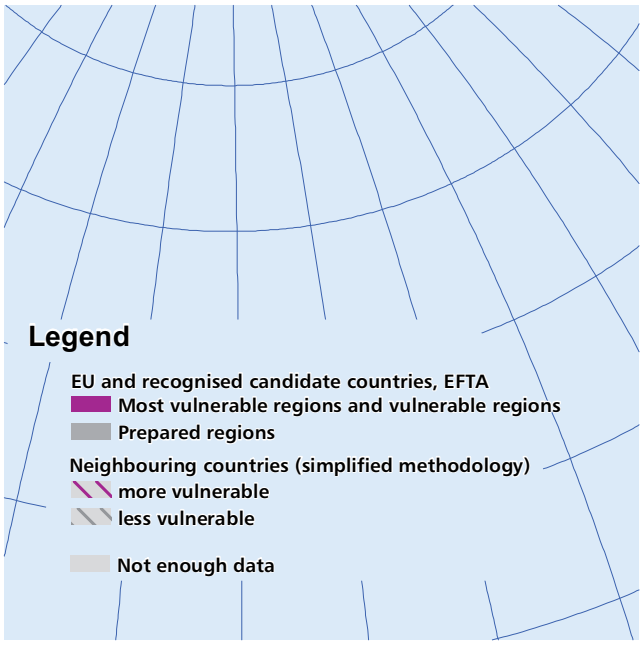
Map II Demographic change vulnerability at a glance (following page)

Demographic change vulnerability at a glance









Kilometres
0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

Indicators

Ageing population

Exposure:
- Mean age
- Life exptectancy at birth

Sensitivity:
- Dependecy ratio
- Billeter index
- Healthy life expectancy at birth

Adaptive capacity:
- Labour force replacement ratio
- (Social) Support index

Shrinking population

Exposure:
- Population development 1998-2008 in %
- Accumulated natural development 1998-2008
- Accumulated migration 1998-2008

Sensitivity:
- Population density
- Share of third level education employment
- Share of population with third level qualification

Adaptive capacity:
- Disposable income of households, net
- Labour costs

International migration and integration

Exposure:
- Accumulated migration 1998-2008

Sensitivity:
- Population in working age born outside of the EU

Adaptive capacity:
- Innovation performance

Map developed by ÖIR

Regional Challenges in the Perspective of 2020

The New Member States at the time of writing do not face major international migration; however, on account of their economic structure, most of their regions mainly attract less-skilled migrants that have been statistically shown to be more difficult to integrate into their new society.

The European neighbourhood in the East faces similar problems with ageing and shrinking as the EU. The North African and Near East countries still have relatively high outflows of people; however, these are compensated by generally very high birth rates

Climate change: the long-term threat to many European regions

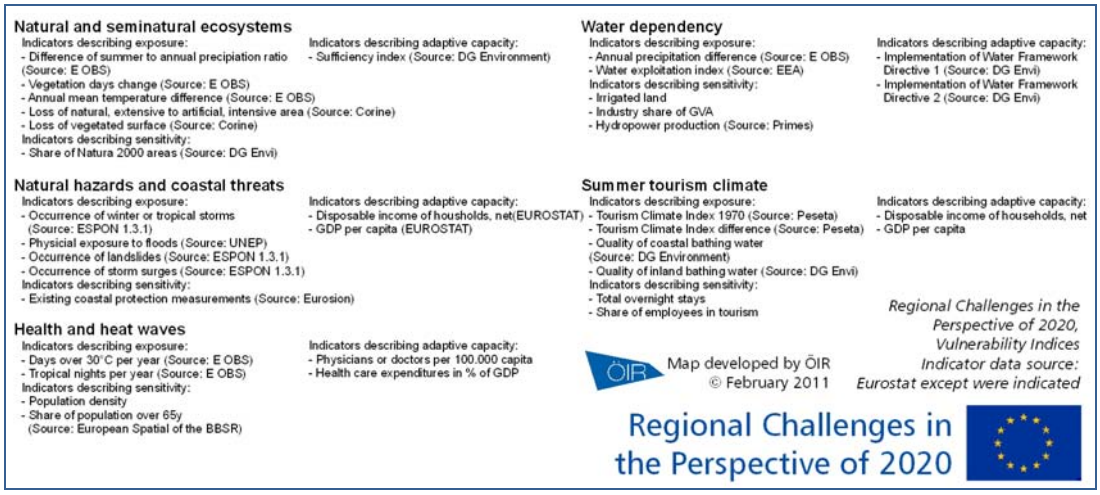
Climate change is a challenge Europe is facing that differs considerably from the other challenges examined in this study. The most serious effects of climate change will not occur within the time horizon covered by this analysis (until 2020). They are long-term threats to Europe's natural resources, quality of life and, not least, its economy. An overview of the content of the following paragraphs will be shown in Map III on the opposite page.

There are no regions in Europe that can ignore climate change. However, the generally most challenged regions are the Mediterranean regions in Southern Europe, which often face combined threats such as the increasing frequency of heat waves and their impacts on human health, increasing water scarcity and precipitation differences combined with the water dependency of the agriculture and tourism sectors, and natural hazards in the form of brush fires and the like. The frequently high sensitivities (importance of valuable ecosystems for the primary sector and tourism) require numerous adaptive measures that can exceed existing adaptive capacities.

In North Western and Scandinavian Europe, it is usually a specific aspect of climate change that threatens regions. Natural hazards and coastal threats in the form of Atlantic storm surges and coastal flooding aggravated by rising sea levels are the major issues in this macro region. From an integrated point of view however, these regions are amongst the least vulnerable to climate change and are even somewhat favoured on account of milder temperatures and higher crop potentials (for instance, initial viticulture efforts were established in the 1990s in the UK and southern Sweden). Summer tourism could profit in regions too cold at present, while existing tourism locations in Southern Europe would need to adapt their facilities to even hotter summers.

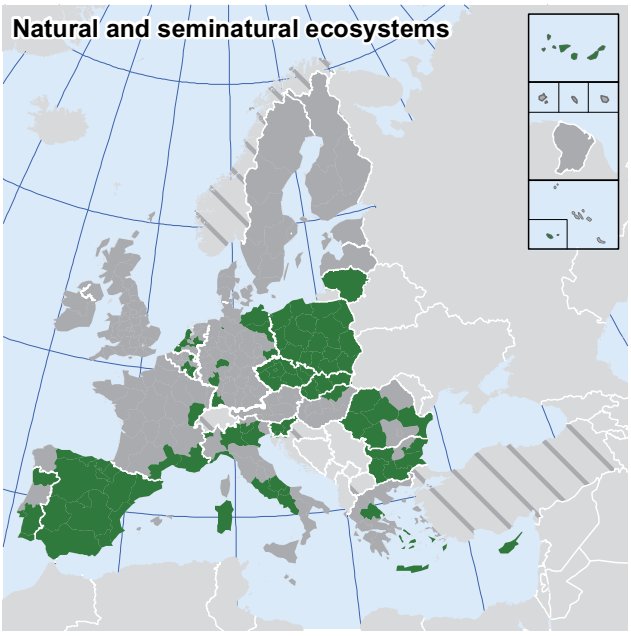
Large parts of the European mainland have average exposure, average sensitivity and considerable adaptive capacities for most climate change aspects, if viewed within the time range of this study, i.e. through 2020. Therefore they are not especially vulnerable at present.

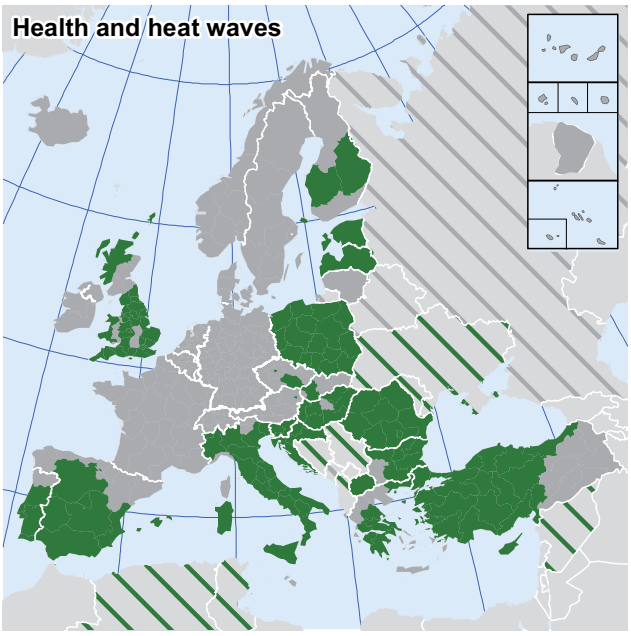
Indicators of Map III 'Climate change vulnerability at a glance' (page VII)

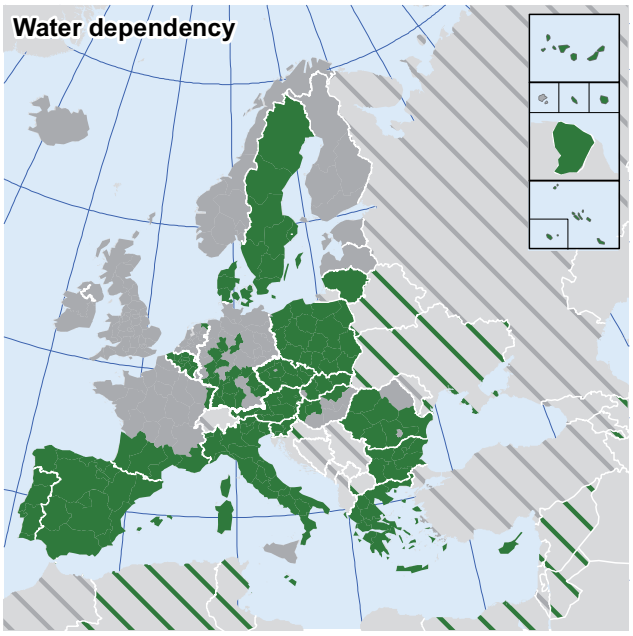


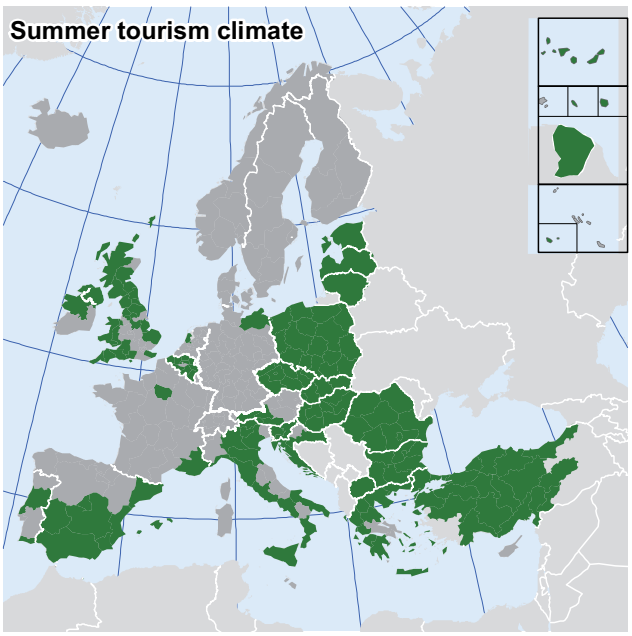
Map III Climate change vulnerability at a glance (following page)

Climate change vulnerability at a glance









Legend

EU and recognised candidate countries, EFTA

- Most vulnerable regions and vulnerable regions
- Prepared regions

Neighbouring countries (simplified methodology)

- more vulnerable
- less vulnerable

- Not enough data

Indicators

Indicators listed on page VI

Kilometres

0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source: Eurostat except were indicated

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Regional Challenges in the Perspective of 2020

In the continental climate regions of Eastern Europe, the exposure to climate changes until 2020 is also within the European average. But as these regions generally have low adaptive capacities toward the challenges, for example due to low GDP levels or weak environmental policies, they nonetheless face increased vulnerabilities. This area also faces specific threats, for instance an increase in major river floods in the Danube, Odra, Vistula and Elbe basins could be observed in the last decade leading to high vulnerabilities to natural hazards. On the other hand, Bulgaria and parts of Romania, as well as candidate and neighbouring countries in the subtropical Balkan regions and Turkey, are confronted with similar threats as those faced by the Mediterranean regions. The rest of the European neighbourhood will face similar problems as Europe depending on their climatic zones. However, adaptive capacities are generally lower, making particularly the Mediterranean neighbourhood and the Caucasus area highly vulnerable because of rising temperatures, less rainfall and the high importance of the primary sector in most of these countries. These vulnerabilities will not have an immediate impact on the climate challenge in Europe – except possibly through the spread of new pests and diseases not tackled in neighbouring regions. However, demographic trends coupled with effects of climate change could aggravate issues of social polarisation and migration pressure with possible repercussions on Europe.

Climate change cannot be stopped within this century. However, the sooner effective measures to mitigate climate change are introduced, the less adaptation will be needed in the long run. Both mitigation and adaption interests must be kept in mind over the next decades. Fast and strong economic growth increases adaptive capacity to the challenges of climate change, but strong economic growth likely also increases GHG emissions and therefore enhances climate change.

Secure, sustainable and competitive energy: a key issue for Europe's resources and global position

Energy supply is one of the most crucial issues Europe is facing today and will be facing in the future. Since 2008, European regions have been challenged by various crises and changes in the energy markets. The biggest challenge however was the economic and financial crisis, which has massively weakened the energy demand. There is clear evidence that energy investments in most regions and sectors dropped sharply in 2009. Decrease in energy demand, especially in OECD countries, contributed to a decline in international prices of oil, natural gas and coal, and both supply and demand side investments are being affected. As for the demand side, which Europe cannot directly influence, the most recent developments in North Africa show the high elasticity of energy prices.

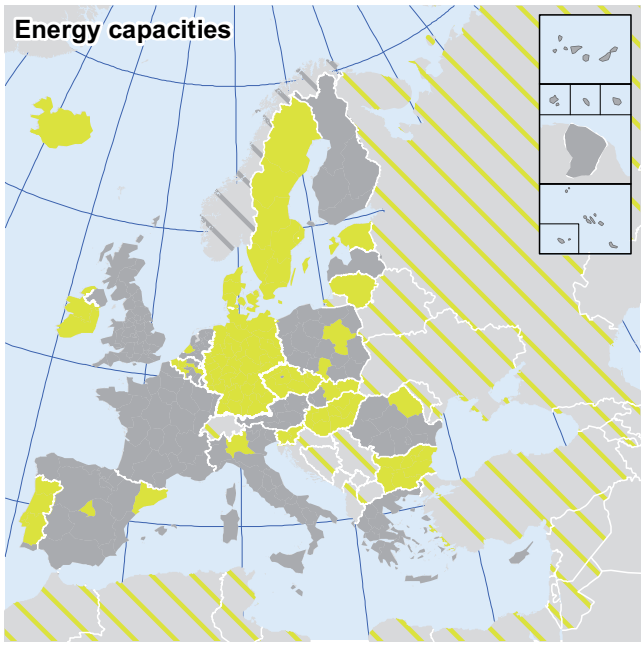
There was a positive (external) effect of the crisis: GHG emissions decreased due to trade flow decline. However, in the mid-term, the economic crisis may lead to higher emissions in a scenario of increasing reliance on fossil fuel capacities. If a recovery takes longer than expected, a shift to coal- and gas-fired plants, in addition to the prolongation of nuclear power plant operation at the expense of more capital-intensive options such as renewables, is expected. There is a justifiable danger that sustained lower investment in supply could lead to a shortage of capacity and result in a severe increase of energy prices, just when the economy is on the road to recovery. In light of this, it is expected that the effects of the crisis on investments in the EU energy sector, the EU's increasing dependence on fossil fuel imports from non-EU countries and extreme weather events will affect regional competitiveness and that some regions may be more exposed than others.

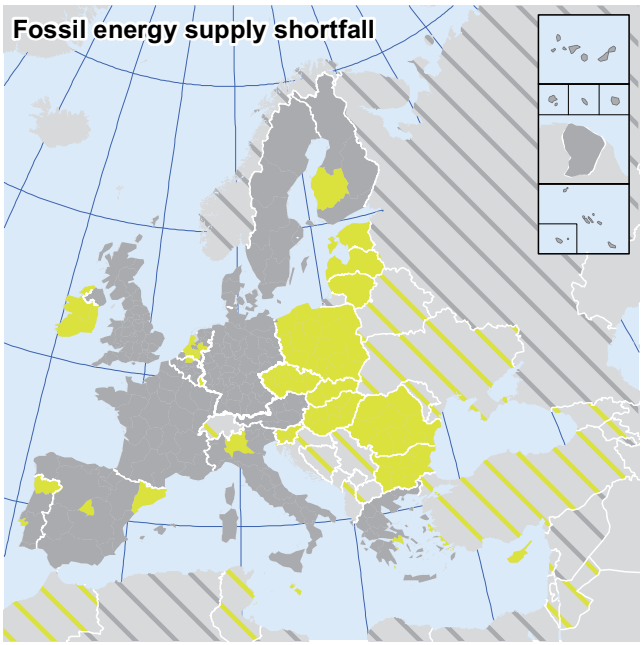
An overview of the content of the following paragraphs will be shown in Map IV on the opposite page.

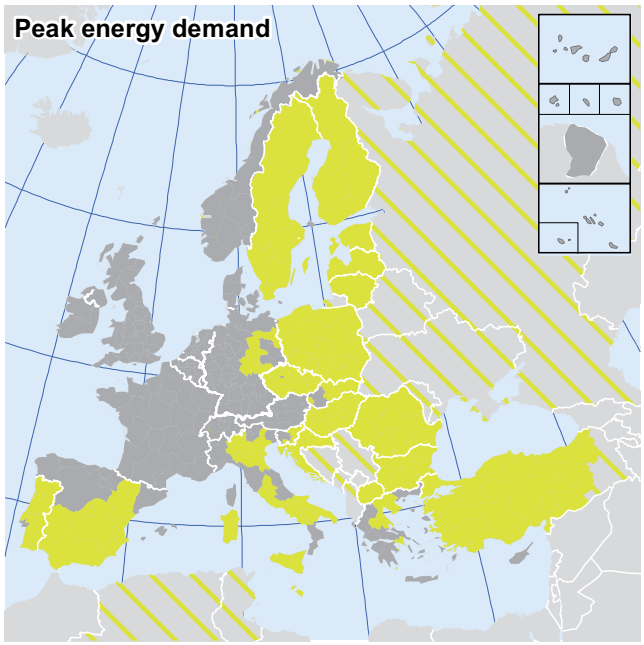
Generally, most European countries depend on imported fossil fuels. Only Norway, Denmark and the UK are able to cover most of their demand from their own resources, which makes them less vulnerable to global developments. Denmark does, however, have capacity vulnerability in power production as do Slovenia, Sweden, Iceland, and Portugal. Countries with larger shares of renewables, e.g. Portugal, Austria, Romania, Finland and Sweden, even if not exposed to capacity deficits, might still be vulnerable towards climate change driven changes in water regimes if they depend on hydraulic power. All New Member States and the candidate countries still have notable deficits in energy efficiency.

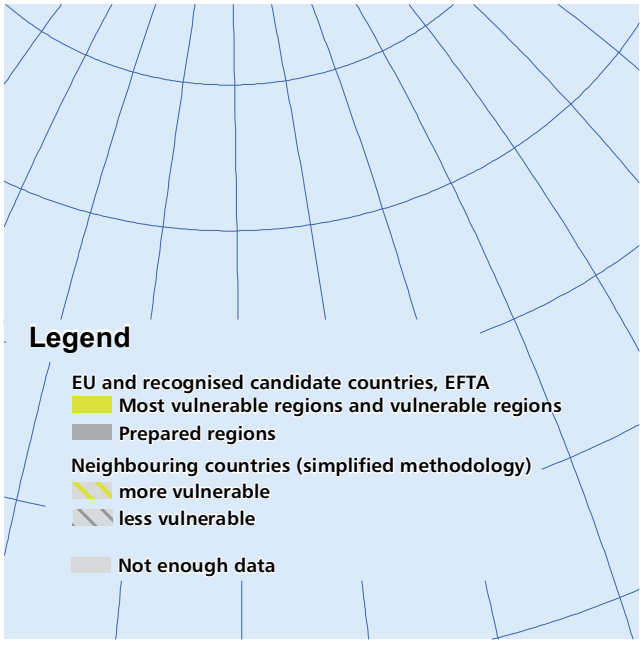
Map IV Secure, sustainable and competitive energy vulnerability at a glance (following page)

Energy vulnerability at a glance









Indicators

Energy capacities

Exposure:
- Average load factor (Primes)
- Flexibility margin (Primes)

Sensitivity:
- Share of electricity in total final energy consumption
- Share of wind in net generation capacity
- Electricity market price, domestic
- Electricity market price, industry

Adaptive capacity:
- Electricity intensity
- GDP per capita

Fossil energy security

Exposure:
- Resource Concentration Price Indicator fossile fuels (ECOFYS)
- Resource Concentration Physical Availability Indicator gas (ECOFYS)

Sensitivity:
- Share of oil and gas imports
- Share of renewable sources in final energy demand
- Gas price, domestic

Adaptive capacity:
- Energy intensity
- GDP per capita

Peak energy security

Exposure:
- De-rated electricity peak capacity margin

Sensitivity:
- Cooling degree days
- Heating degree days
- Share of electricity in total final energy consumption

Adaptive capacity:
- Electricity intensity
- GDP per capita

Kilometres
0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

Map developed by ÖIR

Regional Challenges in the Perspective of 2020

The closer European neighbourhood is an important source for fossil imports (mainly Russia, Algeria, Libya, and Azerbaijan). They will play a strategic role at least in the mid-term to Europe's energy demands and the present upheavals in the Arab countries may have a crucial influence. Europe needs to intensify its existing cooperation in addressing issues of mutual interest ranging from regulatory cooperation to infrastructure development and from the promotion of sustainable policies to joint projects.

In the mid-term efficiency and availability of renewable energy sources will depend on economic development; in the case of lost output levels it might take longer for renewable sources to succeed in the energy markets and the dependency on fossil imports will continue. However, a sustainable recovery will also lead to an increasing demand that can probably not be met by higher efficiencies and increasing renewable production. The EU needs a technological shift in order to reach its 2050 ambitions to decarbonise the electricity and transport sector if it wants to deliver the 20-20-20 targets on greenhouse gas emissions, renewable energy and energy savings. Additional priorities include the completion of the internal energy market, achieving energy savings and promoting low carbon innovation.

Social polarisation: the nationally driven challenge

As an indirect effect of all other topics analysed in this report, the challenge of social polarisation heavily depends on economic progress influenced by globalised markets, changing natural conditions influenced by climate change, demographic aspects such as the workforce and its skills, and affordable and secure energy. Although a key political issue in the EU, there are still hardly any powerful common policy measures on the macro-level. The unequal distribution of material or immaterial resources in a society hampers equal access to public and private services and affects the opportunities to participate in society. This in turn leads to self-reinforcing social inequity which affects every sphere of socio-economic life.

An overview of the content of the following paragraphs will be shown in Map V on page X.

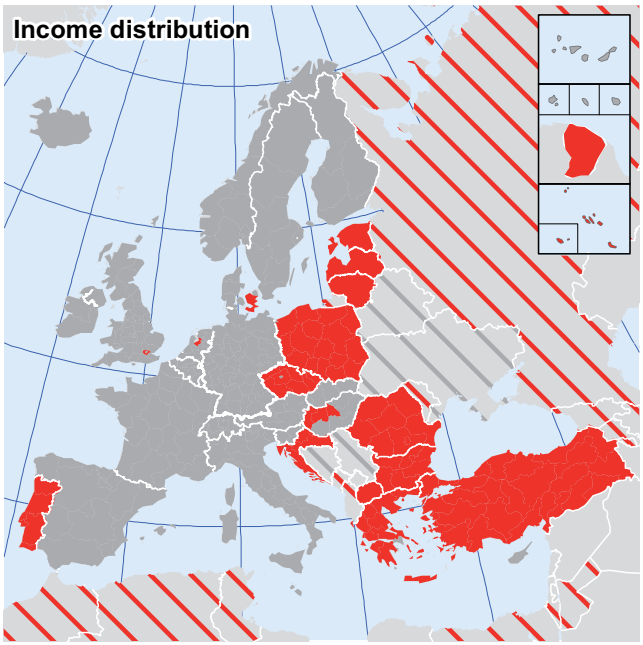
Generally speaking, social polarisation vulnerabilities follow the general European regional split with Eastern and Southern regions being more vulnerable than the rest of Europe. With respect to education levels, the South-Eastern regions show the largest deficits. Youth unemployment is a major threat to the Mediterranean countries, while the New Member States and especially the candidate countries are affected by income distribution. The dangers of ongoing labour market transformations towards a service and knowledge economy cause rising unemployment and calls for adaption efforts. This affects equally the economically weaker periphery and the most industrialized regions of the European centre.

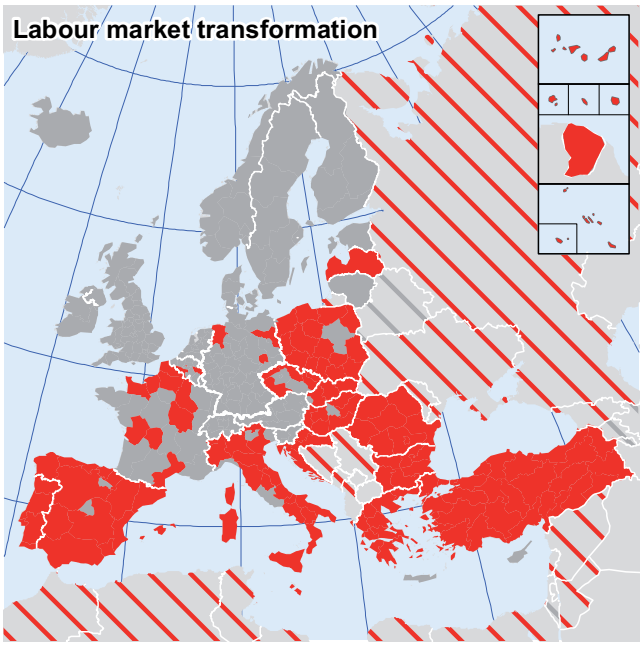
Economic wealth and incomes in Asian and African neighbouring countries are distributed much more unequally than in Europe. Youth unemployment and unemployment in general is highly concentrated in the Balkans and in the Mediterranean neighbourhood and has been a major driving force of the early 2011 political upheavals in the Arab region.

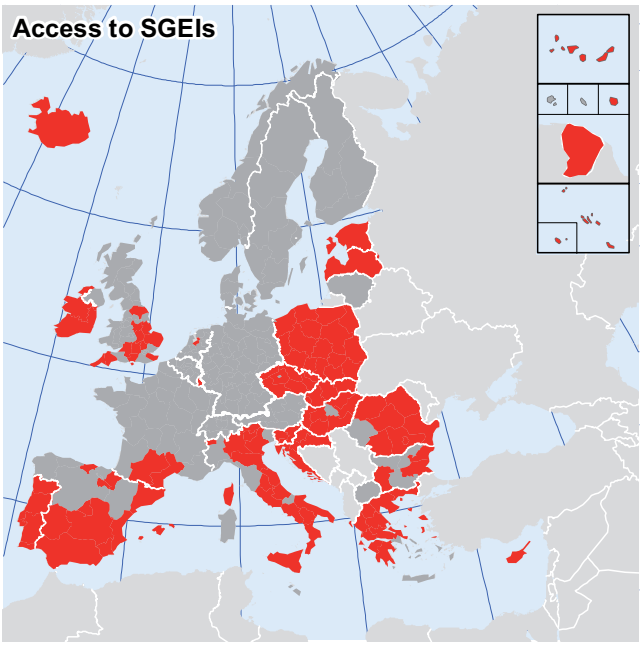
In the mid-term social polarisation is expected to improve in the sustainable recovery scenario due to the return to a path of economic growth. However, the threat of increasing income disparities may increase. Labour market transformation will favour new sectors and thus lead to a more balanced territorial distribution of wealth. The sluggish recovery scenario bears the challenge of slower growth rates and thus of less labour market opportunities for young people. The economy will show more path dependencies and fewer opportunities with respect to decreasing disparities. The lost decade scenario will hit, in particular, the wealthier central European regions with respect to income inequalities and decreasing levels of SGEIs. The European periphery will be less affected due to low starting conditions.

Map V Social polarisation vulnerability at a glance (following page)

Social polarisation vulnerability at a glance







Legend

EU and recognised candidate countries, EFTA
- Most vulnerable regions and vulnerable regions
- Prepared regions

Neighbouring countries (simplified methodology)
- more vulnerable
- less vulnerable

- Not enough data

Kilometres
0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

Map developed by ÖIR
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Indicators

Income distribution
Exposure:
- Inequality of income distribution, Gini coefficient

Sensitivity:
- Disposable income of households, net

Adaptive capacity:
- Disposable income of private households as % of primary income
- GDP per capita

Labour market transformation
Exposure:
- Unemployment rate, 15 years and over

Sensitivity:
- People with max.edu. ISCED Level II (%)
- Empl. in sel. sectors at risk of offshoring (Eurostat/Eurofound)

Adaptive capacity:
- Share of Persons (25-64 Y) participating in life long learning courses on total population 25-64 Y
- Tot.intramural R&D expenditure as a share of GDP

Youth unemployment
Exposure:
- Unemployment rate 15-24 years

Sensitivity:
- Population aged 18-24 with at most lower secondary education and not in further education or training (%)

Adapitve capacity:
- Students in tertiary education, as share of the population aged 20 to 24 Y
- Students at upper secondary and post-secondary non-tertiary education, as share of the population aged 15 to 24

Access to SGEIs
Exposure:
- Hospital beds / 100.000 capita
- Physicans or doctors / 100.000 capita
- Expenditures for elderly care in % of GDP
- Road density
- Children in pre-primary education

Sensitivity:
- Population development 2001-2007

Adaptive capacity:
- Health care expenditures per capita
- GDP per capita

Regional Challenges in the Perspective of 2020

One region, multiple challenges

When statistically analysing all of the various challenges that European regions are facing, one discovers distinct economic, societal and geographical patterns (Methods of cluster analysis were used). A number of regions are barely vulnerable to any challenge. These are all economically strong which helps them to affirm their demographic status and to maintain social peace and equality. These regions are the globally integrated and successful metropolitan areas, the Nordic countries, the UK, Switzerland and Luxemburg. Most of the regions in these countries also have a favourable climatic position which makes them well prepared for climate change. The other most prosperous European regions in economic terms, e.g. the European centre except for the major metropolitan areas (in France, Germany, Austria, Belgium, and the Netherlands), shows moderate vulnerability. They are, however, prepared for most challenges as a result of their economic wealth, which offers them the possibility to adapt. Also, many former convergence regions, located in Spain, Ireland and Italy, which managed to close the gap to the leading European economies, are generally only moderately vulnerable. Due to their geographical position they partly have increased vulnerability to climate change issues.

The rest of Europe can be defined as highly vulnerable because these regions are each facing a number of challenges. In the New Member States, effects of globalisation and indirect effects of social polarisation are a major challenge. These regions have to adapt by increasing their global integration and moving away from their prevailing agricultural and manufacturing economies towards knowledge and service oriented activities. A crucial requirement to achieve this will be adequate infrastructures and the better usage of the relatively high education levels in these countries. The very southern periphery of Europe (Portugal, parts of Spain, Southern Italy, Greece, and to some extent Turkey) not only relies largely on the unstable sectors of agriculture and tourism but is also severely threatened by climate change. If these regions wish to maintain their economic mix, adaption measures will clearly have to take place.

Lessons learned for Cohesion Policy

The findings of the European vulnerability analysis seem to underline most of the lessons for the future Cohesion Policy drawn from the 5th Cohesion Report. It must be emphasized that it is necessary to pay attention to a territorially specified policy mix in line with the identified vulnerabilities. It is important that all funding not be concentrated only on the lagging regions. For instance, classic convergence regions have difficulties capitising innovation funds, because institutional and economic structures for innovation are often missing. In more successful regions, funding impulses might produce more positive effects, because they can make use of synergies and present structures.

Regional circumstances are to be considered with respect to multiple challenges, especially in the most vulnerable regions to the South and the East. The development of adaptive capacities is important even if the current regional conditions seem to be relatively favourable (see, for instance, the Central European regions facing the challenge of an ageing population and the associated social challenges). This is consistent with the need of Cohesion Policy to target beyond short term and directly increasing GDP measures. In particular, quality of life, health and long-term environmental changes will have to be captured in order to evaluate the capacity of Cohesion Policy to find answers that address the challenges. Other aspects continue to be the balanced development of regions (i.e. balanced distribution of economic sectors contributing to the regional economic income) and their embeddedness in strong socio-economic unions and cooperation, which seems to decrease vulnerability and strengthen the adaptive capacities of regions. This is in line with the general concept of resilience of systems, with a higher variety and diversity within systems proving stronger against external shocks. This principle should lead to Cohesion Policy taking notice of overemphasis of growth poles and overspecialisation of regions.

The following table attempts to summarize the findings of this report. The table shows the regions on an aggregated level that resulted from a cluster analysis of multiple challenges. The five subsequent columns show the challenges most crucial for the macro regions, while the three ‘growth strategy’ columns give an impression which of the three Europe 2020 growth strategy strands should be most strongly emphasised. Compared to the Cohesion Policy criteria based on economic wealth, it becomes clear that there is a tendency among economically lagging regions to also need more support in order to reach the 2020 targets. This is, at least to some extent, a result of low adaptive capacities towards challenge impacts that are often measured by economic power and wealth. The table may be seen as a compass to territorially guide Cohesion Policy by showing which regions should be

emphasised by Cohesion Policy. To a large extent this corresponds to existing objective areas, which are indicated in the final column. Cohesion Policy is in need for an update beyond the programming period. Regions need to better address the challenges by concentrating on them and setting the right priorities for the investments and fuind the right policy mix. There are some regions which will have to address more challenges and need broader approaches than others. It is important that future investments have the critical mass to change challenges into opportunities. Achieving the right policy mix that is attached to this criteria and its implementation will have an influence on whether the Cohesion Policy will be more or less successful in contributing to the answers to the challenges Europe will face in the next decade.

Table II European macro regions, their challenges and emphasis on growth strategies

Challenges / **Macro regions**	**Globalisation**	**Demographic change**	**Climate change**	**Secure, sustainable and comp. energy**	**Social polarisation**	**Smart growth**	**Sustainable growth**	**Inclusive growth**	**growth strategies** / **Present cohesion policy objective**
Barely vulnerable – global economic high performers	+	+	++	+	+	+	++	++	Competitiveness and Employment Regions
Barely vulnerable – social and economic high performers	+	+	+	+	+	+	++	+	Competitiveness and Employment Regions (mostly third countries)
Barely vulnerable – social and knowledge high performers	++	+	+	+	+	+	++	+	Mostly Competitiveness and Employment Regions
Barely vulnerable UK	+	+	+	+	++	+	+	++	Mostly Competitiveness and Employment Regions
Moderately vulnerable – economic high performers	+	++	++	++	++	+	++	++	Mostly Competitiveness and Employment Regions
Moderately vulnerable – climate change challenged regions	++	++	+++	++	++	++	+++	+++	Mostly Competitiveness and Employment Regions
Highly vulnerable – globalisation and energy security challenged regions	+++	++	++	+++	++	+++	+++	+++	Mostly Convergence Regions
Highly vulnerable – globalisation and climate change challenged	+++	++	+++	++	++	+++	+++	+++	Mixed Convergence and Competitiveness and Employment Regions
Highly vulnerable – globalisation and socially challenged regions	+++	++	+++	+++	+++	++	+++	+++	Candidate country

+	Barely challenged/basic emphasis on growth strategy	++	Moderately challenge/average emphasis on growth strategy	+++	Highly challenged/high emphasis on growth strategy

1. Introduction

The present study *Regional Challenges in the Perspective of 2020 – Phase 2: Deepening and Broadening* commissioned by the Directorate General for Regional Policy expands the analysis presented in the European Commission publication *Regions 2020 – An Assessment of Future Challenges for EU Regions* dating back to November 2008. It identifies potential impacts of present and upcoming pivotal European challenges on regional disparities and regional development potential in the perspective of 2020.

Globalisation, *demographic change*, *climate change*, *secure, sustainable and competitive energy*, and *social polarisation,* in addition to the *economic and financial crisis*, are the major challenges with which Europe is confronted today and will be confronted in the medium and long term. While these challenges all have different regional impacts, the European regions each have a specific vulnerability towards them. To assess these regional peculiarities, the concept of regional vulnerability, which is borrowed from environmental impact assessment, is expanded to include socio-economic objects of investigation. It distinguishes between a region's strength of exposure towards an influence, the specific regional sensitivity and the capacity of a region to adapt to negative impacts. Additionally, the study broadens the perspective of its precursor by including the neighbouring countries to the south and east. It serves as an information source for the regional policy implementation of the *Europe 2020* strategy for smart, sustainable and inclusive growth put forward by the Barroso Commission in March 2010.

To conduct the study, a group of thematic (economy, energy, meteorology, regional development) and cross-cutting experts was assembled. Additionally, three workshops each with 30-40 external and Commission experts provided peer review and discussion of project findings. A scientific board consisting of five independent academic experts served as an internal sounding board which provides consistency and review.

The results are presented on the NUTS 2 geographical level (in most Member States medium-level provinces) and mainly examine the time span until 2020; however, hints for further outlooks are also provided. It takes into account different underlying development paths based on assumptions regarding the manner in which the way out of the financial crisis will progress.

In the chapter *Methodological remarks* the most important scientific tools that were used for the study will be summarized.[1] The chapter *The policy context of Europe 2020* will present the initial point of the analysis. In the subsequent five thematic chapters the regional vulnerabilities towards the five challenges of *globalisation*, *demographic change*, *climate change*, *secure, sustainable and competitive energy and social polarisation* will be assessed.[2] Following the thematic chapters the chapter *Integrated discussion of future challenges for EU regions* will discuss the effects of multiple challenges and key issues on the regions. In the end, the chapter *Policy implications* will identify potential ways to address the challenges Europe is facing by policy design (with a special focus on Cohesion Policy).

[1] A more technical methodology is annexed.

[2] Regional vulnerabilities towards the *economic and financial crisis* are assessed in a separate publication in the framework of the study.

2. The policy context of the study

The original "Regions 2020" raised considerable interest in the Member States and the Regions. Discussions pointed to the need for a deeper and broader analysis in order to better contribute to the debate on the future of Cohesion Policy in the framework of the new Europe 2020 growth strategy that follows the Lisbon Strategy adopted by the second Barroso Commission in 2010.

Europe 2020: A European strategy for smart, sustainable and inclusive growth (EC 2010-2) is a 10-year strategy proposed by the European Commission on 3 March 2010 for reviving the European economy that expands upon the (only partly successful) Lisbon strategy. It aims at "smart, sustainable and inclusive growth" with greater coordination of national and European policy heavily influenced by the European and global economic crisis that has wiped out years of economic growth and job creation. It addresses answers to long-term challenges arising from globalisation, pressure on resources or ageing would still intensify.

The new strategy centres around overcoming the crisis and preparing the economy of the EU for the next decade and shows ways how Europe can achieve an intelligent, sustainable and integrative growth, create new jobs and give orientation to our societies. Europe 2020 sets out a vision of Europe's social market economy for the 21st century and puts forward three mutually reinforcing priorities that should facilitate high levels of employment, productivity and social cohesion:

- *Smart growth*: developing an economy based on knowledge and innovation.
- *Sustainable growth*: promoting a more resource efficient, greener and more competitive economy.
- *Inclusive growth*: fostering a high-employment economy delivering social and territorial cohesion.

The strategy identifies five headline targets that the European Union should aim for in order to boost growth and employment. These are:

- To raise the employment rate of the population aged 20–64 from the current 69% to at least 75%.
- To achieve the target of investing 3% of GDP in R&D, in particular by improving the conditions for R&D investment by the private sector, and to develop a new indicator to track innovation.
- To reduce greenhouse gas emissions by at least 20% compared to 1990 levels or by 30% if the conditions are right, increase the share of renewable energy in final energy consumption to 20%, and achieve a 20% increase in energy efficiency.
- To reduce the share of early school leavers to 10% from the current 15% and increase the share of the population aged 30–34 having completed tertiary education from 31% to at least 40%.
- To reduce the number of Europeans living below national poverty lines by 25%, thus lifting 20 million people out of poverty.

These headline targets are broken down in turn into seven topical flagship initiatives called *innovation Union*, *youth on the move*, *a digital agenda for Europe*, *resource efficient Europe*, *industrial policy for the globalisation era*, *an agenda for new skills and jobs*, and *European platform against poverty*. The strategy proposes an integrated approach, which implies the necessity of mobilising sub national actors for the success of the strategy. A necessity, which has been identified as one of the failures of the Lisbon strategy in the past.

The study *Regional Challenges in the Perspective of 2020* serves as a Regional Policy information source analysing the related challenges and relating them to the Europe 2020 strategy.

3. Methodological remarks

The methodological core of this study is the application of the concept of regional vulnerability to socio-economic analysis. Based on the definition given by the Intergovernmental Panel on Climate Change (IPCC), in the context of which this concept has been used in the past, the notion of vulnerability is defined as a function of regional exposures and sensitivities towards the analysed challenges and the regional adaptive capacities that are available to mitigate the impact exerted by the challenges.

Regional exposure describes the way and the intensity in which the European regions are affected. In the case of climate change this might be increasing temperature, while in the field of demographic change this could mean trends in population development. Exposure is the variable that is supposed to change dynamically according to overall trends.

*Regional sensitivity d*efines how a region will behave in relation to an exposure and thereby reflects the structural character of a region. In climate change this might be described by the occurrence of crops sensitive to temperature changes, in the challenge of demographic change by the present population density. A function of a given exposure in a region and its present sensitivity then builds the *(potential) regional impact*.

Regional adaptive capacity, as the third variable, is the ability of a region to adjust to this impact or to cope with any other consequences. In many cases the adaptive capacity is defined by variables that describe the (policy) intervention potential (e.g. economic wealth); however, in many cases socio-economic conditions provide a more solid adaptive base. In demographic change, for instance, rising income levels might decelerate or even reverse population outflows. Finally, *regional vulnerability* represents the synthesis of the three elements as a function of (potential) regional impact and regional adaptive capacity. This means that a region with high adaptive capacity is less vulnerable, more resilient and better prepared than one with the same impact level but lower adaptive capacity. This concept is schematically pictured in Figure 1. The subsequent function of vulnerability is based on White (et al., 2005):

(1) V = f (E,S,AC)

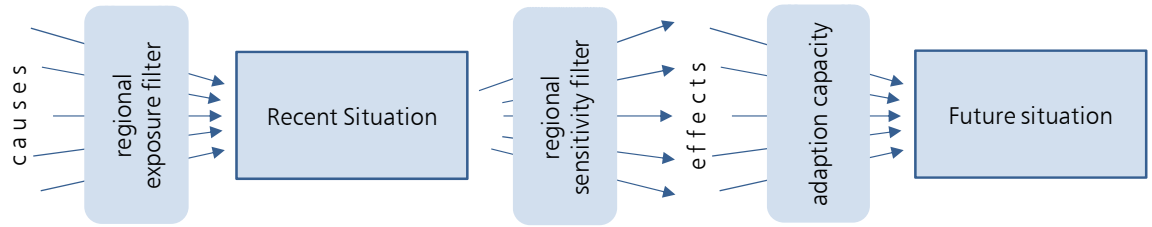
where E = Exposure, S = Sensitivity, AC = Adaptive capacity

In practise, the different dimensions of regional vulnerability must of course be filled with statistical indicators. As the analysed challenges exhibit a very complex nature, more than one indicator usually has to be used for analysis. To be able to reduce this complexity it was decided to split the challenges into topical *key issues* based on an initial literature research. This makes it possible to avoid overly aggregated indicators that are hard to interpret and enables the challenges to be broken down into a manageable number of indicators available on a regional level.

The creation of composite and integrated vulnerability maps

In order to produce easily readable and interpretable vulnerability maps, these fairly heterogeneous indicators must be aggregated and combined. For aggregation, the method of z-transformation, also known as standardization or auto-scaling, was used. The indicators are made comparable by observing the present means and standard deviations of a sample of indicators and then setting the mean to zero and the standard deviation to one in every row of indicators, which enables the simple aggregation of indicators. In order to avoid a data range related bias of the indicators, the respective weight of indicator values was set the same. Additionally, each indicator has been polarised according to its influence on the regional vulnerability (a rising indicator value increasing the regional vulnerability was set positive and vice versa).

Figure 1 Schematic of the concept of vulnerability in the concept of Regions 2020



Source: Spatial Foresight

In the next step, the standardised indicators have been aggregated to composite exposure, sensitivity and adaptive capacity indices. A pragmatic approach was used in this respect as the indicators to be combined in some cases retained completely different types of information.

Logical disjunctions and conjunctions were used as a form of meta-level weighing: the *conjunction* joins two or more indicators, which means all indicators have the same influence on the composite index. In practice this was expressed by the simple arithmetic mean of all indicators. For most aggregate indices in the project the conjunction was used to avoid losing any information. A *disjunction* selects one of two or more indicators. In practice the indicator that has the most extreme influence on vulnerability was selected (for example, regardless of whether a region faces high variability of crop yield or many fire hazards, it is highly exposed to a decline in biomass production). The disjunction is useful when all individual indicators by themselves cause discrete and comparable levels of exposure, sensitivity or adaptive capacity.

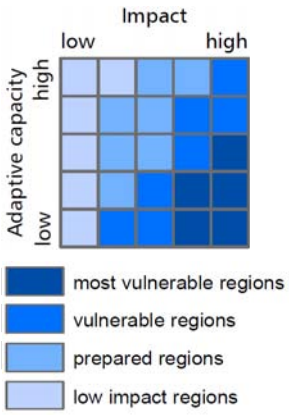
Finally, the results of the steps presented so far have been categorised for presentation in the thematic maps. For easy processing, a five-part ordinal scale based on the mean values of 0 (always 0 for the z-transformed indicators) and shares of standard deviation (always -1 or +1 for the z-transformed indicators) was used:

- equal to or below negative standard deviation: *highly below average*
- above negative standard deviation but below 1/3 negative standard deviation: *below average*
- above 1/3 negative standard deviation and below 1/3 positive standard deviation: *average*
- above 1/3 standard deviation but below total positive standard deviation: *above average*
- equal to or above positive standard deviation: *above average*.

This resulted in impact and adaptive capacity indices for all analysed NUTS 2 regions and for each key issue within the five challenges. Not only the 27 EU member states were analysed, but also of the candidate countries Iceland, Turkey, Croatia and the Former Yugoslav Republic of Macedonia, the associated EFTA countries Norway, Switzerland and Liechtenstein. Additionally, all countries of the European Neighbourhood Policy in the Mediterranean Basin and Eastern Europe and the Libyan Arab Jamahiriya and Russia were included. These countries (and in some cases, when not enough data was available, also the candidate and EFTA countries) were analysed using fewer, however representative indicators on a national level.

To create an index for vulnerability another method besides aggregating up the normalised indicators was chosen, owing to the difficulties in some key issues to define meaningful indicators for adaptive capacity that go beyond rather trivial GDP numbers. A typology that combined impact and adaptive capacities into four classes was chosen and is presented in Figure 2.

Figure 2 Vulnerability typology



It resulted in four types of regions:

- the impact is either greatly below average or below average and the adaptive capacity greatly above average: *low impact regions*
- the adaptive capacity is higher than the impact or both are average: *prepared regions*
- the adaptive capacity is the same or slightly lower than the impact: *vulnerable regions*
- the impact is above average and the adaptive capacity is below: *most vulnerable regions*.

Integrated and multiple challenges

Owing to the fact that, on one hand, the analysed challenges have been divided into thematic issues and, on the other hand, there are five independent challenges that nonetheless have specific impacts on every single region (multiple challenges), a tool had to be introduced that allowed for connecting these results. For this exercise the technique of *cluster analysis* was used. The term cluster analysis (first used by Tryon, 1939) encompasses a number of different algorithms and methods for grouping similar objects into respective categories. Cluster analysis is an exploratory data analysis tool which aims at sorting different objects into groups in such a way that the degree of association between two objects is maximal if they

belong to the same group and minimal otherwise.

For the present study one cluster analysis was conducted for each challenge and one for a combination of all five basic challenges. After various rounds of testing the single indicators, the aggregate indices for exposure, sensitivity and adaptive capacity were used. This facilitated the interpretation of the sheer amount of indicators surveyed; and cluster analysis only works in the context of this study as a combination of quantitative statistical calculations and careful qualitative interpretation of the results.

The definition of scenarios

As a final step in the analysis framework of the study, the mid-term development – particularly regarding the effects of the financial and economic crisis – had to be taken into consideration. In a first step *umbrella scenarios* were defined in order to elaborate a story line describing potential development paths of the European Union. They form an envelope around the developments within each challenge and serve as the backbone of the analysis of EU Regions 2020 under multiple challenges. The Europe 2020 strategy incorporated three potential growth paths to which the scenario development of this study was incorporated (see Box 1). In a second step, these umbrella scenarios were linked to the five challenges analysed in the study in a systemic way. Due to the vast number and the complexity of indicators used in the vulnerability approach, it was decided not to apply the quantitative methods for the status quo of vulnerability to the scenarios. As even short-term GDP forecasts are not reliable in times of crisis, a more qualitative approach was taken. Also taking GDP modelling into account (e.g. EC 2009-1), the growth of the overall output does not allow for deductions of neither sectoral nor regional diversities and disparities.

On an economic level, the activity mix must be estimated largely according to recent trends, i.e. the tertiary sector still will see growth, yet at the expense of the primary and secondary sectors. However, it can be expected that for the ambitious 2020 goals the share of knowledge and research-intensive activities will have to increase. On the other hand, production costs in emerging economies are steadily rising and the gap in competitiveness might narrow. At the challenge level, certainly not all five challenges will behave according to the growth scenarios. Greenhouse gas emissions, for example, tend to rise with the increase of economic output; just as income disparities do not automatically fade away with a rising GDP. At a regional level, it can be suggested that not the entire Union will develop according to one of these scenarios. Some regions might recover faster than others, while others (for instance structurally weak regions or regions with permanent macro-economic imbalances) might suffer from lower levels of growth than indicated prior to the crisis, also in the mid-term, even if policies address their deficits properly. Regions with a solid structural background that are, for instance, focusing on upcoming growth technologies might make a quick full recovery. However, these are predictions that are even shaky in non-crisis times. There is already some evidence in 2010 that some regions, which suffered most from the crisis, are also among the fastest to recover. Regions that got off relatively easily during the 2008/2009 shock (mostly service-oriented regions) will have continuous but weaker positive growth rates for the short term (Bank Austria 2010, EC 2010-3).

Box 1: Umbrella scenarios

- *Sustainable recovery*
  In this scenario, Europe is able to make a full return to the earlier growth path and raise its potential to go beyond. Economic output will rise highly by 2020 and policies are enabled to react to the challenges facing European regions accordingly due to high revenues. On the other hand, institutional and structural reforms will not happen as fast as the crisis indicated because the crisis effects could be relatively quickly overcome. Europe will maintain and consolidate its role as a driving force in knowledge economy to overcome the loss of employment in the production sector to emerging industrialised countries. To compensate for competitive disadvantages with emerging players that have less restraints in resource use, the business environment, especially for SMEs, will be improved in order to develop a strong and sustainable industrial base.
- *Sluggish recovery scenario*
  Europe will have suffered a permanent loss in wealth In this scenario and start growing again from this eroded basis. The economic growth levels will reach the pre-crisis levels, but overall there will be a permanent gap compared to the former output levels. The freedom of designing far-reaching policies will be restricted. To keep the recovery going, forces will be concentrated into innovation and knowledge so as to keep the global competitiveness of Europe on pre-crisis levels. Europe will maintain its wealth and its role as a driving force in knowledge economy but will still be threatened by emerging countries.
- *Lost decade scenario*
  In this scenario, Europe will have suffered a permanent loss in wealth and potential for future growth. Until 2020 the pre-crisis economic growth levels cannot be reached again, which makes the financial manoeuvring room for policy makers to respond to upcoming challenges more restricted. Nonetheless, efforts will be made to foster innovation and knowledge economy, yet a number of neighbouring and overseas economies will slowly but steadily erode Europe's global competitiveness. Europe will contend hard to keep pace and can only compete by retaining high productivity levels while simultaneously tapering off income and social security levels. Many regions will therefore take their fate into their own hands and look for alternatives to growth.

4. Globalisation

The idea of regions as potential global units has been a prominent feature of the literature on territorial development over the last decades, especially focusing on the importance of "global cities" and other major metropolitan areas, but also by identifying the importance of transnational networks and interactions in the growth strategies of a wide range of regions. Some authors have asked whether the confidence in globalisation processes as vectors of development has been broken in the aftermath of global international financial crisis (e.g. Hieronymi, 2009). On-going political processes will show whether these interpretations hold true. However, irrespective of whether current globalising trends continue or not, it is obvious that globalisation related processes will play a prominent role in the development of European regions. The present chapter proposes an analytical framework to monitor these evolutions and to assess the exposure and vulnerability to major globalisation related processes.

For this purpose, we approach globalisation as a twofold process. First, it is a "process where local economies and social systems experience a rapid increase in their sphere of action and their reciprocal interdependence" (European Commission, 2009). Second, the globalisation process is intimately linked to the emergence of a new economic order. In this system, the increasing role of international bodies such as the WTO, the IMF, the G-20 and Central Bank Governors is often emphasized (Cohen, 2001). New modes of financial accumulation also play a determining role by conferring an increased relative weight and greater power in the systems of economic governance to actors of the financial sector. Additionally, the growth and assertion of transnational corporations (TNC) is a component of the globalisation process. They initially emerge from the strategies of industrial actors to deal with a situation of increased mobility of goods and services by exploiting differentials in productivity and divides in fiscal and regulatory framework conditions to optimise their competitiveness. The transnational mergers and acquisitions resulting from these processes create new types of power relations that strengthen the relative importance of the concerned firms and which can directly influence the functioning and regulatory framework of the global market. This is illustrated by the notion of triangular bargaining introduced by Susan Strange in the early 1990s, to analyse the respective roles of firm-firm, state-firm and state-state relations in shaping the framework conditions for local and regional development.

The region can be approached as a point of convergence between a number of international dynamics emerging in the context of regulatory frameworks established in interaction between TNCs and international regulatory bodies *and* the region's characteristic features. Among these features, geographic specificities such as a peripheral or central position and a high or low population density may play a significant role; however, the inherited social structures, e.g. in terms of income disparities and distribution of groups at the intra-regional level, must also be considered. Finally, the orientation of the regional economy is crucial for being capable of asserting itself and competing in a globalising context.

Correspondingly, the analysis of the challenge of globalisation in territorial terms does not only refer to the primary division of the EU, e.g. into East and West, nor solely to the commonly discussed urban-rural division. While these territorial characteristics admittedly matter, the regional economic profiles and functions are crucial for global competitiveness and global integration.

Within this framework, we identify four cross-cutting key issues of crucial importance for regions facing globalisation and serve as the basis for the analysis:

The (demographic and economic) **global players** of regions not only increases their capacity to influence global processes, but is also a significant factor when seeking to attract key advanced service activities such as those belonging to the financial sectors. Social polarisation and spatial segregation are furthermore phenomena that are accentuated in large agglomerations.

The effect of general levels of **mobility of persons and goods** on the economic and social trends of individual regions is particularly obvious in transport hubs where a significant proportion of the population works in the transport sector. The strength and geographic positioning of transport corridors and the orientation of flows are an additionally important determinant of the relative dynamism of individual regions.

All types of demographic and economic polarisation are largely influenced by levels of **accessibility** at different geographical scales and based on different modes of transportation. However, it has to be taken into consideration that accessibility is not the only influencing factor and

that both European/international accessibility as well as regional connectivity are important factors for increasing competitiveness.

High **knowledge and know-how** intensity and high levels of education are the hallmark of successful regions across Europe. They allow for an improved adaptive capacity of regions and higher productivity. Both of these factors make it possible to preserve competitiveness in spite of the generally higher wage levels. Knowledge intensive activities can also have an important symbolic function, to the extent that being world-leading within a specific branch or field contributes to shaping a regional identity both externally and internally.

The regions' exposure, sensitivity and adaptive capacities are analysed along these key issues within the field of globalisation. In addition, it is to be noted, that the globalisation challenge is also linked to all other challenges dealt within this report. The main linkages can be summarized as follows:

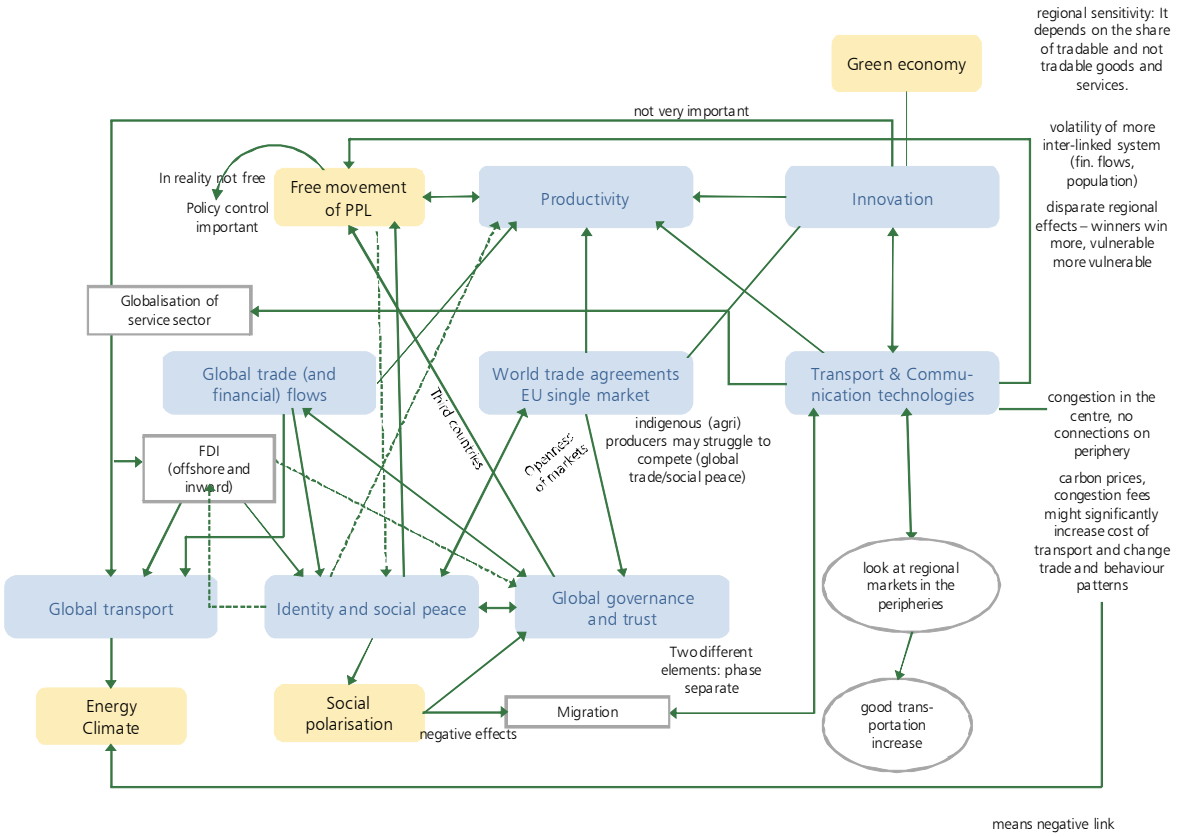
The challenge of *demography* is strongly linked with the globalisation issue *mobility of persons and goods*: The EU faces a severe demographic change with an ageing population and a decreasing share of world population. As of the wealth of the EU this enhances migration and may thus affect the mobility of persons.

The *climate change* and *energy* challenges are necessarily linked to the globalisation issue *mobility* of persons and goods as well as to *accessibility*: Any transport activity implies the use of energy, which in turn can contribute to the emissions of GHG.

Finally, not only do varying *knowledge*, productivity and wage levels contribute to *social polarisation* between and within societies, but also to territorial concentration processes in metropolitan areas. Figure 3 attempts to illustrate the systemic links around interrelations.

In addition to the links of the globalisation challenge with the other thematic challenges, it is necessary to scrutinize the EU in the context of its neighbouring countries: The EU territory is one of the most populous and densely populated regions in the world. Total GDP is one of the highest in the world, and can be compared to ones of the NAFTA zone. At the same time there is a divide between Europe and its neighbouring areas. This divide is substantial when it comes to a range of important development factors, such as GDP per capita, the human development index and the age structure.

Figure 3 Systemic overview of the globalisation challenge

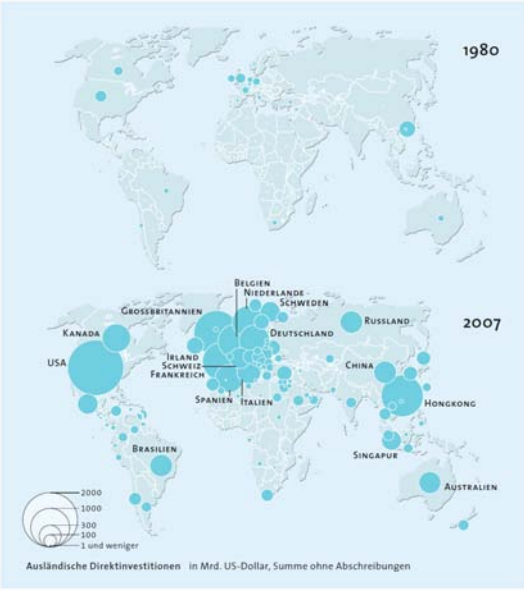


The corresponding discontinuities can induce important flows of migration. However, given the different levels of actual wealth, some of the neighbouring countries will have higher growth figures than the EU. Together with the considerably higher growth figures in other parts of the world, this implies that the EU's share of the world GDP will decline. This is a continuation of the developments over the past 50 years (ESPON, 2006) and will similarly affect the EU's role in terms of world trade, population, etc.

Global players

Globalisation is more than international trade growing more quickly than global production. International capital markets have grown even more strongly than international trade. Map 1 gives an idea about the development of the Global players function as it illustrates the growth of FDI volume. This function largely draws on the arguments related to agglomeration economies. As emphasized by Turok (2010), Bairoch (1988), Krugman (1991) and many other authors, cities and especially agglomerations are privileged locations well placed to maintain competitive advantages through their unique capacity to foster innovation and productivity growth. In particular, in an economy that is increasingly based on knowledge intensive economic activities, they function as nodes of intense business interaction and sharing of ideas and insights. This leads to mutual learning and creativity by drawing on their labour force potential, which is not equally available in other places. This labour force potential is characterised by the wide availability of advanced skills, research and technology facilities, specialized services such as venture capital and international connectivity.

Map 1 FDI in billions of US dollars by country where the investment takes place



Source: Le Monde diplomatique (2009:66) based on UNCTAD 2008

These agglomeration advantages tend to represent disadvantages for many other European regions, imposing corresponding challenges on them. However, differences between agglomerations matter as well. This is illustrated, for example, by the discussion about the characteristics, links, functions and power of global cities. They are the centres of strategic control and command points of the global economy. This encompasses in particular the headquarters of the world's major corporations, major banks, other financial institutions and governments. Therefore, the global players function is critical for the agglomerations' global integration. Because of their international links, however, these regions are simultaneously exposed to global developments and can suffer strongly from a global recession especially in terms of their income. Depending on their specific economic structure, their sensitivity towards global developments varies. However, in agglomerations the Global players function generally allows for a diversification of economic activities, which enhances the adaptive capacity. Basically the inverse of this argument holds for regions without the corresponding Global players.

The indicator system for regional vulnerability

The corresponding indicator system reflects the functional and quantitative characteristics of agglomerations, which distinguish them from other regions. For the regional **exposure** they include the *total population,* the *number of flight passengers* coming to and leaving from a region as well as the *number of employees in banking and insurance*. For measuring **sensitivity**, *GDP per capita* is a measure of the production value achieved by a region. For the **adaptive capacity** those indicators have been chosen which empower a region to deepen global connectivity: In this context TNCs play a crucial role, thus, the *number of transnational headquarters* is included as well *total R&D spending*. *GDP per capita* is used a basis for comparisons with neighbouring areas, as a measure of the overall production of wealth compared to the population.

Table 1 Indicators used for 'Global players' vulnerability in NUTS 2 regions

	indicator	minimum	mean	maximum	SD.
Exposure	Population density	3.00 (Ísland, IS)	346,63	9,443.00 (Inner London, UK)	873.33
	Total flight passengers in 1000 per year	0 (various regions)	6,491	86,683 (Île de France, FR)	11,755
	Employment in banking and insurance in 1000	1.30 (Åland, FI)	104.45	1,185.60 (Île de France, FR)	123.36
Sensitivity	GDP per capita	2,000 (Van, TR)	23,805	96,000 (Inner London, UK)	14,279
Adaptive capacity	Number of transnational headquarters per 1000 jobs	0.93 (Comunidad Valenciana, ES)[a]	179.24	1,163.59 (Noord-Holland, NL)	224.16
	R&D expenditure as a share of GDP	0.08% (Severen tsentralen, BG)	1.39%	6.77% (Braunschweig, DE)	1.17

Neighbouring countries and cross-border effects

Although the EU is an important global player in terms of mass and power, there is an overhanging risk that its role will diminish over the next decades. This regards both its global economic weight – where the change in power relations is already visible by China's role in the European recovery process – as well as the demographic weight of an aging Europe. Globally, wealth is concentrated in simple patterns, a large northern triad (United States and Canada, Europe and the Near East, and East Asia). This triad also forms the dominant corner stones of the world trade. Furthermore, a small southern triad can be observed (Brazil-Argentina, South Africa, and Australia-New Zealand) and the BRIC countries will most likely influence these patterns over the coming decades. The growing importance of China in the wake of the global financial crisis may even accelerate this process. Thus the global economic power relations are likely to change over the next decades.

Zooming in to a European neighbourhood perspective, major discontinuities are located in the Mediterranean and in the Sahara and, to a lesser but considerable extent, along the Finish-Russian border (see Map 2). This double line of discontinuities can induce considerable flows of migration, thereby affecting the mass function.

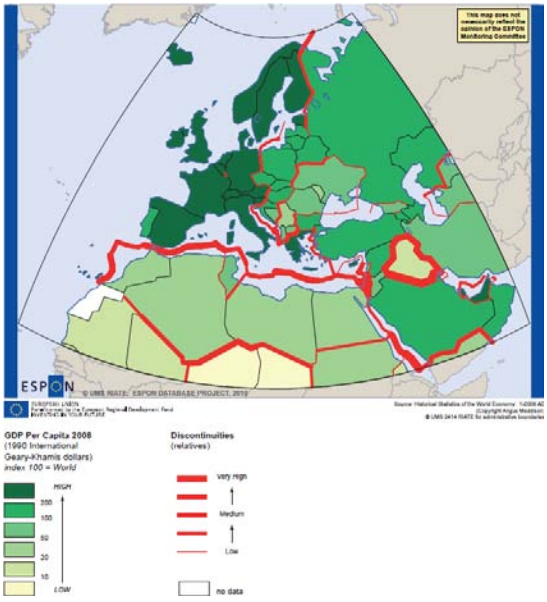
Despite the expected migration, it can be assumed that the developments over the last decades with a consistently decreasing European share of world population and GDP will continue. As other world regions have a fast growing population, also European agglomerations are likely to become less significant – at least in terms of their population, even though many European countries are the goal of many migrants from the eastern and southern neighbourhood (Le Monde diplomatique, 2009).

One approach for adapting to the danger of marginalisation lies in the constitution of wider, interregional and cross-border alliances. These can be part of a strategy to increase the global visibility of a specific area, to increase its competitiveness, economic robustness, and demographic and social stability through functional integration, as well as to exploit complementarities with neighbouring areas. The challenge consists in developing functional networks on the basis of the advantages of physical proximity, i.e. translate the idea of an integrated area into the 'network society' and make it economically and socially viable and integrated. Such areas are partly referred to as 'global integration zones' (ESPON, 2006) or as 'mega-city regions' (Polynet).

The vulnerability map

The synthetic representation of the indicators described above shows the overlay of two main types of geographic patterns (Map 3). First, the largest metropolitan regions stand out within each national context.

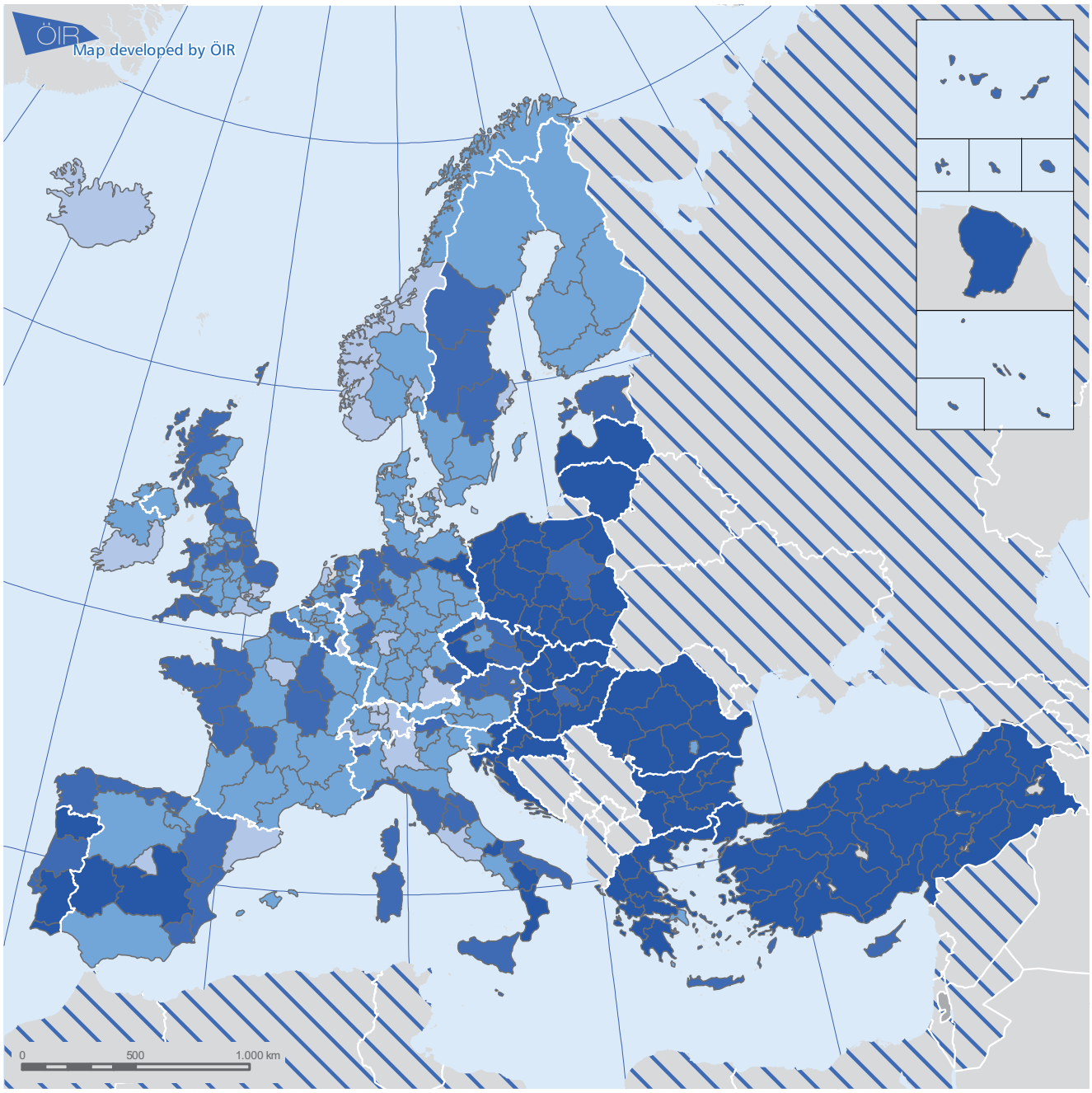
Map 2 Discontinuities of GDP per capita, 2008



Source: First ESPON 2013 Synthesis Report

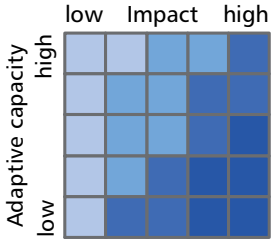
Map 3 Key vulnerability 'Global players'' (following page)

Global players - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Population density
- Total flight passengers (embarked/disembarked)
- Employment in banking and insurance

Indicators describing sensitivity:
- GDP per capita

Indicators describing adaptive capacity:
- Number of transnational headquarters per 1000 jobs (Source: Fortune)
- R&D expenditures in % of GDP

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- GDP per capita

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

This is not surprising, since it is a characteristic of these regions' to have high population numbers, many flight passengers and relatively high GDP per capita. Secondly, there is a contrast between affluent regions of Western Europe and those situated in the EU12 as well as Greece. Additionally, the northernmost parts of Sweden and Norway appear to be in a challenging position. Northernmost Finland appears relatively more robust because of the strength of the Oulu region, but would be otherwise characterised in the same way. In the northernmost regions this position is largely a result of the particularly low population densities found there. In contrast, for the regions of the EU12 and candidate countries this is much more the result of accumulated Global players challenges. Many of these regions are part of the cohesion countries, challenged by their low GDP per capita levels. This is accompanied by limited flight connections and a still lagging international banking and insurance sector. Furthermore, due to economic structures and public finance limitations, R&D expenditures are lower than in the more prosperous Western European regions.

The most robust regions are the metropolitan regions of Western Europe, including not only capital regions, but also regions such as Barcelona, Lyon, Milan, Munich, Frankfurt and South-Western Norway. Due to these regions' Global players functions combined with a critical diversity in economic activities, they are least vulnerable to general globalisation developments. The Portuguese and Greek metropolitan regions appear weaker. The metropolitan regions of the EU12 stand out within their national context, but are classified similarly to weaker regions of Western Europe. The most fragile regions in all respects are the non-metropolitan regions of the EU12 together with lagging Mediterranean regions.

In total, the Global players key issue already reveals a first glance at the above mentioned primary subdivision of the European territory and urban-rural divisions. Furthermore, especially with regard to some northernmost regions, it also highlights functional diversity. The contrasts in GDP along the outer borders of the EU are sharp. All neighbourhood countries are below the critical mass compared to the EU. The lowest value in the EU neighbourhood are to be found in Moldova and Ukraine, Morocco, Syria and easternmost Turkey. More urban parts of Turkey, however, display values that are higher than those of many new member states (also see Map 40 in the Social polarisation chapter).

Mobility of persons and goods

Mobility is crucial for the international exchange in a globalised economy. People, capital, goods and services become increasingly mobile in the interactive milieu of the global economy. They constitute a wide range of networks, embracing scientific knowledge, technology, production, service, finance, culture and many more. At the same time, mobility is highly dependent on a number of factors, such as energy prices, security and global trust, just to name a few. Thus, the vulnerability of mobility and its role for connectivity represents an important key issue for the globalisation challenge. For our analysis, mobility is approached as a key sector of activity for some regions. However, for others it is approached as the need to provide the means of transport, which enables access to the regions and thus their participation in international flows.

Transport hubs have historically proven to be advantageous to cities and, by extension, regions (Ross et al., 2006). The efficient movement of goods is essential because (freight) transportation significantly affects economic productivity. The transport infrastructure that connects agglomerations, allowing multimodal commodity movement, is vital to competitiveness and is used by basically all actors and firms. They are all embedded in the settings of international, national and regional institutions. The mobility of persons and goods, however, depends on a number of external factors such as trust between global trading partners, transport safety and energy prices (read: transport costs). The recent decades have shown the vulnerability of our global transport systems to any kind of larger shocks affecting these factors. Prominent examples are the effects of volcanic eruptions, increasing piracy, terror attacks or oil price "shocks" which illustrated the vulnerability of our global transport systems.

The indicator system for regional vulnerability

The aspects and thereby the indicators to choose for this issue are many. Although financial flows have become increasingly important over the last decades, as of the more energy intensive means for transporting goods and persons, their mobility is the most crucial **exposure** to the above threats.

Table 2 Indicators used for 'Mobility of persons and goods' vulnerability in NUTS 2 regions

	indicator	minimum	mean	maximum	SD.
Exposure	Total air cargo handled at airports in 1,000 tons	0.00 (various regions)	70.61	2,104.00 (Darmstadt, DE)	246.97
	Total flight passengers in 1,000	0 (various regions)	4,658.79	86,683 (Île de France, FR)	10,378.70
	Total sea cargo in 1,000 tons	0.00 (various regions)	13,625.91	391,355.00 (Zuid-Holland, NL)	32.581.95
Sensitivity	Proportion of employment in trade, transport, hotel & restaurants	12.96% (Nord-Est, RO)	24.85%	47.70% (Notio Aigaio, GR)	4.07
	Proportion of GDP in trade, transport, hotel & restaurants	12.41% (Groningen, NL)	21.84%	43.27% (Notio Aigaio, GR)	5.05
Adaptive capacity	Motorway density in km per 1000 sqkm	0.00 (various regions)	23.71	222.30 (Lisboa, PT)	30.22

This includes *total air cargo handled by airports, the amount of sea cargo handled by harbours as well as* the *number of flight passengers*.

In order to identify the corresponding **sensitivity** indicators, it was asked which economic activities depend most strongly on energy intensive transport modes and are thus most quickly affected by transport price increases or shocks interrupting transport flows. Not surprisingly trade, transport and tourism sectors are the most sensitive and are directly affected in terms of their contribution to GDP and employment: *proportion of GDP in trade, transport, hotel and restaurants* and the *proportion of employment in trade, transport, hotel and restaurants*.

Energy intensive transport means are especially exposed to globalisation processes. Since Europe is highly dependent on energy sources from non-EU countries, energy **adaptive capacity** indicators were not included (the topic will be discussed further in the energy challenge section). Assuming that international connectivity is highly dependent on air transport, regional adaptive capacity may lie, however, in the potential use of alternative transport modes if air transport is becoming more expensive or disrupted e.g. for safety reasons. The *density of motorways* represents such an alternative transport mode.

Comparisons with neighbouring areas are based on the proportions of imports and exports, compared to the total national GDP. This gives an indication of the integration of each economy in international trade flows, inducing advantages linked to the exploitation of internal and external comparative advantages when seeking to maximise the overall economic performance, and reflecting different forms of vulnerability due the reliance on policies and socioeconomic dynamics on which no direct influence can be exerted. A weakness of this indicator is that it does not incorporate the relative weight of trade within transnational areas of cooperation and integration, as compared to that to and from other types of countries.

Neighbouring countries and cross-border effects

The global position of the EU in terms of mobility of persons and goods is also affected by a number of developments outside the EU. Among them are the political stability of trading partners, energy prices and also the development of the trade of commodities with other countries. Besides the already mentioned energy issue, in the context of the European neighbourhood, trust and political stability is a crucial issue for trade flows. In the EU neighbourhood there are countries with at least potential political instability, as underlined by the protest movement which started in various Mediterranean neighbouring countries in early 2011. These developments can influence the EU, since social unrest and potential actions in these areas may cause challenges of a larger magnitude, e.g. in the field of international security, trade and migration movements.

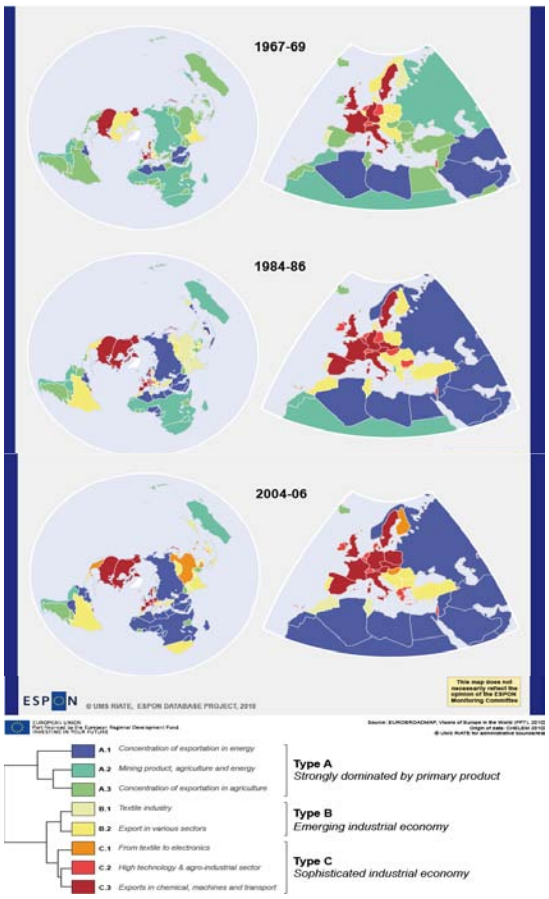
Figure 4 Restoration of Thessalonica Port, GR

Source: DG Regio

Another important feature in the relation between the EU and its neighbouring countries is the energy question. Developments in Russia are crucial, owing to the fact that the combination of the natural gas dependency and dwindling resources at home has created a volatile political environment and fuelled fears of an 'energy weapon'.

Besides these above influences (social unrest and energy issues) affecting global trade, European international trade is also affected by the changing composition of other countries' traded commodities. Map 4 illustrates a shift from trade in agricultural products from many other regions of the world towards other products. Particularly the countries in the eastern and southern neighbourhood of the EU now export mostly energy products.

Map 4 Typology of international exports by products



Source: ESPON Database Project, 2010

While they are exporting their energy products worldwide, Europe is in this respect highly dependent on a few countries. This tends to affect European regions specialised in the production of industrial products, including regions depending on the export of high-tech goods. A look at the direction of trade flows, however, reveals that Europe is much more inward-oriented than any other region in the world. About three quarters of European international trade is directed towards other European destinations – this offers a wide range of potential regional economic profiles and functions for the EU. The mere trade volume with the neighbourhood is less important than trade with other world regions. However, considerable trade deficits have lately developed with the Asia/Pacific region, which is increasingly becoming a competitor in manufactured products, not least of the catch-up processes in China and India.

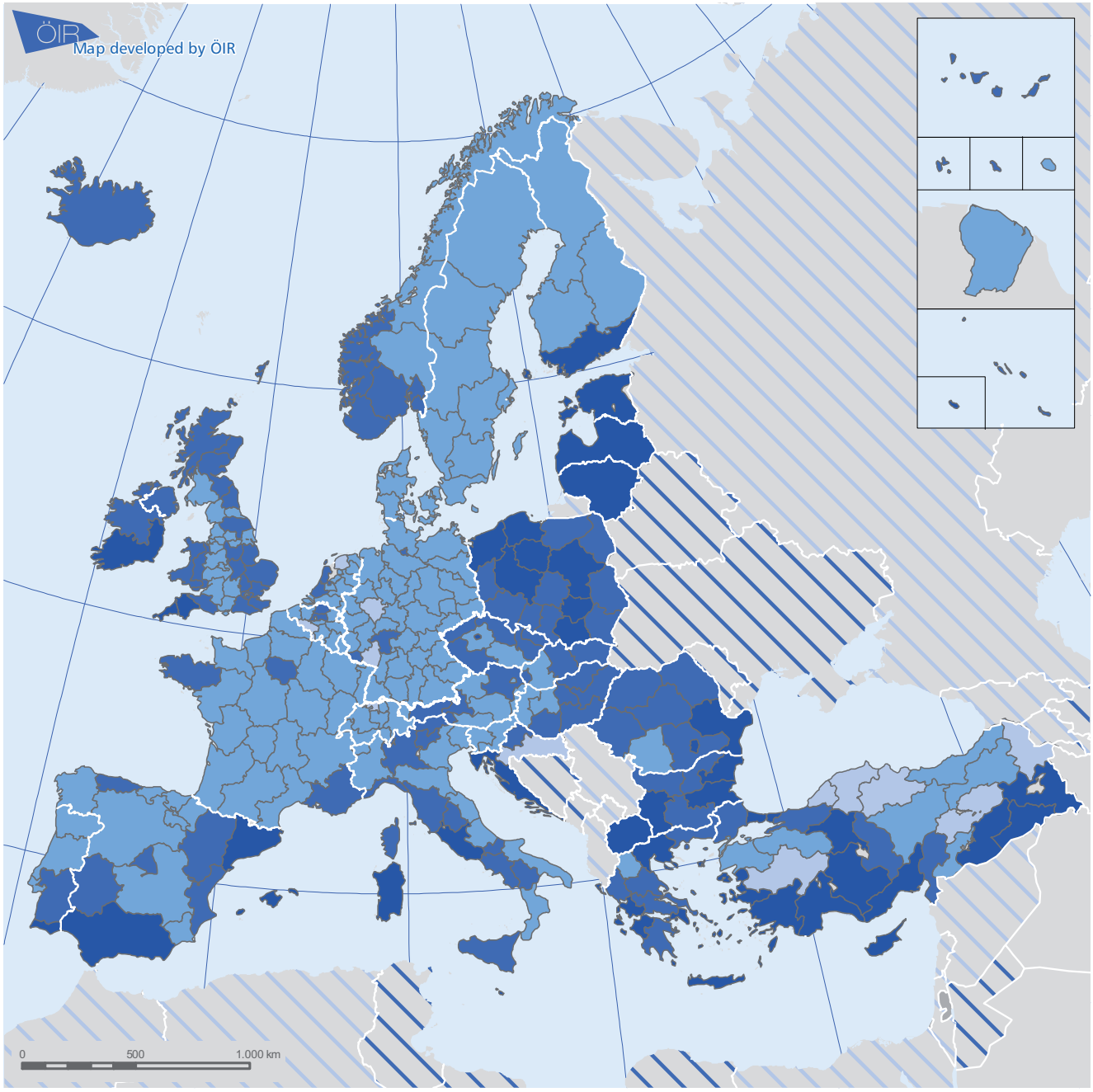
The vulnerability map

The synthetic representation of the indicators above (Map 5) highlights the importance of a limited number of transport hubs and the generally higher transport infrastructure endowment of the EU15. It shows the strategic importance of Rotterdam for sea transports, as well as of London, Paris, Frankfurt, or Amsterdam as air transport hubs and also indicates the vulnerability of hubs relying mostly on one mode only. The future trends in this latter respect are uncertain. However, the deregulation of European and, more recently, trans-Atlantic flights has facilitated the development of traffic at a larger number of airports in secondary or even tertiary cities. Finally, the development of low cost carriers has changed the territorial organisation of air connections, favouring peripheral parts of European metropolitan regions and creating new, but vulnerable connections. These recent developments indicate one functional option for regions previously not as well integrated in globalisation processes. At the same time trends of consolidation in airline sector, may bring the risk of stronger centralisation of transport services in the future.

The lower endowment of air and sea transport infrastructure in the EU12 and in Greece is particularly visible in the vulnerability map. This relative weakness, however, implies that there is considerable opportunity for the successful implementation of development strategies based on transportation hub functions in this part of Europe.

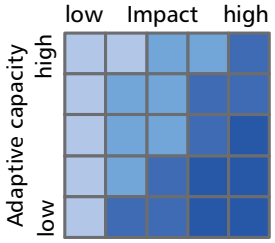
Map 5 Key vulnerability 'Mobility of persons and goods' (following page)

Mobility of persons and goods - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Total air cargo handled at airports
- Total flight passengers
- Total sea cargo

Indicators describing sensitivity:
- Share of employment in Trade, Transport, Hotel and Restaurant
- Share of GDP in Trade, Transport, Hotel and Restaurant

Indicators describing adaptive capacity:
- Motorway density

Neighbouring Countries (simplyfied methodology)

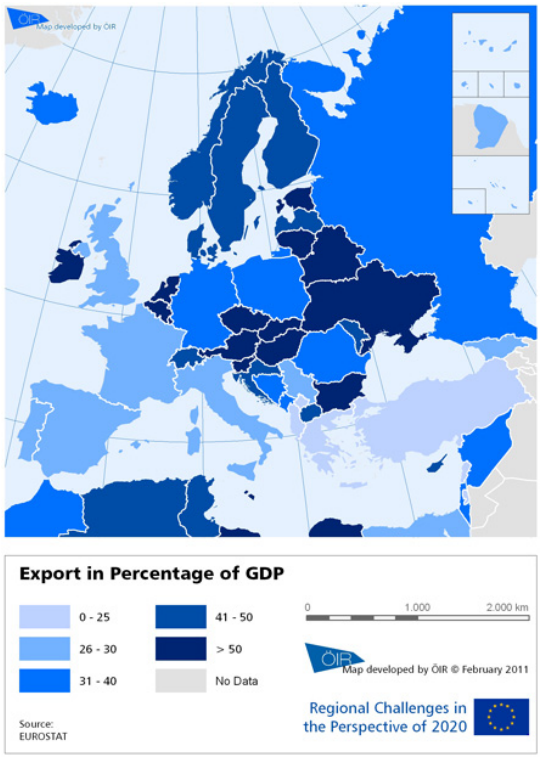
- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Imports as a % of GDP plus exports as a % of GDP

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

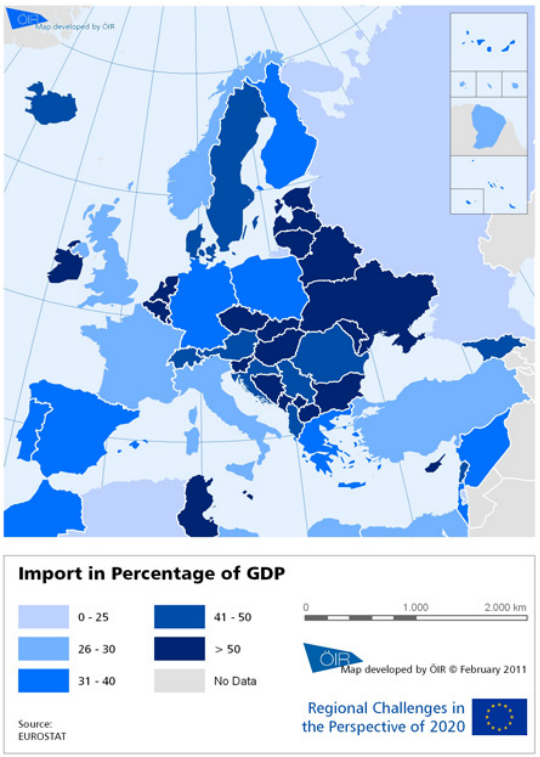
Regional Challenges in the Perspective of 2020

Map 6 Europe and its neighbourhood: exports as a share of GDP



This goes beyond road infrastructure and include the smart connection of different transport modes. The central question is whether the metropolitan regions in these countries can exploit their potentially favourable position, or whether existing hubs will expand their area of influence into these new markets. Imports that correspond to a high proportion of the total value of GDP are to bet found both in countries that were previously part of the Soviet Union: Slovakia, Bulgaria, Hungary, the Czech Republic, Bosnia Herzegovina and Montenegro.

Map 7 Europe and its neighbourhood: imports as a share of GDP



These countries display values that within the EU are only reached by the Benelux countries, Ireland and the Baltic states. Patterns for exports are quite similar, with the notable exception of the West Balkans and relatively higher values in North Africa. In the vulnerability map, an aggregated indicator for imports and exports is used to mark the countries more vulnerable, i.e. less integrated in global trade flows, than the European average.

Accessibility

Differences in levels of accessibility largely determine the capacity of individual regions to position themselves in the flows described in the mobility section. Contradictions may arise between the aspirations to position Europe in global systems of flows, and the concern for intra-European territorial cohesion. In this regard, peripherality has been considered in terms of the geographical distance of an area from the 'core', with distance being a surrogate for higher transport and communication costs resulting in poorer access to markets and resources, such as capital and innovations (McQuaid, 2000). Accessibility is, however, always relative. It changes over time, for instance, because of new investments in transport infrastructure in different places, changing quality of the given transport infrastructure and changes in the population size. In a global perspective, it is important to consider not only intra-European accessibility, but also connections to extra-European markets.

Peripheral areas are generally understood as those areas with poorer connections to agglomerations in terms of travel times, travel costs and the diversity of transport modes and routes available. This latter aspect can have a particularly important impact on transport reliability, which is of key importance for most industrial development. Other important aspects can be access to transport services such as next day delivery, the higher costs of operating transport services, and the cost-benefit ratios of infrastructure investments. Distance as such is however – in particular with regard to

competitiveness in the service sector – often a secondary concern. Here poor levels of transport accessibility can be compensated by alternative ICT communication means. This however also depends on the necessary ICT infrastructure and competitive adaptation strategies.

The indicator system for regional vulnerability

Because the effects and vulnerabilities of different modes of transportation are distinct, separate **exposure** indicators are used for the different transport modes: *road, rail and air accessibility*.

In the context of accessibility, *labour costs* represent a **sensitivity**, since they must adjust to competitiveness as determined by regional production possibilities. This indicator is complemented by the number of *nights in collective accommodation per inhabitant*. The underlying rationale is that areas with low accessibility and high tourism intensity have developed a specific form of adaptation to their peripheral position; their sensitivity to changes in accessibility will therefore be specific.

Regions disadvantaged in terms of accessibility need to find other capacities which can enhance their **adaptive capacity**. By means of modern communication infrastructure at least services and know-how can be transferred efficiently even if accessibility levels are relatively low. This kind of adaptive capacity can be depicted by the *number of households with broadband access*. Another possibility to offset high labour costs and/or high travel costs is the achievement of a highly innovative and possibly specialised production: the more innovative, the less important are cost advantages. Therefore, the number of *patent applications* also represents an adaptive capacity.

Because of the multiple types of accessibility and internal variations within territories, general comparisons with neighbouring countries are not possible on the basis of a single synthetic indicator. However, the trunk road network density per inhabitant reflects the quality of the transport infrastructure endowment. It therefore expresses the capacity to take advantage of investments in hubs and other logistics centres for actors situated in areas beyond their immediate vicinity.

Neighbouring countries and cross-border effects

The accessibility of European regions is interlinked with the accessibility of major agglomerations in the European neighbourhood. On the on hand, access to neighbouring regions is important for the accessibility and development of European regions, in particular those close to EU borders. On the other hand, the European neighbourhood comprises – next to regions with very low accessibility figures – a number of agglomerations with global accessibility figures outranging most regions within the EU – often linked to a substantial demographic and economic power. Among them are e.g. Moscow, St. Petersburg or Istanbul, which also influence the global position and competitiveness of European regions. Furthermore, there are strong players in the wider neighbourhood. There are, for example, ambitions to establish hubs in the Middle East as transport platforms for movement from other parts of the world to and from Europe. Consequently, the European transport hubs with global profiles will receive additional competition. Additionally, by means of low communication costs, countries like Russia and Turkey – but also India and China – are able to improve their connectivity for participation in globalisation.

As discussed above, innovation (e.g. patent applications) can be used as indicator reflecting the adaptive capacity related to accessibility vulnerabilities. Though Europe is among the world regions with the highest patent intensities, there are stronger players around, i.e. Japan, South Korea and the USA.

Table 3 Indicators used for 'Accessibility' vulnerability in NUTS 2 regions

	indicator	minimum	mean	maximum	SD.
Exposure	potential road accessibility	0 (Guadeloupe, FR)	97.19	234.97 (Düsseldorf, DE)	68.58
	potential rail accessibility	0 (Guadeloupe, FR)	97.30	283.12 (Région de Bruxelles, BE)	70.09
	potential air accessibility	0 (Guadeloupe, FR)	96.56	193.18 (Bruxelles Capitale, BE)	39.52
Sensitivity	Labour costs/employee in representative sectors [a)]	6,598.76 (Podlaskie, PL)	35,889.53	61,984.90 (Outer London, UK)	12,810.64
	nights spent in collective tourism accomodation per 1000 capita	0.45 (Nord-Est, RO)	6.12	56.67 (Illes Balears, ES)	8.14
Adaptive capacity	share of households with broadband access	9.00% (Nord-Est, RO)	53.96%	87.00% (Ísland, IS)	17.50%
	patent applications per 1 mio. capita	0 (Voreio Aigaio, GR)	64.03	469.32 (Stuttgart, DE)	83.23

a) all NACE sectors, except agriculture, fishery, public administration, private households & extra-territorial org.

However, in the EU's neighbourhood patent intensity is quite low. Even in the EU high patent intensities are concentrated in only a few countries, none of them in the EU12. If more EU countries were to achieve patent intensities similar to those of the leading European countries, this would certainly boost Europe's adaptive capacity as a whole.

The vulnerability map

Map 8 illustrates the geographical pattern of core-periphery contrasts in Europe. Classically, a central belt stretching from the Netherlands to Northern Italy is identified. Together with some main nodes such as Paris, Berlin, Prague and Vienna it forms the core area benefiting from the highest degree of centrality. At the other end of the scale, the Iberian Peninsula, Western Ireland, Iceland, Scandinavia, EU12 countries, Greece and Southern Italy constitute the European periphery. The most peripheral situations are identified in Croatia (which does not appear in the map because of a lack of data on the adaptive capacity) and the Former Yugoslav Republic of Macedonia. What cannot be exactly identified visually is which aspect of adaptive capacity offsets the impacts. The adaptive capacity based on broadband access and patent applications is, however, highly concentrated in Northern and some parts in central Western Europe.

This implies that in most of the regions in the core of Europe with high accessibility their vulnerability in terms of accessibility is further reduced by a high adaptive capacity. For the Northern countries this shows that broadband access, for example, can make up for some of the vulnerability potential induced by peripherality. For the Eastern and Southern European regions relatively low accessibility values are accompanied by limited broadband access. This implies a twofold challenge, where a capacity which could possibly offset accessibility disadvantages is not yet available.

Summarising, the accessibility issue hints at the role of division between core and periphery as well as East and West of the European territory in the context of global integration.

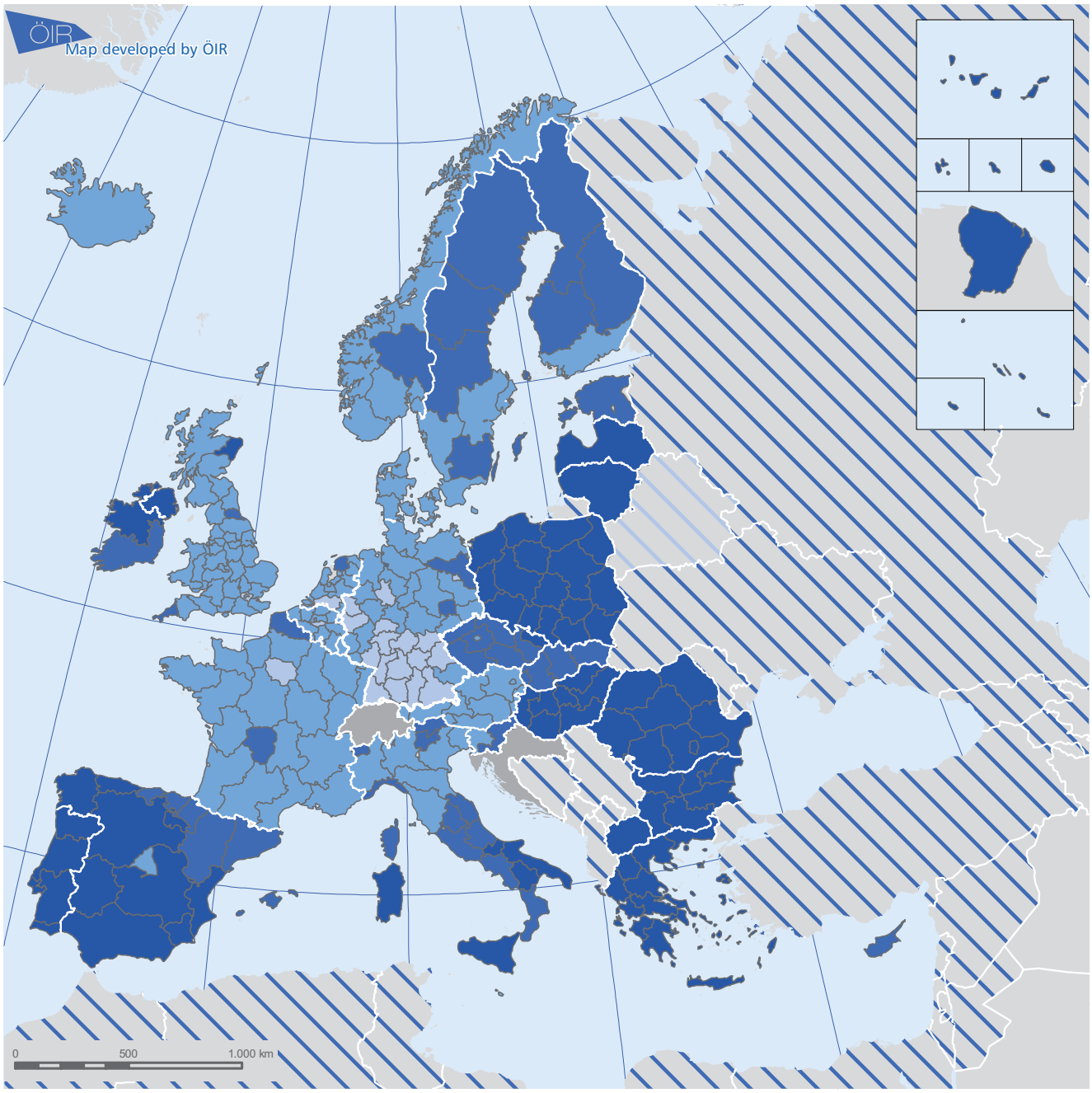
The observation of road infrastructure endowment in neighbouring areas shows that the endowment with transport infrastructure is low compared to the European average almost everywhere. However, network density compared to population is relatively higher in Russia, Belarus and Ukraine than in New Member States. Turkey and the Mediterranean neighbourhood have distinctly lower road densities, they are also sparsely populated. Rail network densities compared to population, on the other hand, are distinctly higher within Europe than in Neighbourhood states.

Knowledge and know-how

In the context of a global knowledge and learning economy, access to different kinds of knowledge has become a key issue (Lundvall, 2009). In order to achieve and maintain competitiveness, the role of science and technology by which regions exhibit their capacity for scientific and technological innovations has become a particularly important aspect – especially in regions with high labour costs (cf. sensitivity in the accessibility section) and for the development of a regional economic profile. Regions that have a substantial scientific infrastructure are most likely to generate knowledge. There are three main conditions that favour the generation of scientific knowledge in a given region: the presence of research institutes; the existence of a highly educated workforce; and a local milieu sufficiently equipped with urban amenities to attract and hold the educated workforce (Singh & Allen, 2006). Therefore, investment in education and research is the key for creating a knowledge-based labour force to compete globally (Goldberg, 2006) and to enhance the necessary preconditions for knowledge creation. In this sense, networking is an essential means of knowledge exchange and learning. Recent studies have shown how externalisation has been adding new ties or reinforcing existing ones in the local production system (Cusmano et al., 2010). Service firms play a crucial role by generating innovation and supporting knowledge creation and the innovative activity of their industrial and service clients. However, the power of knowledge creation, networks and collaboration in the major innovation centres or cities has promoted clustering of knowledge-intensive activities, especially services, within a few cities and thereby contributed to the intensification of the spatial division of labour (Ock Park, 2006) and is thus linked to the distinction between urban and rural areas.

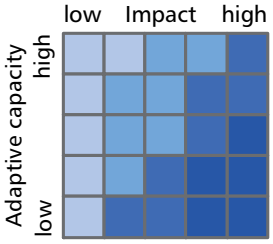
Map 8 Key vulnerability 'Accessibility' (following page)

Accessibility - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Potential road acessibility
- Potential rail acessibility
- Potential air acessibility

Indicators describing sensitivity:
- Labour costs per employee in private sec. & tert. sectors
- Total nights spent in collective tourism accomodation per 1000 capita

Indicators describing adaptive capacity:
- Share of households with broadband access
- Patent applications per 1 mio. capita

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- road network density km/capita plus rail network density km/capita

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

Nevertheless, large parts of the European territory consist of regions whose economy is not dominated by knowledge intensive activities, not to mention services. These are sensitive to globalisation in different ways. It can be argued that changing price relations, e.g. because of rising wages, are unfavourable for productivity in the respective sectors. In contrast, regions with a high total productivity level can adapt more easily like regions that focus on knowledge production.

The indicator system for regional vulnerability

This general chain of arguments leads to indicators for the **exposure** dimension of the vulnerability analysis of knowledge and know-how, which indicate the role of economic activity outside the knowledge economy: the *share of employment in agriculture* and the *share of employment in manufacturing*.

As global trade affects price relations and as wage levels in low productivity sectors are affected by country wide wage development, productivity levels describe the **sensitivity** to global developments. Different agricultural and industrial structures observable in Europe indicate that there are considerable differences in *agricultural* and *industrial productivity*.

When it comes to the utilisation of knowledge to achieve competitive-ness, there are different options to define the regional **adaptive capacity**. Among them are high *total productivity* levels, which can offset cost disadvantages to a certain extent. Another adaptive capacity lies in the *share of R&D personnel*, as their work is strongly based on technological know-how and knowledge, which makes it possible not only to maintain competitive-ness through permanent innovation but also to adapt to changed market needs including even shifts in the actual field of economic activity as new sectors develop.

For comparisons with neighbouring areas tertiary education enrolment provides the basis to assess the situation. It is corresponding to the proportion of a cohort that is admitted to courses that require, as a minimum condition of admission, the successful completion of education at the secondary level. This expresses the degree to which younger generations acquire the competences required to develop internally competitiveness.

Neighbouring countries and cross-border effects

Even if the discussion in the previous accessibility section pointed out that there are few dominating countries outside Europe when it comes to patents, this should not be misinterpreted to assume that there are only a few strong players worldwide in the field of knowledge and know-how. In the Middle East some countries are preparing for the time after the oil boom. To a large extent they are developing profiles which are strongly European influenced and could impose direct competition in economic fields which have thus far been dominated by only a small number of countries.

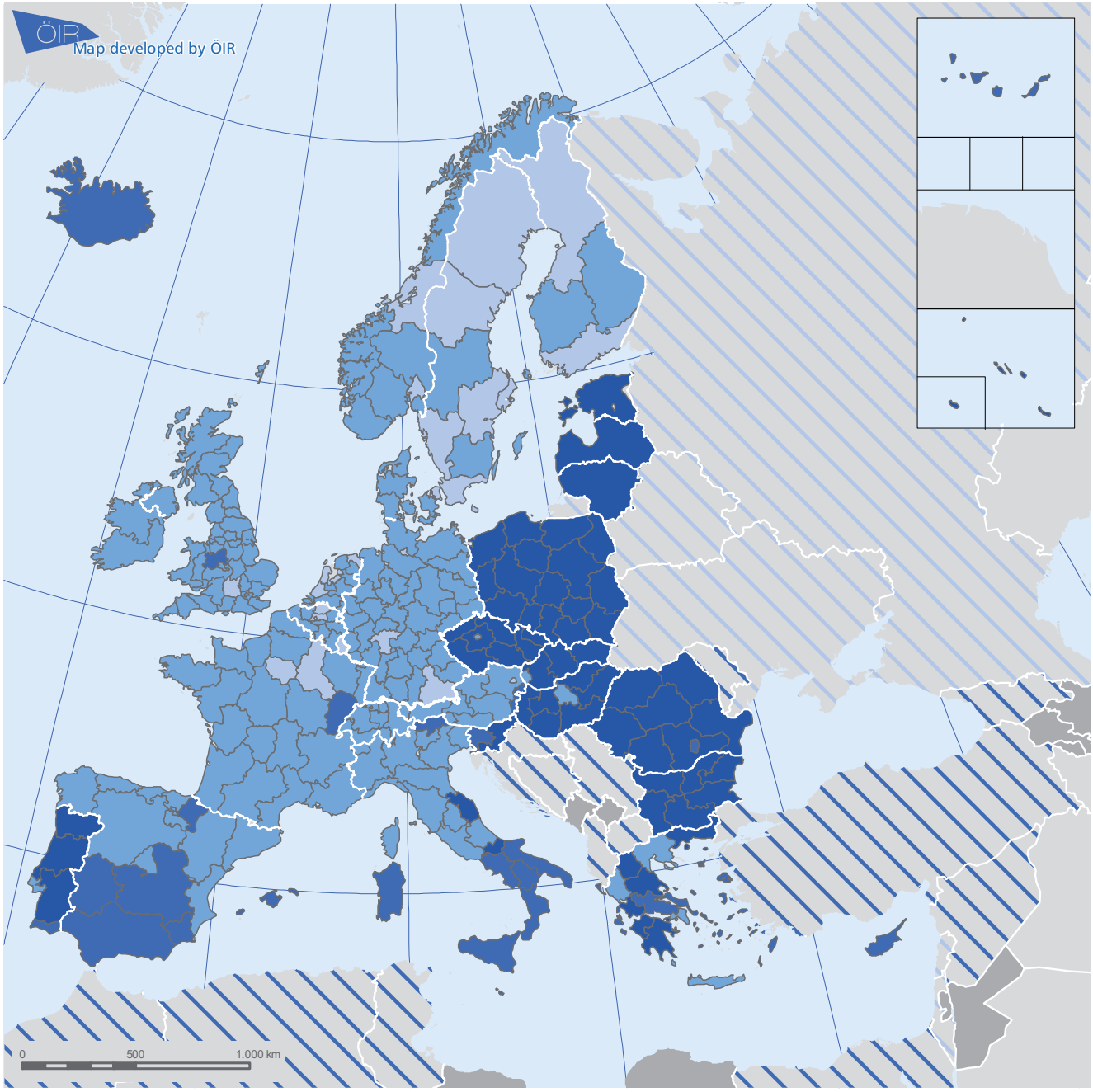
These developments can also be illustrated by means of a comparison of the share of R&D personnel. The creation of knowledge is not concentrated solely in the EU. Especially the North African countries and in the Eastern neighbourhood, tertiary education enrolment does not lag behind the European average. While it is reasonable to assume that European knowledge regions can maintain their advantageous position for the years to come, two other factors will affect the knowledge position of European regions. Firstly, in light of the demographic change ahead, the countries with a sound knowledge basis may suffer in the long run; particularly if large numbers of more poorly educated people continue to migrate from the neighbourhood to European countries. Secondly, increasing competition for European regions that lack a sound knowledge base makes them more vulnerable as other world regions catch up.

Table 4 Indicators used for 'Knowledge and know-how' vulnerability in NUTS 2 regions

	indicator	minimum	mean	maximum	SD.
Exposure	share of employment in manufacturing	3.46% (Ciudad Autónoma de Ceuta, ES)	18.32%	38.61% (Severovychod, CZ)	7.29
	share of employment in agriculture	0.17% (Praha, CZ)	5.55%	47.78% (Nord-Est, RO)	6.52
Sensitivity	productivity in agriculture	0.76 (Nord-Est, RO)	20.90	86.06 (Övre Norrland, SE)	13.87
	productivity in industries	2.72 (Yuzhen tsentralen, BG)	38.18	142.64 (Groningen, NL)	22.45
Adaptive capacity	total productivity	2.53 (Yuzhen tsentralen, BG)	35.55	73.48 (Groningen, NL)	17.97
	R&D personnel in % of active population	0.17% (Sud-Est, RO)	1.33%	5.52% (North Eastern Scotland, UK)	0.90

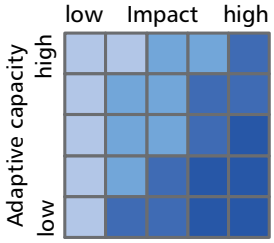
Map 9 Key vulnerability 'Knowledge and know-how' (following page)

Knowledge and know-how - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Share of employment in manufacturing
- Share of employment in agriculture

Indicators describing sensitivity:
- Productivity in agriculture (Source: Politecnico di Milano & DG Agriculture)
- Productivity in industries (Source: Politecnico di Milano & UK Statistics Authority)

Indicators describing adaptive capacity:
- Total productivity (Source: Politecnico di Milano & UK Statistics Authority)
- R&D personnel in % of active population

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- tertiary education enrolment % of population

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

The vulnerability map

In the resulting Map 9, the most favourable situations are identified in metropolitan regions such as Paris, Frankfurt, and Munich as well as in non-metropolitan regions of the British Isles and the Nordic countries. In these regions favourable employment structures and/or corresponding productivity levels occur simultaneously with high total productivity levels and/or R&D intensity. Overall, however, there is a relatively homogenous pattern – in terms of vulnerability – across all of Western Europe. The majority of these regions appear to be prepared regions for different reasons. Among them are a large number of rural regions in which agricultural employment is on a relatively high level (e.g. some regions in France, Austria and different parts of Germany) compared to these countries' averages. At the same time many of these regions show relatively high levels of agricultural productivity. This can be linked to industrial structures in agriculture as well as regional labels (e.g. Champagne in France). But there are also regions assigned to the prepared regions, which have a particularly high share of employment in the manufacturing sector. In regions in which this coincides with high manufacturing productivity, as it is the case e.g. in high-tech regions in Southern Germany, their exposure to the knowledge challenge is again offset. Finally, even some metropolitan regions are included in this group, even if they are not exposed by high manufacturing employment their adaptive capacity is limited by only intermediate total productivity levels. These are mostly metropolitan regions where services outside the knowledge intensive sectors are of high importance. This may include household services as well as public services.

Low performances, i.e. high vulnerability, is observed in a number of southernmost and the EU12. In the latter, only a limited number of urban nodes such as Prague and Bucharest stand out as well prepared regions. Similarly to other globalisation challenges, high impact values coincide with low adaptive capacity in many regions of these countries. This can be illustrated by the example of the majority of (Eastern) Polish regions and Romania: In some of these regions agricultural employment is still particularly high. In contrast to Western European regions with a strong agricultural sector, however, in these regions low productivity agriculture dominates with small family farming plots. Due to the corresponding economic structure, this leads to low total productivity levels. Moreover, they also do not have a significant number of R&D personnel in the active population. Therefore, the knowledge and know-how issue points at both, the primary subdivision of the European territory as well as urban-rural disparities. However, the example of some Western and Northern European non-metropolitan regions indicates the potential for knowledge intensive functions beyond the metropoles.

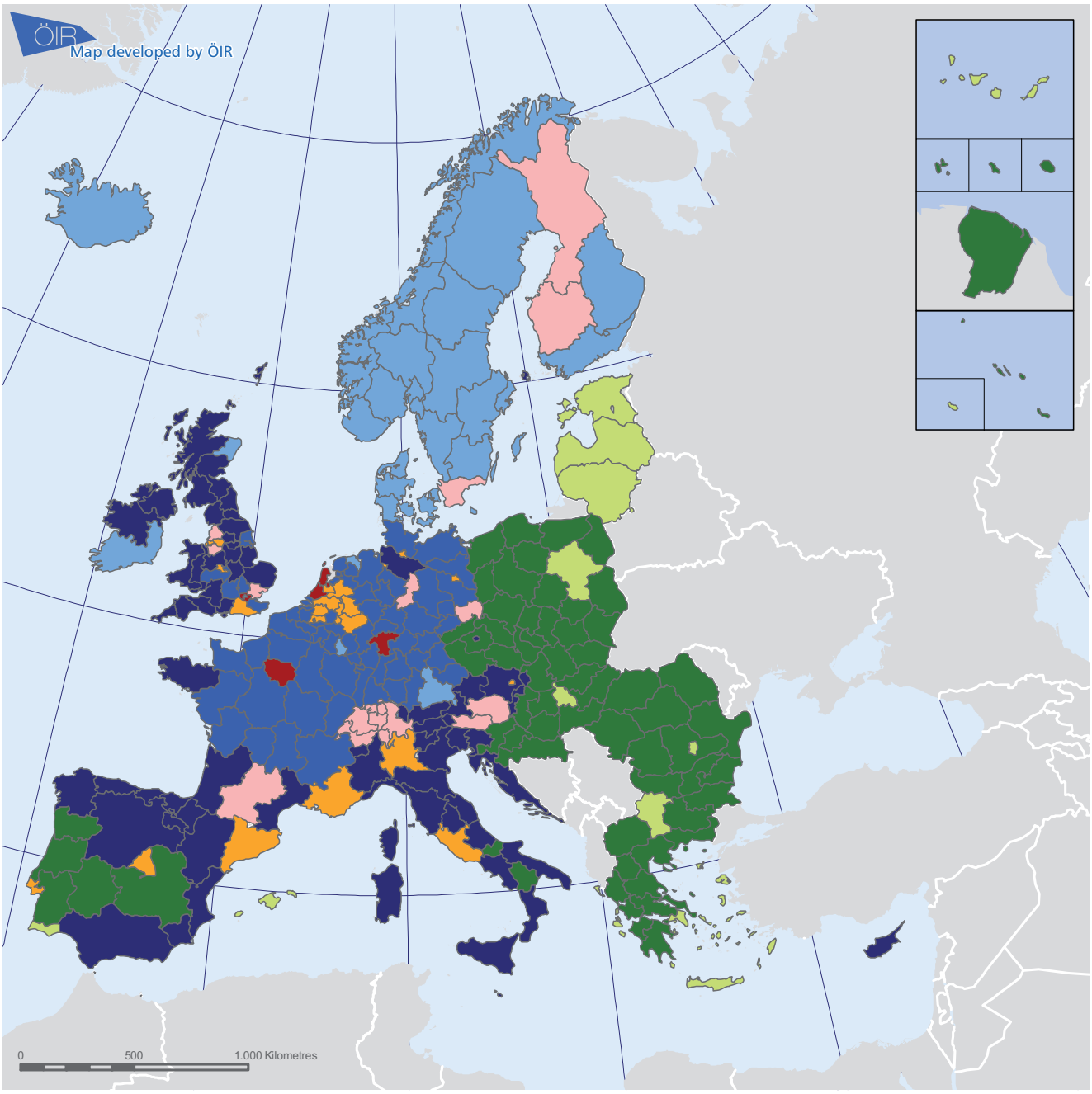
Tertiary education enrolment rates across the Eastern neighbourhood states, Israel and Lebanon are higher or equivalent to those observed within the EU in average, while they drop rapidly towards the southern and south-eastern neighbourhood. The West Balkans, Turkey and the Arab countries are among the more vulnerable countries.

An integrated picture of the globalisation challenge

As explained in the methodological remarks, the methodological tool for reviewing the entirety of key issues within one challenge is the multivariate cluster analysis, in which groups of similar are identified on the basis of a limited number of structuring indices, without not ranked. In the case of globalisation, these indices are mainly the exposures towards mobility of people and goods and the exposure towards knowledge and know-how, which can also be considered as the territorially most differentiating and therefore account for most of the homogeneity achieved within clusters. The number of clusters is the result of a balancing exercise between a number of clusters showing a fairly equal distribution of objects among the clusters and limiting the number of objects within the clusters so that a fairly clear differentiation of European regions is safeguarded. Altogether eight regional classes were obtained, which are depicted in Map 10 and will be characterised in the following paragraphs.

Map 10 Clusters of the globalisation challenge (following page)

Globalisation challenge - Integrated vulnerability



Type of Regions

Globalised regions

- Global metropolitan regions
- European metropolitan regions
- Knowledge intensive globalised regions

Regions vulnerable to globalisation

- Service-oriented vulnerable regions
- Highly vulnerable periphery

Regions handling globalisation

- Low-mass economic high performers
- High productivity regions
- Regions prepared for globalisation

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

ÖIR Map developed by ÖIR

Regional Challenges in the Perspective of 2020

The first three selections are the globalised regions. The '**global metropolitan regions**' are ten regions covering the global business hotspots London, Paris, Amsterdam, Rotterdam and Frankfurt. These are the regions which are outstanding in terms of their Global players function. R&D intensity and transport volume are also very high. In neither of the globalisation key issues do these regions exhibit a poor performance according to the vulnerability methodology. While it might be argued that these regions are particularly vulnerable to globalisation (e.g. the latest economic crisis), not least due to their mass and economic diversity, they have the ability to offset these effects rather quickly, therefore usually not leading to sustained negative impacts. The '**European metropolitan globalised regions'** comprise a wide range of Western European metropolitan regions, including for instance Vienna, Berlin, the German Ruhr area, some British urban areas, Lisbon, Madrid and Milan. Due to the metropolitan character of these regions, it does not come as a surprise that Global players values are relatively high, as well as productivity and R&D activity. In addition, this cluster achieves particularly high accessibility values – with Lisbon as the only exception. This cluster may be characterised by limited vulnerability towards globalisation and good adaptive capacities, especially in the knowledge and know-how issue. The '**knowledge intensive globalised regions**' consist of 29 regions in central and Northern Europe, mostly located in Switzerland, Germany, Great Britain and Finland. These regions encompass urban nodes which are not among the largest European metropolitan regions. But even if not metropolitan by mass, most of these regions fulfil metropolitan functions by power, backed by knowledge production (high scores in broadband access, high-tech industries, R&D and patents). Summing up, the cluster comprises regions with a low vulnerability towards globalisation and particularly well developed adaptive capacities.

The second group of regions are, if not highly globally integrated, at least prepared for globalisation. The '**low-mass economic high performers**' comprises twelve mainly wealthy regions and covers most of Scandinavia, Iceland (the position of Iceland is based on economic data prior the collapse of the Icelandic banking systems and its consequences for the Icelandic economy), the Scottish region of Aberdeen, Southern Ireland, Luxembourg, Groningen and Upper Bavaria. The majority of these regions have deficits in terms of concentration, which they are able to offset by high GDP per capita levels. These result, however, from quite different and very specific economic structures. Apart of the central European regions, the regions in this group have rather poor accessibility values to which they adapt by way of electronic and knowledge networks, thus indicating the role that communication technologies can have for peripheral regions. R&D intensity and total productivity are among the highest in Europe. In terms of mobility, most regions face only a low impact. Altogether these regions exhibit mostly low vulnerabilities towards globalisation. The '**high productivity regions**' consists of 53 regions and covers large parts of France, Germany, Belgium, the Netherlands and some regions in England. Their outstanding average features are low shares of transport and tourism related employment together with high productivity employment in manufacturing and especially agriculture. Since this cluster especially encompasses regions without large urban nodes, it is not amazing that some of these regions are vulnerable in terms of their weak global player function, whereas for mobility and knowledge issues nearly all regions are 'prepared' and they also show little vulnerability towards accessibility. The majority of these regions are not among the most integrated in terms of globalisation, but vulnerability levels are still relatively low. **Regions prepared for globalisation**' comprises a heterogeneous set of regions including large parts of Spain and Italy, as well as parts of Ireland and the UK, some French and Austrian regions as well as Prague, Bratislava, Western Slovenia, Malta and Cyprus in the EU12. This cluster is characterised by an average performance across most indices. The majority of these regions are 'prepared' in terms of Global players, mobility and knowledge and know-how issues. However, in accessibility some of the southern peripheral regions of this cluster are defined as vulnerable. In total, for the majority of these regions vulnerability appears to be rather low.

Figure 5 Bridge over Guadiana River linking Spain to the Algarve, PT

Source: DG Regio

The final two types of regions are the one most vulnerable to globalisation. The '**service-oriented vulnerable regions**' contains two main sub-groups of regions: the majority of EU12 capital regions, including the Baltic countries, on the on hand and some major South European tourism regions such as the Aegean islands, the Balearic islands and Algarve. Thus, this group is characterised by regions which are service-oriented either because of their capital functions or their tourism sector. As compared to their neighbouring regions they stand out in terms of all globalisation key issues: while the East European metropolitan areas are likely to continue their catching up process irrespective of the development scenario, albeit at variable speeds, Mediterranean tourism regions are highly dependent on the continued high levels of mobility and available income in the countries that constitute their main markets. However, all of these regions are among the more vulnerable regions for the globalisation key issues. Thus, especially as compared to their Western and Northern European counterparts, these regions face accumulated globalisation challenges. Finally, the '**highly vulnerable periphery**' comprises almost all regions of the EU12, except for their capital regions, some Southern European regions in Portugal, Spain, Italy and most of Greece as well as French overseas departments (56 in total). These regions have a clearly below average GDP and are among the regions with the lowest global connectivity and knowledge function; also accessibility remains an issue. High agricultural and industrial employment shares with low productivity result in low total productivity. Essentially all regions of this cluster are characterised as 'most vulnerable' in terms of accessibility and knowledge. The main problem for these regions is the accumulation of high impacts and low adaptive capacities, which implies an accumulated vulnerability in terms of globalisation challenges. Albeit these regions may only be affected indirectly by global developments, as in some cases the regional economies have only few direct links with global markets. In theses cases the impacts may be perceived with a certain time delay.

A comparison of all eight clusters points out that there are five clusters which have no or only limited vulnerability towards globalisation. The cluster of 'regions prepared for globalisation' shows, basically medium vulnerability levels. And the last two clusters, which include regions mostly located in the EU12 and some Mediterranean areas feature accumulated, often high globalisation vulnerabilities. To sum up, the clusters describe the three aforementioned fundamental territorial differentiations and therefore confirm their importance for global integration.

(1) The primary subdivision of the European territory is quite apparent, since the clusters can be clearly distinguished according to a West-East and North-South pattern.

(2) Not least of the Global players key issue the urban nodes distinguish themselves from their neighbouring regions – both in the EU15 as well as EU12.

(3) The role of different urban functions was already pointed out with respect to the 'low-mass economic high performers'. Similar arguments also apply to the other blue shaded regions, especially the 'high productivity rural regions', e.g. in the Nordic countries, UK, France, Austria or northern Italy: they have different economic profiles and depending on their degree of global integration they fulfil different – partly niche – functions.

Mid-term scenarios

As previously described, globalisation challenges and especially the theme **global players** primarily relate to the role of metropolitan areas within the European territory. Polarising trends, concentration and dispersion, convergence and divergence are the key issues to be addressed in the mid-term scenarios. Demographic trends are in this respect both a key driver and a result of processes of economic concentration. Within the sustainable recovery scenario, one may expect an accentuation of demographic polarisation insofar as future economic growth can be expected to follow similar geographic patterns as in previous decades and be concentrated in metropolitan regions. Based on this reasoning, the further polarisation of the European territory would be alleviated in a sluggish recovery and can be expected to be very limited in case of a lost decade. In the sustainable recovery the concentration of transport functions to a limited number of metropolitan regions would follow this demographic pattern. A sluggish recovery or a lost decade would lead to a corresponding reduction in the concentration of transport functions. A lasting reduction in intercontinental transport volumes would weaken the role of major hubs and limited

investments would tend to preserve the current patterns of the transportation system. The concentration of advanced business and financial functions and corresponding employment is a key effect of globalisation, as illustrated by Saskia Sassen's understanding of "Global Cities". In terms of trends, however, these functions concentrate in a very limited number of metropolitan regions. Even if the recent crisis has demonstrated, for example, the capacity of banking activities to maintain high levels of performance in spite of a general degraded economic context, one may nonetheless expect the continued development and concentration of advanced business services to be facilitated in the sustainable recovery scenario, while it will be reduced in a situation of sluggish recovery and may be very limited in the situation of a lost decade. Very similar developments can be expected for the three scenarios with regard to transnational headquarters, since they have very similar location needs as the financial and insurance sector.

The recent economic crisis strongly impacted the **mobility** issue within globalisation. As international trade was drastically reduced in some world regions, both air and sea cargo volumes dropped, thus affecting employment and production in the trade and transport sectors. This affected the larger transport hubs. In territorial terms, recent developments with regard to air freight show, that air cargo hubs do not necessarily follow the general European urban hierarchy. Also the person transport has been affected, next to business relations in particular the tourism industry and various destinations are impacted. With decreasing real incomes and rising insecurity concerning future incomes, people's propensity to travel was also reduced, and partly shifted towards low-cost carriers. This in turn affected the tourism sector and development of selected destinations as well. In terms of concentration or dispersion of flows, according to each of the three scenarios, the sustainable recovery scenario can be expected to stimulate the demand for air freight in the EU12 and therefore contribute to the accelerated development of traffic in nodes serving these parts of Europe. For the sluggish recovery and lost decade scenarios, the demand for air freight will grow less quickly. It can be expected however that demand stimulations – on a lower level – will be generated mostly by the EU12 as they are still in the process of catching up. These catching up processes can be expected to be facilitated by the mobility of persons. As both air and sea cargo volumes as well as the number of flight passengers are expected to grow considerably during the sustainable recovery, the corresponding transport hubs can be expected to experience related production and, to some extent, employment growth. Because of the smaller proportions of the transport sector in the major metropolitan areas, their increase will be less visible than in specialised transport hubs. On account of the growing transport demand in the EU12, related GDP and employment will grow more than proportionally. In the case of the lost decade scenario, it is reasonable to assume that not much will change with regard to the transport sector's share of GDP and employment. The sluggish recovery scenario refers to a perspective between the other two scenarios.

Accessibility considers the territorial organisation, orientation and quality of transport infrastructure as a determinant of development opportunities for individual regions in a context of globalisation. The objective is in particular to assess the trends in peripheral European regions in the face of globalisation. In the sustainable recovery scenario, the calculations for accessibility are based on the hypothesis that all projects of the Trans-European Transport Networks (TEN-T) will be implemented. Beyond the TEN-Ts, transport infrastructure in the metropolitan areas and the transport hubs (seaports, airports) are particularly improved and extended. In a policy setting more tightly focused on cross-border links, on the development of multimodal nodes and on carbon reduced traffic means corresponding investments could be undertaken. Passenger air transport generally increases and the main international hubs gain passengers and cargo considerably above average. Even though accessibility of peripheral and rural areas also increases slightly, these areas lose their relative position as their accessibility growth rates tend to be smaller compared to the central parts of Europe. Overall in the sustainable recovery scenario a single European Network with carbon reduced traffic could be advanced. In the sluggish recovery scenario, only the priority projects of the TEN-T will be implemented. Focus will be given to high-speed rail projects, and to extending the capacities of air hubs and main cargo seaports. Due to emigration and negative natural demographic trends, and due to a lack of transport infrastructure investments, peripheral regions and rural regions experience slight losses in their level of accessibility. Overall European priorities of a single European Network with carbon reduced traffic will be addressed to a smaller extent than in the sustainable recovery scenario and the development of multimodal nodes will be

weakened. In the lost decade scenario, the funding of the TEN-T will not be secured and hence the total investments will not be enough to create a true single European transport network. Due to migration processes towards the metropolitan areas, the level of maintenance in transport infrastructure remains adequate only in agglomerations and along major transport routes, thus leading to the increasing accessibility of these regions. The contrasts between core and periphery therefore increase.

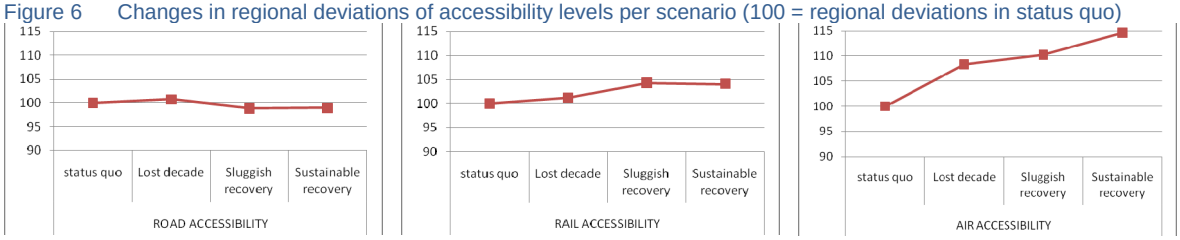
These general results for the different scenarios however differ for each transportation mode as far as the convergence or divergence of accessibility levels is concerned. For the lost decade scenario it leads to a strongly polarised development for air transport, because the concentration of investments favours metropolitan areas. Similar, but more limited polarisation trends are observed for rail and road. Because TEN-T priority projects are implemented in the sluggish recovery scenario, a significant number of new high speed rail connections are established. As a consequence, we observe a higher degree of polarisation as far as rail accessibility is concerned for this scenario. The impact of TEN-T priority road investments spreads more equally across the regions, allowing for a weak convergence of accessibility levels. In the sustainable recovery scenario, the realisation of all TEN-T projects makes it possible to create new and improved connections between a large number of second-tier cities. This makes it possible to achieve a small reduction in polarisation levels compared to the sluggish recovery scenario as far as road and rail accessibilities are concerned. While no reductions of accessibility in absolute terms is foreseen in the scenarios, the relative accessibility levels of many regions decline.

Rather than only focusing on research, high-technology and higher education, we approach **knowledge and know-how** as an important aspect of overall regional economic development. One can expect employment in low productivity agriculture and industrial employment to decline rapidly in a context of sustainable recovery when there are numerous alternative employment opportunities with higher wages. In a sluggish recovery scenario, one may expect current trends in terms of change in sector employment to continue, while the decline in agriculture would be quite low in a situation of a lost decade.

The lost decade scenario would however imply a rapid decline in industrial employment irrespective of productivity levels, as the limited demand for industrial products leads to a larger number of lay-offs. Total productivity levels can be expected to increase in the sustainable recovery scenario. This development will be the result of two effects. This scenario implies that productivity will increase due to innovation, the development of new markets etc. Secondly, the above illustrated shift of employees from low productivity to high productivity sectors will enhance total productivity as well. Regions without alternative employment opportunities will fall behind. As little and slow changes in employment structures are expected for the sluggish recovery scenario, productivity levels will grow more slowly and mainly along with the utilisation of innovations. The case of the lost decade is likely to continue with more or less stagnating productivity. The future development of R&D employment is not exclusively dependent on the scenarios, but rather on the policies and investments of public and private stakeholders. However, as pointed out above, especially in the case of the lost decade scenario there is a danger of Europe losing ground, since public and private funds available for R&D will be lower than in the case of the other scenarios. This could trigger a downward spiral if not actively counterbalanced.

Most of the adjacent European neighbourhood finds itself in a similar situation as large parts of the European periphery, with low productivity levels, weak service sectors and insignificant knowledge production. However, a distinction needs to be made between the more rural areas and aspiring metropolitan agglomerations. Some of these regions, especially Turkey and Northern Africa, might catch up quickly and challenge the neighbouring European periphery. Apart from countries in other parts of the world, Russia and the Middle East are already successfully competing with Europe on a global level.

Figure 6 Changes in regional deviations of accessibility levels per scenario (100 = regional deviations in status quo)



Source: Spatial Foresight

In Table 5, the globalisation scenarios were qualitatively summarised to more or less homogeneous groups of the previous section's clustered regions. In terms of the objectives of territorial cohesion, these perspectives might give rise to the idea that a sustainable recovery scenario is not to be aimed for, since it will aggravate existing disparities between metropolitan and other regions, offering some benefits for few other regions besides the metropolitan regions. Polarisation will be most severe from the Global players as well as knowledge and know-how perspectives. From this point of view, at first glance, a lost decade would correspond better to territorial cohesion. However, this implies lost world shares in, among other things, trade, a weakening of the European position in globalisation and can easily induce a downward spiral, especially in light of other countries becoming increasingly integrated into globalisation (e.g. BRIC countries). This scenario, therefore, does not represent an alternative to further concentration induced by globalisation. Instead, it is important to find alternatives for the regions that are not equally benefiting from globalisation by either developing other opportunities for raising income or by developing appropriate conditions and structures favourable for the participation in globalisation processes.

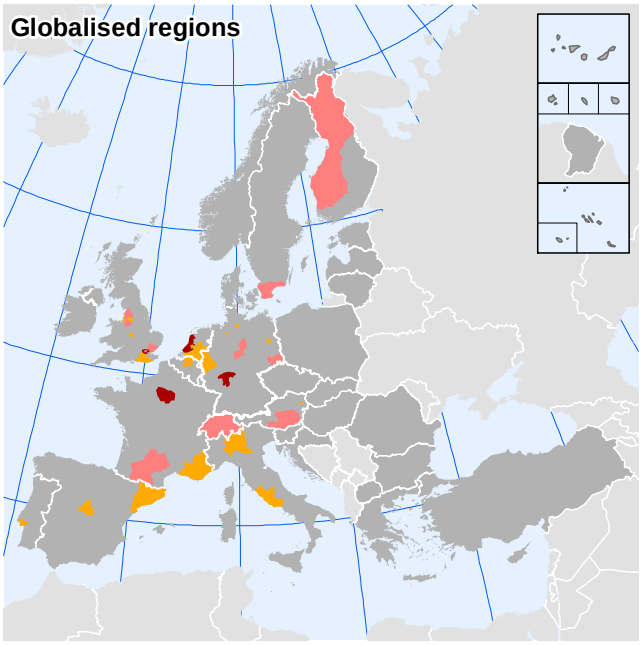
Table 5 Scenario overview for globalisation challenges

Scenarios	↗ situation improves → situation stable ↘ situation worsens trends	groups of regions Globalised regions	Regions handling globalisation	Regions vulnerable to globalisation
Global players				
Sustainable recovery	Polarisation trends between metropolitan and non-metropolitan regions will be further strengthened in terms of demography, transport, business services & headquarters, GDP per capita and R&D. Wealth disparities between EU15 and EU10 metropolitan regions can be expected to decrease.	↗	↗	↗
Sluggish recovery	Similar polarisation trends as in sustainable recovery scenario, however, not as strong.	↗	↗	↗
Lost decade	Current patterns of polarisation and disparities in terms of demography, transport, business services & headquarters, GDP & R&D will remain more or less unchanged.	→	↘	↘
Mobility of persons and goods				
Sustainable recovery	Polarisation trends in terms of air freight volume, transcontinental container ports and transport employment & production between the respective hubs and other regions. Only some of these hubs are identical with the major agglomerations. EU10 hubs will grow more strongly than EU15 transport hubs.	↗	↗	↗
Sluggish recovery	Polarisation trends between transport hubs and other regions will be less strong as compared to the sustainable recovery scenario. Only some of these hubs are identical with the major agglomerations. EU10 hubs will nevertheless catch up and reduce gaps with EU15 hubs.	→	→	↗
Lost decade	Little change of current degree of polarisation between transport hubs and other regions. EU10 transport hubs might catch up somewhat in terms of air freight volumes if necessary infrastructure investments can be realised.	↘	→	→
Accessibility				
Sustainable recovery	Despite infrastructure investments and accessibility improvements in peripheral regions, main hubs will grow more strongly than other regions, leading to continued polarisation.	↗	↗	↗
Sluggish recovery	Because of more concentrated infrastructure investments and continued migration, peripheral regions will be slightly negatively affected, leading to further polarisation.	→	↘	↗
Lost decade	Accessibility levels keep diverging, only metropolitan regions are benefiting since other infrastructure cannot be maintained, due to strained public finances.	→	↘	↘
Knowledge & know-how				
Sustainable recovery	Decreasing employment in low productivity sectors as a result of alternative employment opportunities will induce growth of total productivity. As not all regions are likely to offer high productivity and well paid employment, there is a potential for increasing polarisation.	↗	↗	↗
Sluggish recovery	Productivity increases will be more a result of innovations than large employment shifts. Therefore, they are more moderate and imply less potential for polarisation.	↗	→	→
Lost decade	Decreasing demand for industrial goods will induce lay-offs while productivity basically remains. Employment shifts towards high productivity sectors do not take place. R&D spending will be endangered because of low public and private funds, which could trigger a downward circle.	→	→	↘

Map 11 Mid-term scenarios for the globalisation challenge (following page)

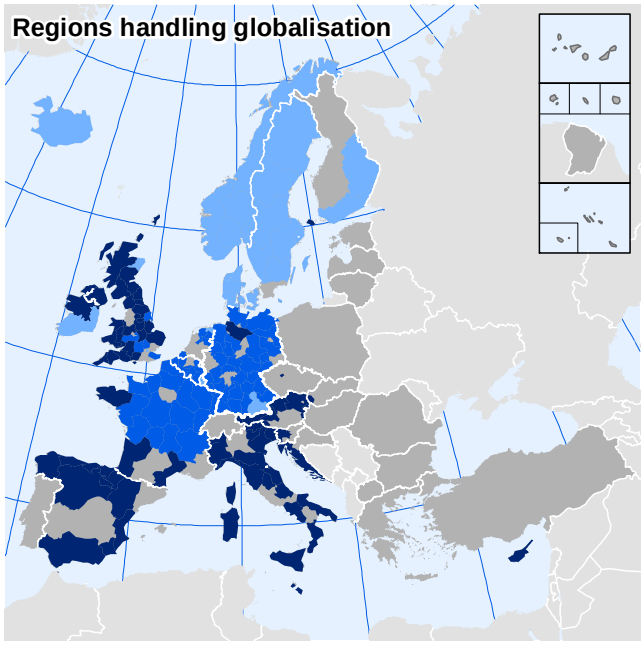
Scenarios for the globalisation challenge

Globalised regions



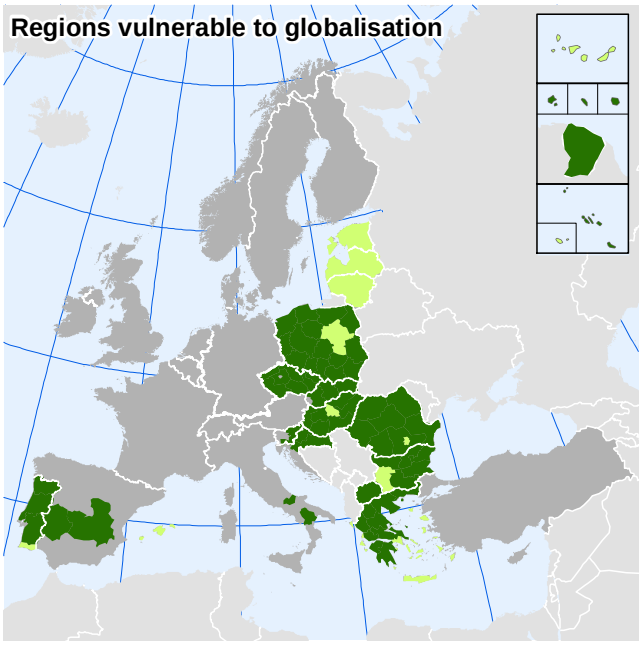
Global players	↗ ↗ →	Global metropolitan regions
Mobility of persons & goods	↗ → ↘	European metropolitan regions
Accessibility	↗ → →	Knowledge intens.glob.integr.
Knowledge & know-how	↗ ↗ →	Other Group of Regions

Regions handling globalisation



Global players	↗ ↗ ↘	Low-mass economic high perf.
Mobility of persons & goods	↗ → →	High productivity regions
Accessibility	↗ ↘ ↘	Reg.prepared for globalisation
Knowledge & know-how	↗ → →	Other Group of Regions

Regions vulnerable to globalisation



Global players	↗ ↗ ↘	
Mobility of persons & goods	↗ ↗ →	Service-oriented vulnerable
Accessibility	↗ ↗ ↘	Highly vulnerable periphery
Knowledge & know-how	↗ → ↘	Other Group of Regions

Prospects 2020

Trends	Scenarios: Sustainable recovery	Sluggish recovery	Lost decade
Challenge increases	↗	↗	↗
Challenge constant	→	→	→
Chellenge reduces	↘	↘	↘
Unknown	?	?	?

Type of Region

- Type of Region
- Other Group of Regions
- Neighbouring Countries

Kilometres

0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

Map developed by ÖIR
© December 2010

Regional Challenges in the Perspective of 2020

The challenge of globalisation in a nutshell

- *Globalisation is both a challenge and opportunity for Europe's regions. What globalisation actually means for a region depends largely on its function within the European territory and the profile of its economy. In general, EU 15 and larger agglomerations (both in EU12 and EU15) are more likely to be favoured by globalisation developments. However, most decisive is how well integrated a region is into the global economy. This integration can build on different profiles such as economic or demographic power, global transport hubs, or high-level service and know-how activities. Depending on these profiles different types of exposure, sensitivities and adaptive capacities need to be considered for strengthening regional competitiveness.*
- *The primary subdivision of the European territory opposes non-metropolitan parts of the EU12 and some Mediterranean regions to the rest of Europe. The reduction of these contrasts over the last decade will continue in a sluggish growth scenario and to a lesser extent in a context of sustainable recovery. The lost decade scenario leads to a risk of accentuated contrasts. The development of the metropolitan regions in the EU12 is associated to the growth of EU15.*
- *Larger agglomerations are favoured by globalisation developments, however to a varying extent depending on their geographical position, their endowment with infrastructure and their knowledge production. The Eastern and South-Eastern metropolitan regions are still lagging in this respect, although they are in a process of catching-up. Taking the primary subdivision and the development potentials of the EU12 metropolitan regions together, this implies that they might be dissociated from their immediate regional neighbourhood. Polarisation trends within the EU15 on the other hand mainly differentiate between regions that are well-integrated in the global economy (e.g. knowledge intensive regions globally integrated, economic high performers or high productivity regions) and other regions. This implies that the contrast is not just between urban and rural or centre and periphery, but depends on regional economic profiles and functions.*
- *The analysis therefore confirms that the degree of urbanisation does not necessarily determine the performance in the face of globalisation: Many more rural Nordic and Central European regions manage to deal with the globalisation challenge even without concentration advantages. Their key to success is mainly high productivity and know-how.*
- *Besides the global and European metropolitan regions, especially knowledge intensive regions are among the main beneficiaries of globalising trends in a context of sustainable growth. Given their capacity to position themselves within niches that are less exposed to international competition or falling demand, they may be the most robust type of region. On the other hand, transport hubs are highly dependent on the development of global trade and interaction. Therefore, they gain considerably under sustainable growth conditions, and are equally vulnerable to the effects of a lost decade.*
- *The rural Eastern and very Southern periphery is the most challenged by the globalised economy. Deficits in productivity and accessibility can not (yet) be counterbalanced by high-level service and know-how activities, an exception perhaps being tourism-intensive regions. The latter, however, remain vulnerable to changes in mobility.*
- *In the light of the development of economic profiles and specific functions regions with activities of a more ubiquitous nature may be of importance as they can enable other regions to perform globally, for example by providing resources and environmental services. They may therefore be described as "supporting regions". While they are less affected by negative global trends in a "lost decade" scenario, they depend on globally integrated regions to draw benefits from overall economic growth in a context of sluggish growth or sustainable recovery.*
- *Most of the adjacent European neighbourhood finds itself in a similar situation as large parts of the European periphery, with low productivity levels, weak service sectors and insignificant knowledge production. However, a distinction needs to be made between the more rural areas and aspiring metropolitan agglomerations. Some of these regions, especially Turkey and Northern Africa, might catch up quickly and challenge the neighbouring European periphery. Apart from countries in other parts of the world, Russia and the Middle East already compete with Europe successfully on a global level.*
- *Under consideration of the different potential effects for different regions, it becomes obvious, that the division of labour between different types of regions needs to be taken into account when designing policies to reap the benefits from globalisation and to combat its negative effects. This would lead to a functional understanding of polycentricity in which the motors of European growth are not only urban and metropolitan areas. Instead, they comprise a wide range of regions that have a role in the global division of labour.*

5. Demographic change

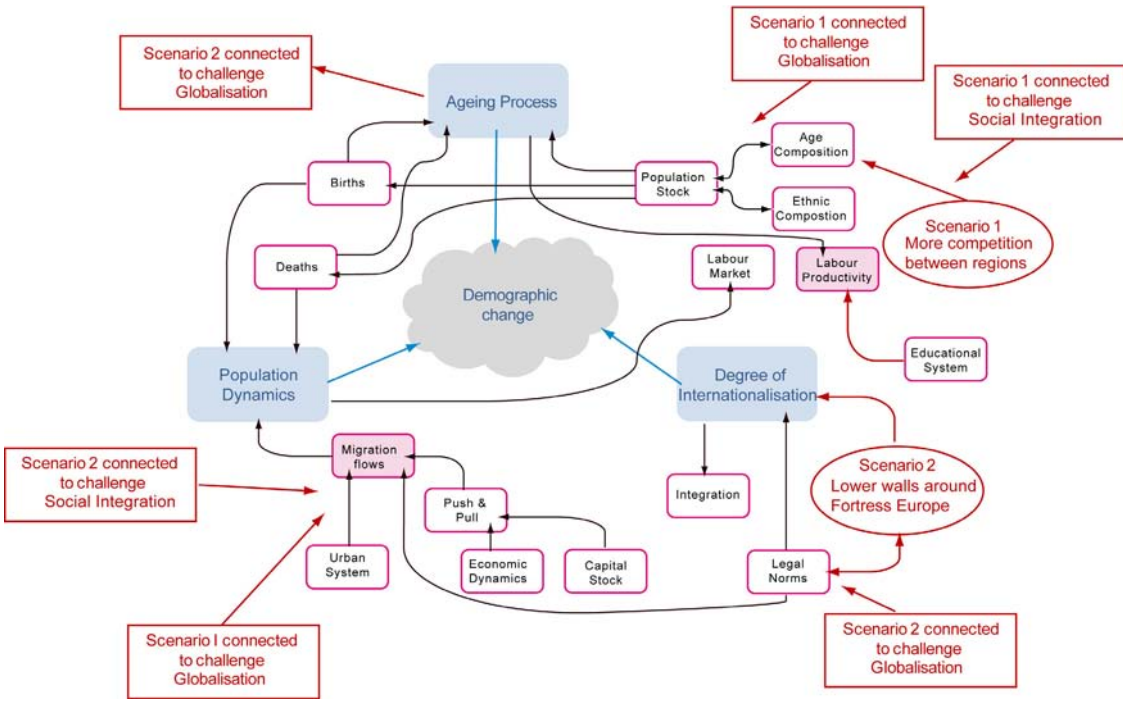
The economic challenges previously analysed in the globalisation section strongly depend on demographic developments, with regions drawing their power from the consumption behaviour and the labour force of their inhabitants. As such, the current demographic change might influence many regions' economic activities. Regional competitiveness is a complex system with numerous interrelated elements affecting both public and private activities. Demographic flows, i.e. births, deaths and migration, change the size, composition and regional distribution of population stocks. For instance, labour markets are exposed to a permanent exchange of the active segment of the population. Dynamics in the formation of private households influence the demand side of housing markets, the need for public goods and for infrastructures. To avoid any unwanted conflicts, adjustment activities must be constantly refined into a coherent framework in order to maintain and improve territorial cohesion.

The basic long-term driving force of European demographic change is a fertility rate that is below the reproduction level and which implies that every generation of women will bear fewer children than their own or their mothers' generation. The effect leads to a shrinking population if this loss is not replaced by a migration surplus. However, there are no normative thresholds when a positive demographic trend turns into a negative one. But in economic aspects you can easily prove that an ageing population produces higher social costs. The growing share of elderly and the shrinking portion of young people outline the most urgent component in the challenge of demographic change: the **ageing population**. An ageing population requires different strategies to adjust specific infrastructures and has major consequences for the labour force and – supposedly – its productivity.

The second major component of demographic change is the regionally diverging population dynamics. They can be observed in **shrinking and growing regions**. Several strategies are discussed to prevent shrinking dynamics or, more recently, to simply accept them and head for mitigation procedures.

The third key issue results of these population dynamics and is determined by migration and its consequences for the ethnic composition of a population. **International migration and integration** cause on one hand a stronger global orientation but on the other hand often raise needs for social and cultural integration tasks. Integration in this respect is broadly defined as immigrants participating in society at all levels – social, cultural, economic and political fields of activity – and being supported in their participation. The key task of integration is the education system, which should provide the knowledge of the local language and skills required in the labour markets.

Figure 7 Systemic overview of demographic change issues



Ageing population

Ageing is a shift of the proportions between the age-groups of a population that is driven basically by fertility and life expectancy. All 27 EU countries have a fertility level below reproduction level, so general demographic change and especially ageing processes are underway almost everywhere throughout Europe. In general, European countries can be classified into three groups of low, medium and high levels of fertility. Twelve countries, mainly in Eastern and Southern Europe, have the lowest fertility rates of 1.2 to 1.3 children per woman. The second group, with medium fertility rates of 1.4 to 1.7 children per woman, is formed by eleven countries – mainly located in Central Europe and Scandinavia. Only four of the 27 EU countries have a higher fertility rate of 1.8 to 2.0 children per woman, which comes close to the reproduction level: Ireland, France, Denmark and Finland. Only a few regions of the Union have fertility rates above the reproduction level: Finnish Pohjois-Suomi and the French overseas regions. In addition, just a few countries show a concise pattern of regional fertility differences, like some North-South differences in Poland and Italy. The much stronger differences, which can be observed at the national level, reflect different national policies (e.g. childcare, family transfers, reconciliation of work and family life, migration policies). As the fertility level dropped in three waves since the 1970s in different parts of Europe, the regions today represent different stages of the ageing process. The more complex Billeter index sets into relation the population not yet in reproduction age with the population that is no longer reproductive and the population of reproductive age. In Sweden and Germany, the older population exceeds the younger. In some countries, such as Ireland, Estonia and Cyprus, and many capital city regions, e.g. Warsaw, Stockholm, Prague, Paris or London, the age composition will remain stable in the forthcoming decade.

The indicator system for regional vulnerability

The level of fertility acts as a very precise long time indicator for ageing. To demonstrate short time effects and as the time horizon of this study is 2020, a different approach for defining **exposure** indicators was chosen, which combines two indicators. The first is the *mean age*, which gives an impression of the status quo of the age of society. It illustrates a considerable range from 35.5 years in Ireland up to 42.6 years in Italy. Most countries have a mean age between 38 and 41 years. Using the mean age to describe the age composition, there is a range of more than 40 years down to 37 years. To measure near-future challenges, the influence of the *life expectancy at birth* is crucial – the longer the life expectancy, the higher the regional vulnerability towards requirements for pensions, elderly care, etc.

Figure 8 Training people as caregivers for elderly people, ES

Source: DG Regio

Table 6 Indicators used for 'Ageing population' vulnerability in NUTS 2 regions

	indicator	minimum	mean	maximum	SD.
Exposure	mean age in years	21.08 (Van, TR)	39.14	46.90 (Liguria, IT)	3.88
	life expectancy at birth in years	70.46 (Trabzon, TR)	78.88	83.80 (Ticino, CH)	3.08
Sensitivity	dependency ratio between the active, not yet active and retired population	34.16 (Bratislavsky kraj, SK)	49.84	86.19 (Mardin, TR)	6.30
	Billeter index [a)]	-0.87 (Chemnitz, DE)	0.67	-0.38 (Mardin, TR)	0.22
	healthy life expectancy at birth in years	51.19 (Mardin, TR)	61.66	72.25 (Ísland, IS)	4.24
Adaptive capacity	labour force replacement ratio	0.52 (Chemnitz, DE)	1.13	7.19 (Van, TR)	0.75
	(social) support index	8.00 (Adana, TR)	22.77	41.11 (Castilla y León, ES)	6.72

[a)] complex reproduction indicator

Sensitivity in the context of ageing regions measures the regional conditions in terms of the younger generation being able to contribute to the mitigation of the challenge of ageing. An appropriate indicator to approach the relation between the economically active, the not yet active and the retired groups of population is the *dependency ratio*. Also used was the *Billeter Index* described before. The third indicator chosen for sensitivity comes from a different realm: the *healthy life expectancy at birth* serves as a proxy for the expenditures for elderly and medical care, i.e. if a region is exposed to people getting very old, the impact will be lower when senior citizens enjoy good health (polarized inversely to the basic life expectancy).

Similar to sensitivity, but looking ahead to the near future, the indicators for **adaptive capacity** measure the mid-term mitigation possibilities of the regions. The interrelation between young people entering and the elderly leaving the labour market is represented by the *labour force replacement ratio*. The intergenerational support, the potential social network between the generation of older persons and their children's generation is described by the *(Social) Support Index*.

Neighbouring countries and cross-border effects

As discussed with regard to the demographic challenge, there is considerable difference between the EU and its neighbouring countries in terms of age structure and population development. All the countries in the Southern neighbourhood have young populations with mean ages between 22 and 32 years, which contrasts with the Eastern neighbourhood (Map 12). Also the fertility rates divide these countries into two groups. The Eastern neighbourhood exhibits a fertility rate that is similar to or even lower than that of the EU. However, as the decline started simultaneously to the process of political transformation, the ageing situation is still less critical than in most of the EU 27. The second group consists of Southern countries with a fertility rate high above the reproduction level. Table 7 presents the main indicators for the neighbouring countries in this respect.

Map 12 Europe and its neighbourhood: mean age

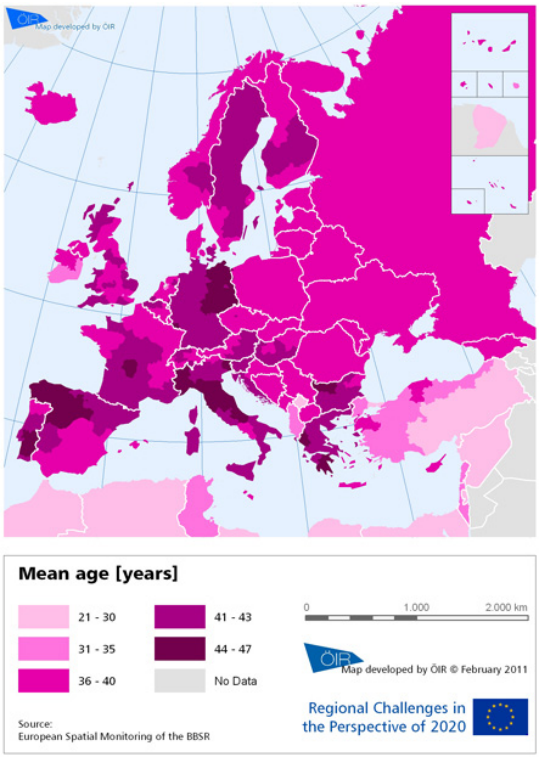


Table 7 Neighbouring countries: indicators for ageing population

	Mean age 2005	Dependency ratio 2005	Life expectancy at birth 2000-2006		Billeter Index 2005	Labour force replacement ratio 2005	(Social) Support Index 2005
	Total	Total	Female	Male	Total		
Albania	32.1	54.2	79.0	72.6	0.094	277.0	11.2
Bosnia and Herzegovina	38.0	43.0	77.2	71.6	-0.257	183.8	10.5
Belarus	38.4	42.9	74.6	62.5	-0.269	219.4	14.8
Georgia	37.3	48.9	75.0	68.0	-0.207	241.1	13.9
Moldova	35.8	42.9	71.2	63.6	-0.152	264.6	9.7
Montenegro	36.3	48.9	77.0	71.9	-0.166	192.3	12.0
Serbia	38.0	49.6	75.6	70.9	-0.275	171.1	13.6
Russian Federation	38.2	40.6	71.8	58.5	-0.277	249.6	12.6
Ukraine	39.6	44.4	73.4	62.1	-0.357	170.2	15.2
Algeria	27.3	52.0	72.2	69.7	0.293	596.0	7.5
Egypt	26.5	60.8	70.7	67.3	0.369	536.0	5.7
Israel	32.3	61.3	81.7	77.6	0.092	263.5	18.8
Jordan	24.4	68.5	73.1	69.7	0.514	563.9	9.1
Lebanon	30.3	53.1	73.2	68.9	0.176	315.8	8.8
Libyan Arab Jamahiriya	26.8	51.8	75.7	70.5	0.315	450.8	6.0
Morocco	28.0	55.1	71.8	67.5	0.284	480.9	6.2
Occupied Palestinian Terr.	21.8	95.7	73.9	70.8	0.816	769.8	8.9
Syrian Arab Republic	23.9	66.7	74.9	71.2	0.510	760.4	6.4
Tunisia	30.2	47.8	75.1	71.1	0.147	422.5	8.9

The vulnerability map

The aging of the population as such is the result of different demographic elements, the composition of the age groups and their changes in time. These are changed by the combined effect of decreasing fertility and increasing life expectancy. The task is to find indications for the age composition of the population and the relations between certain age groups or generations. Upon aggregating the presented elements of the key issue ageing the message is clear: demographic trends indicate that it is not possible for any European region to avoid an ageing population. The question then is rather how to handle it.

The regional vulnerability of ageing (Map 14) is high in those regions where the Billeter Index is lowest, like in Germany and in large parts of Italy, Portugal, Finland and Greece. The age composition reinforces the impact in those regions and also generates high vulnerabilities in Southern and South-Western France or the central regions of Sweden. Eastern European countries are still favoured by their age composition. However, the need for support for the elderly or the labour force replacement index outline limited adaptive capacities in some parts of Eastern Europe. Regions in East Germany, the Czech Republic or Hungary can be allocated to this group. Emerging changes in the impacts in Eastern European countries, for instance Poland, will add to a below average adaptive capacity.

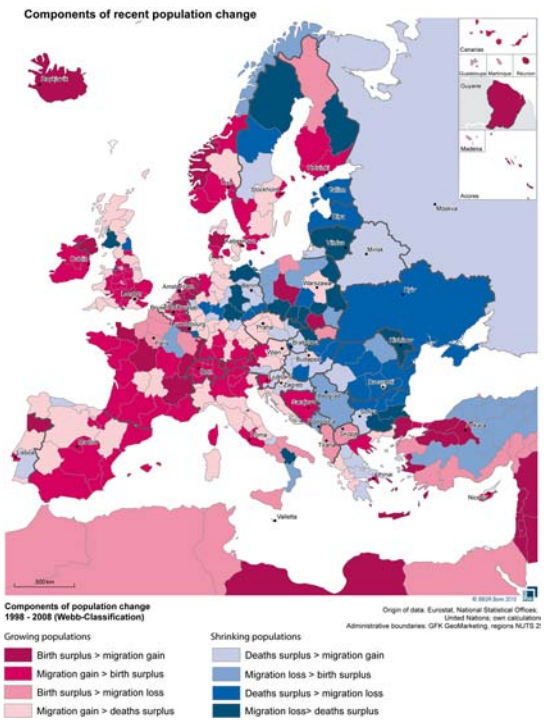
In the neighbouring countries, except for the more vulnerable Ukraine, the mean age is generally younger than in the EU. As mentioned before, especially in the Mediterranean countries ageing is not the crucial issue.

Shrinking population

Regional population decline is a phenomenon that has been known for many centuries. More recently, it was caused predominantly by out-migration from regions with low economic dynamics. However, a large part of Europe still experiences population growth. In fact, a number of regions have a strong growth base with both birth surpluses and migration gains (during the period of 1998 to 2008) sufficiently counterbalance the death surpluses.

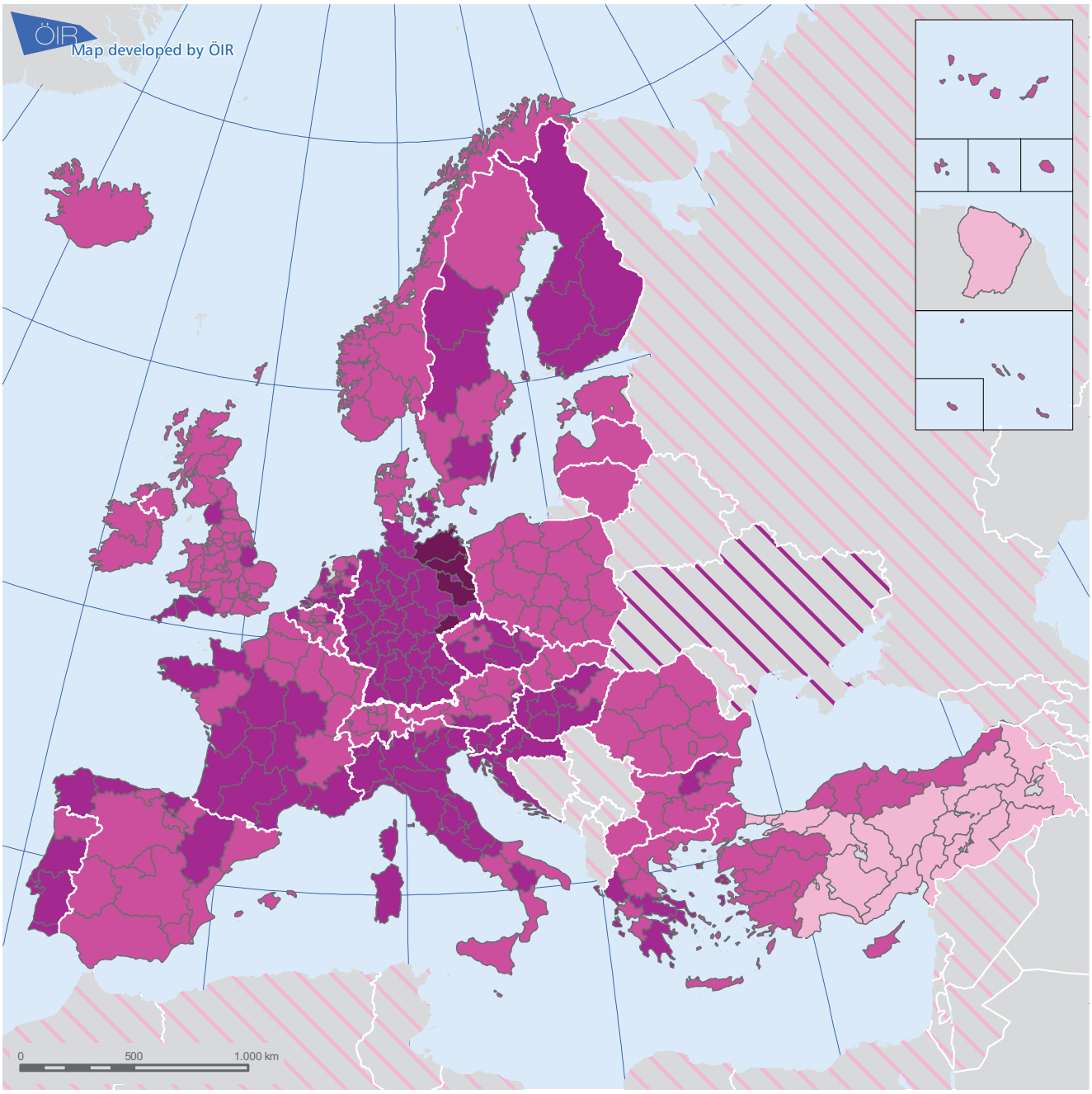
The *Webb Classification* (Map 13) examines the underlying mechanisms in population change and concentrates on the relationship between natural growth and net migration. Using eight categories of relationships between natural changes and net migration, it is possible not only to detect the direction of population change but also to identify the driving forces of those shifts: either natural change or net migration. A double growth situation with birth surpluses even higher than migration gains can be found in the Netherlands, Flanders and London, whereas the situation on the Mediterranean coastlines of France and Spain is the opposite: migration gains exceed the birth surpluses. On the other hand, in Western Germany, Northern Italy or the South of Sweden death surpluses can still be compensated for by migration, demographic growth is imported. Demographic change leads to a new quality of shrinkage: population decline has until now been mainly caused by death surpluses, i.e. by the natural changes and it is difficult to close this gap through migration gains. As the natural change follows an exponential function, it is only a question of time before the influx of migration will no longer

Map 13 Europe and its neighbourhood: Components of recent population change 1998-2008 (Webb Classification)



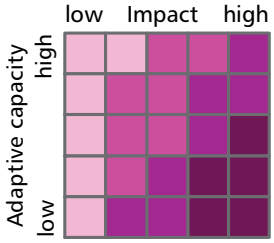
Map 14 Key vulnerability ‘Ageing population’ (following page)

Ageing population - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Mean age
- Life exptectancy at birth

Indicators describing sensitivity:
- Dependecy ratio
- Billeter index
- Healthy life expectancy at birth

Indicators describing adaptive capacity:
- Labour force replacement ratio
- (Social) Support index

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Mean age

Data source European Spatial Observation of the BBSR except where indicated.Detailed indicator description in the annex.
Indicators have been standardised via z-transformation and polarised according to their influence on regional vulnerability.

Regional Challenges in the Perspective of 2020

The indicator system for regional vulnerability

It was evident to choose the *population change 1998-2008* as the indicator for **exposure** and the population density as indicator for the **sensitivity** of regions. Secondly, as a more sophisticated approach, information on the quality of immigration was used. Regions with a high *share of third level education employment* are assumed to have a high proportion of capital intensive and highly qualified work opportunities and to thereby attract workers. Conversely, a mismatch of the level of qualification of the total population and the employed population might indicate regions with a broad educational base not having appropriate working opportunities. This could lead to migration losses and to the export of human capital. The *share of population with third level qualification* will therefore serve as a means to validate the results in this respect.

To quantify the **adaptive capacity**, the *disposable income of private households* and the *labour costs* were used, reflecting push and pull factors both from the employee and the employer side of the labour market. They indicate the relationship between migration and labour in the context of demography and are also linked to the challenges related to social polarisation. Educational and social infrastructures, the need for maintaining basic services and the situation and developments within the housing markets are examples of this.

Neighbouring countries and cross-border effects

Demographic cross-border effects predominantly consist of international migration flows. Globalisation and worldwide population growth have triggered a migration volume of a dimension that has never been witnessed before in history. However, migration flows show certain regularities and patterns. Migration theory explored the determinants of those systematic relations. Based on the gravity model, migration flows depend on the population sizes and the distances between the regions of origin and destination. Additionally, several push and pull factors triggering migration flows can be examined. In international migration, these may be classified in four categories affecting economic, ecological, political and demographic determinants of worldwide migration.

Many countries have an uneven migratory balance. North America, Western Europe and the Middle East are the world regions that exhibit the strongest migration gains. Amongst the macro regions with the highest outflows, the European neighbourhood of Northern Africa and Eastern Europe stands out. The migration gains of Western Europe and the migration losses of Eastern Europe and Northern Africa are closely related to each other: Western Europe was confronted with strong immigration from the former Eastern Bloc countries after the lifting of the iron curtain in the early 1990s. The economic discrepancies—with high wages in the West and instable labour markets and the disorientation resulting from times of economic transition in the East—marked strong push and pull factors. With the diminishing gap between Western and Eastern Europe, the economic push factors will not completely disappear but will lose some of their current importance.

In the meantime two more groups of push factors will increase in importance: the demographic and the political factors. The transition coincided with a decline of fertility in Eastern Europe. Twenty years and almost a generation later, the countries are facing shrinking labour forces and declining population stocks in the near future. The strengthened economies of Eastern Europe will absorb more job seekers, as can already be observed in trends of return migration following the economic crisis that hit Western Europe stronger than the East. The Western demand for labour will have to be covered by higher participation rates and/or higher retirement ages or by migration from other parts of the world. The latter option involves a higher importance of Europe's southern neighbours. The population potential of the Maghreb states is still high. The fertility rate there is sinking; however, it is still above the replacement level. Entering the labour markets for many young people is exceptionally difficult in these countries and is a factor in the youth unemployment rates of up to 50%.

Table 8 Indicators used for 'Shrinking population' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	population development 1998-2008	-19.95% (Ezurum, TR)	3.71%	42.21% (Guyane, FR)	7.59
Sensitivity	population density in inhabitants per km²	3.00 (Ísland, IS)	346.63	9,443.00 (Inner London, UK)	873.33
	share of third level education employment	2.20% (Mardin, TR)	17.89%	40.20% (Oslo og Akerhus, NO)	7.20
	share of population with third level qualification	5.53% (Gaziantep, TR)	24.75%	54.67% (Inner London, UK)	8.88
Adaptive capacity	disposable income of households in €	1,651.70 (Severozapaden, BG)	14,589.99	46,708.12 (Nordwestschweiz, CH)	7,387.25
	Average labour costs per hour worked	1.89 (Yugozapaden, BG)	20.12	40.93 (Île de France, FR)	10.90

This demographic pressure in the Arab countries has led to economic problems that, in combination with the local political contexts, contributed to the series of revolutions witnessed in the first months of 2011. Still, poor future perspectives motivate more and more young people to emigrate. Europe is one of the premier targets of destination: it is nearby, offers attractive jobs and social welfare systems, and is characterised by existing social networks established by relatives and fellow countrymen. As a result, the countries of origin in Northern Africa will gain higher portions of the total migration volume while Eastern Europeans will partly lose their relevance for the Western European labour markets. The shift of the countries of origin contains a shift towards needs regarding integration (also see the migration/integration section).

The vulnerability map

At first glance, the shrinking of regions does not appear to be a large challenge for many parts of Europe (Map 15). However, some areas in the North and East of Europe, such as Sweden, Finland, the Baltic States, some Eastern regions in Germany, Silesia in Poland, as well as most regions in Hungary, Romania and Bulgaria are characterized as most vulnerable or vulnerably. Ireland and Mediterranean Spain are low impact regions, primarily on account of strong immigration (in Ireland this development has broken off as a result of the crisis). In Western Europe, only Wallonia and a couple of regions in Germany seem to be overly vulnerable. Large parts of Central and Western Europe seem to be well prepared, although shrinking has considerable impact on most of the regions. Some regions suffer from their low demographic potential, since shrinking leads to a high vulnerability for demographic sustainability. Densely populated regions can more easily compensate for the shrinking processes and maintain demands on infrastructure. The regions that are actually the most vulnerable are those with a small population; North and Central Sweden being good examples of this, but also Sachsen-Anhalt in Germany.

In the neighbouring countries a clear East-South divide can be observed. The positive or negative population development was exclusively used as an indicator, i.e. nations losing population are tagged as more vulnerable. While the North African and Near East countries are all steadily growing, due to their high fertility rates, the eastern neighbours are losing population, often owing to both emigration and death surpluses (cf. Map 13).

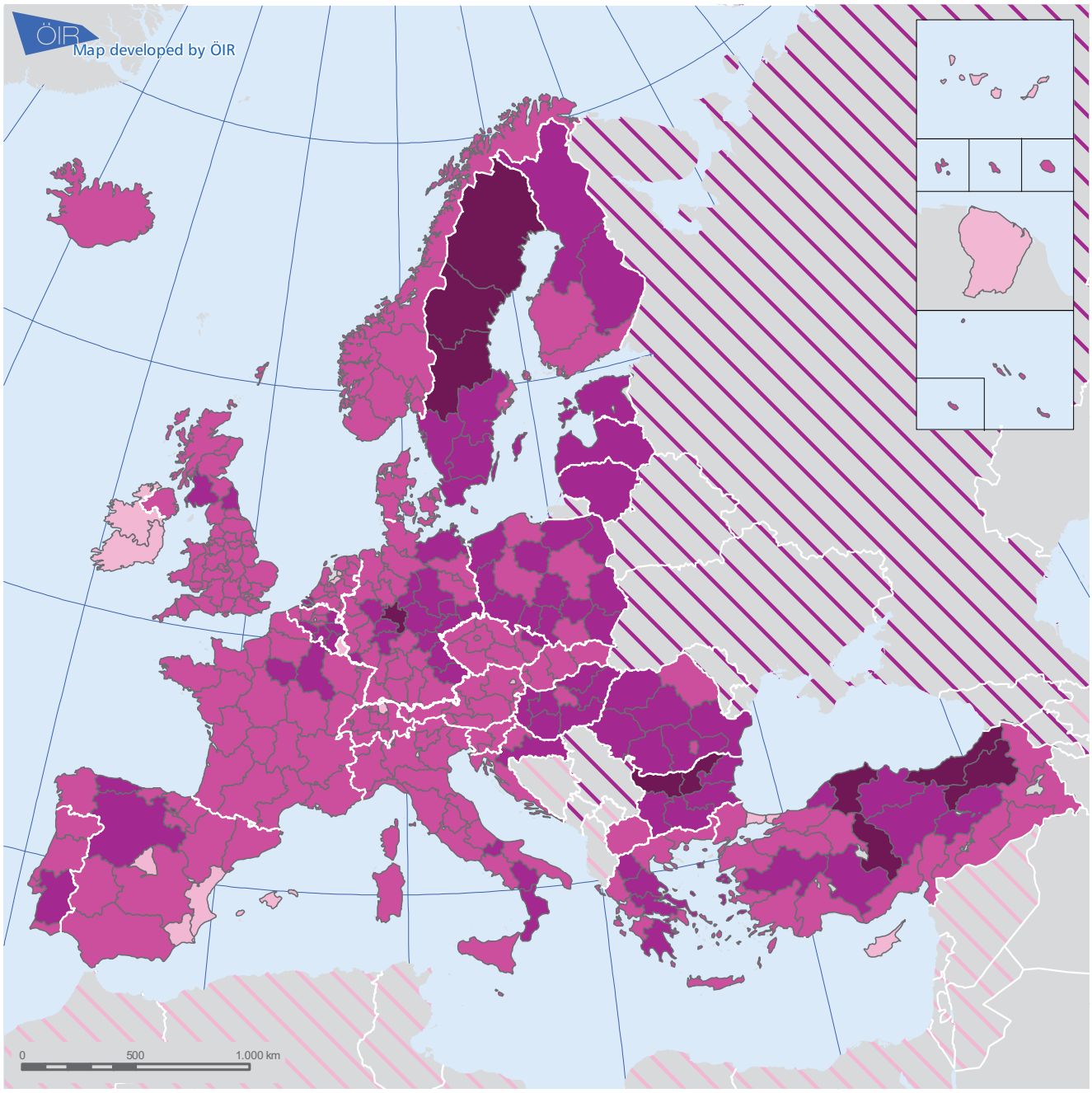
International migration and integration

While the natural change of a population works very slowly in the long term, migration can be influenced relatively fast and in the short term. Since migration flows additionally have an age selective nature, they also influence the ageing process by slowing it down. In a world of massive population growth (current UN forecasts estimate a world population of more than nine billion in 2050) a policy of increased immigration into the EU countries would be a feasible strategy to mitigate the demographic change. The EU 27 is already exposed to increasing migration pressure. The push and pull factors of migration stem from migration theory and include: (a) an economic prosperity gap, (b) demographic pressure due to population growth in developing countries, (c) global political stability/instability and finally (d) the environmental conditions that lead to a shortage of natural resources and to a reduction of land for settlement and cultivation.

Within its borders, Europe has created the conditions for a high level of mobility between the member states: the inhabitants of the *Schengen* countries (almost all) have the free choice of their place of residence anywhere in the Union. But at the same time they have established the ‘fortress’ Europe, which is systematically protected against immigration. On the other hand, there are no common rules to organise a controlled immigration which is in line with the needs of the European labour markets. There are, of course, good reasons for this; one being the cultural distance between the main emigration origin countries and the European destination countries. Over and above, cultural and ethnic heterogeneity often cause increased social polarisation. Thus the challenge in this key issue is not migration as such but rather the future efforts in the field of integration.

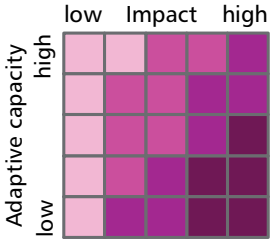
Map 15 Key vulnerability ‘Shrinking population (following page)

Shrinking population - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Population development 1998-2008 in %
- Accumulated natural development 1998-2008
- Accumulated migration 1998-2008

Indicators describing sensitivity:
- Population density
- Share of third level education employment
- Share of population with third level qualification

Indicators describing adaptive capacity:
- Disposable income of households, net
- Labour costs

Neighbouring Countries
(simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Population development

Data source European Spatial Observation of the BBSR except where indicated.Detailed indicator description in the annex.
Indicators have been standardised via z-transformation and polarised according to their influence on regional vulnerability.

Regional Challenges in the Perspective of 2020

The indicator system for regional vulnerability

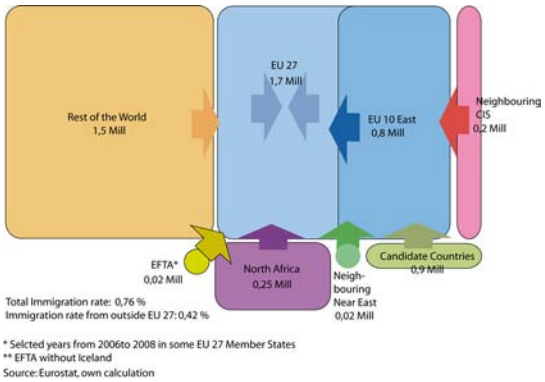
A holistic view of migration in Europe during the period from 1998 to 2008 shows a broader scope of potential target and source regions. One key aspect of migration from this period is the high share of non-EU population in the main economic centres; another is the resulting possibility for many to search for work in a familiar ethnic environment as strong social networks are an important pull factor for immigration.

The measurement for **exposure**, expressed in the form of the *accumulated migration 1998-2008* (in absolute numbers) will give some indication of potential target regions. The changing composition of the population with regards to the age, gender and ethnic composition makes integration one of the main challenges in the context of demography. For this reason, the *population in working age born outside the EU* (respective EFTA/candidate country where feasible) was chosen as an indicator for **sensitivity** and also to identify the regions according the proportion of their population with a migration background. As a proxy for **adaptive capacity**, the *regional innovation potential* is used to identify those regions which attract a highly qualified labour force and thereby face fewer integration difficulties. In contrast, less innovative regions, which attract moderately educated immigrants, will have to cope with more social polarisation.

Neighbouring countries and cross-border effects

Migration regulations now hinders strong official migration flows from Europe's neighbouring countries. Without these restrictions, migration from the Southern Mediterranean, but also from Eastern Europe, might have an even more distinct influence on the EU. However, the demographic developments in countries with shrinking populations, such as Ukraine, will reduce the potential migration pressure on the EU in the future. On the other hand, Sub-Saharan Africa and the Middle East, with their strongly growing population and political upheavals, might exert further pressure on Europe's southern borders.

Figure 9 Immigration to EU 27 by origin, 2008*



Source: Eurostat, BBSR

The establishment of the free internal movement of workers in 2011 will be the most important upcoming milestone in European labour migration for the CEE accession countries and probably will further weaken migration streams from third countries.

The vulnerability map

The major metropolitan areas, the Spanish Mediterranean coast, Southern France and the North of Italy are the main target areas of immigration. The more rural Western and Central European regions, with their long history of international migration, face a high impact; however, the high adaptive capacity in the form of their ability to attract highly skilled workers enables them to be relatively prepared for integration issues. Although most regions in Eastern Europe have a low impact, with only few people entering, they also have a low adaptive capacity and a lack of experience with international migration and integration. In other words, the relatively few immigrants in these regions tend to be working in poorly paid jobs and they are less integrated into society, thus potentially contributing to additional social polarisation.

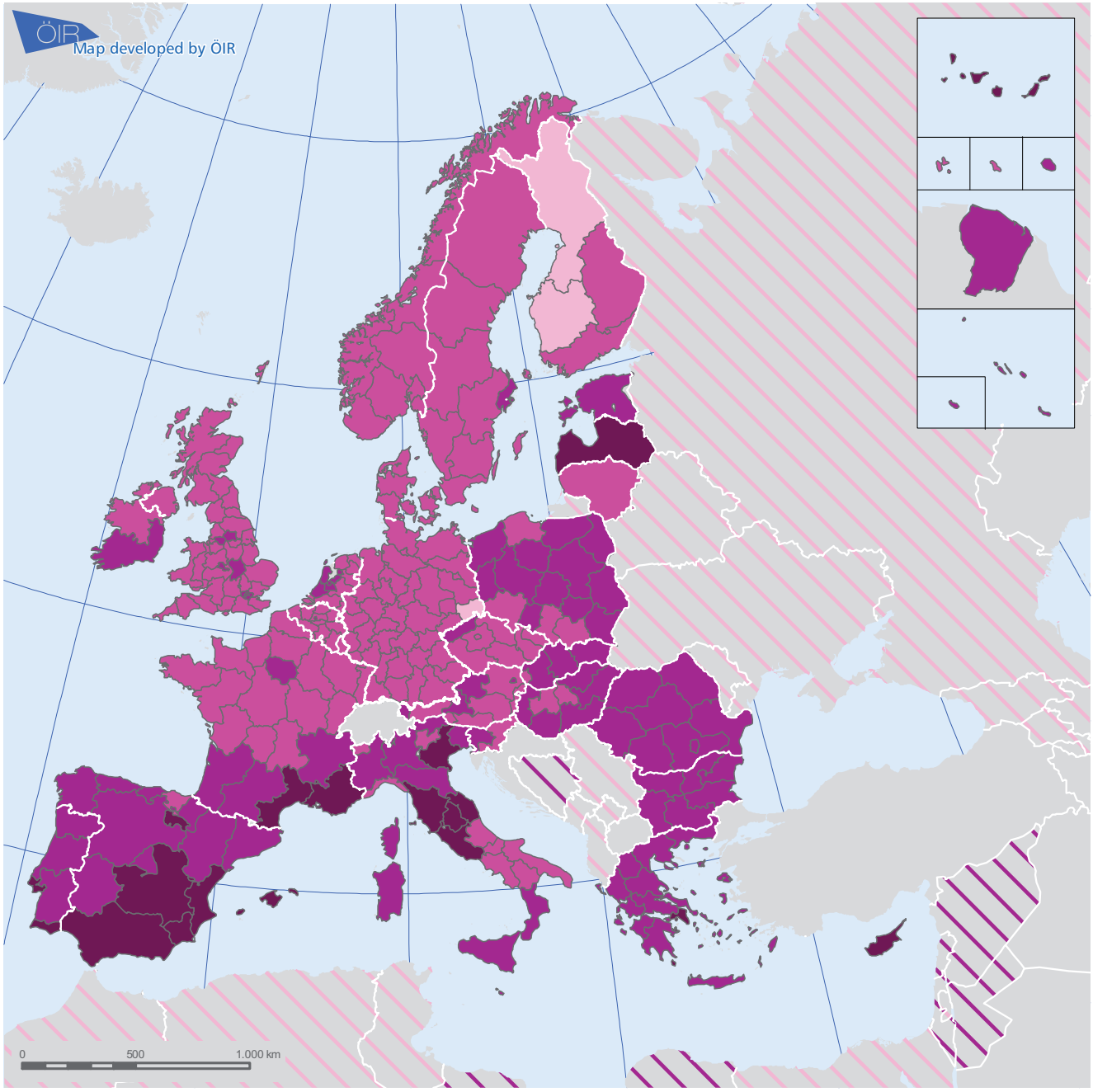
Many Southern coastal regions in Spain, France and Italy are also categorized as most vulnerable, due to their low adaptive capacity.

Table 9 Indicators used for 'International migration/integration' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	accumulated migration 1998-2008 (absolute)	-941.60 (Trabzon, TR)	44.28	1,808.70 (Istanbul, TR)	204.83
Sensitivity	Share of population in working age born outside the EU or EFTA/candidate country	0,00% (Malatya, TR)	5.40%	34.60% (Kastamonu, TR)	5.66
Adaptive capacity	innovation performance (innovation scoreboard)	1 (various regions)	3,11	5 (various regions)	1,31

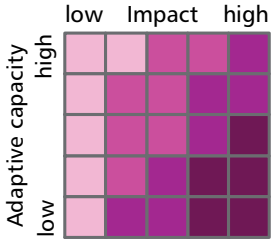
Map 16 Key vulnerability 'Migration and Integration' (following page)

International migration and integration - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Accumulated migration 1998-2008

Indicators describing sensitivity:
- Population in working age born outside of the EU

Indicators describing adaptive capacity:
- Innovation performance

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Migrants 1998-2008 per inhabitant

Data source European Spatial Observation of the BBSR except where indicated.Detailed indicator description in the annex.
Indicators have been standardised via z-transformation and polarised according to their influence on regional vulnerability.

Regional Challenges in the Perspective of 2020

In the case of Spain and France, colonial linkages for a long time have facilitated immigration through personal, social, economic and political ties.

On peculiarity in the map is that the Baltic states of Estonia an Latvia appear highly vulnerable because of their strong Russian-born minorities that even constitute the population majority in some communities. The role of argued the neighbouring countries in migration issues is, as was argued in the related section, the role of a migration source. However, the immigration of foreigners related to the resident population, which was used as an measurement for neighbourhood vulnerability, is especially high in Lybia, Syria, Lebanon and Jordan. With the exception of Israel being a traditional immigration country, this influx is most probably owed to refuge seekers from Iraq and a number of African countries.

An integrated picture of the demographic change challenge

As mentioned above, similarities between European regions in terms of demographic change have been calculated using quantitative analysis (Map 17). Many of the characteristics of the three individual issues are represented in the overall demography typology.

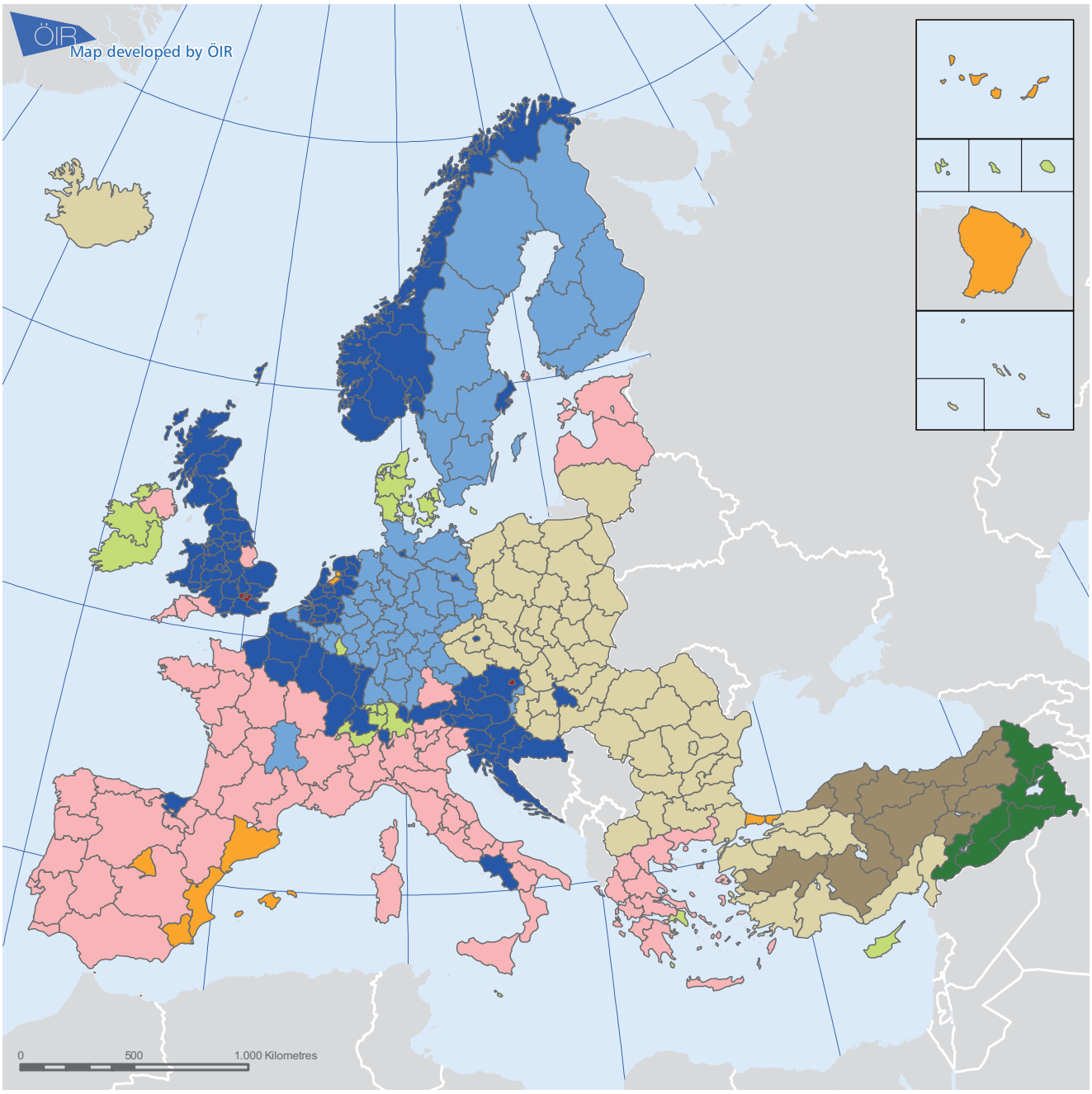
The first two types of regions are the only ones that face birth surpluses on more than a local basis. Nineteen regions were identified as '**the western demographic high-performers**' and are located in Switzerland, Luxembourg, Denmark and Ireland. They are all characterised by relatively high levels of income as compared to the European average. In terms of demographic change, these regions exhibit high gains in natural growth as well as migration gains. However, in light of the current crisis, this development might have been cut short, at least in Ireland. Nevertheless, since societal ageing is not a significant issue, these regions can be regarded as the demographic high-performers of Europe. The second type of regions is very different in character, but quite similar in demographic respect: '**Turkish demographic high-performers** has considerably higher birth rates and a strikingly positive performance in the area of ageing population compared to the European average. What clearly distinguishes these regions as transition regions is the low life expectancy and a trend towards emigration due to fewer local job and development opportunities.

A further regional type comprises growing regions that largely owe their development to migration, which creates issues of migration and social polarisation. As such, they could be seen as migration "hot-spots" in Europe. The '**metropolitan immigration destinations and enclaves**' regional type is made up of only seven regions: the cities of Inner/Outer London, Brussels and Vienna, as well as Liechtenstein and the two Spanish enclaves in North Africa. Although at first sight these regions appear to share hardly any common features, their character shows a highly increased sensitivity in the area of integration. To some extent this increased vulnerability is outperformed by their low vulnerability towards demographic shrinking. The cluster of the '**high-growth immigration destinations**' is very similar in this respect. It covers most of the Mediterranean coast of Spain, Madrid, the Spanish and Portuguese Islands, the Netherlands' Flevoland, Istanbul and French Guyane. This cluster is characterised by a significantly high exposure and sensitivity towards migration and integration. The '**moderate-growth immigration destination**' cluster has only moderate vulnerabilities in total but is still a considerable destination for migration. These sixty-nine regions cover large parts of Portugal, Spain, France and some regions in the UK in the West and Italy and Greece in the South, in addition to Estonia and Latvia. The most significant difference are the increased exposures for ageing and integration.

A separate cluster of regions represents an average demographic performance. The '**balanced demographic regions growing**' cluster ranges from almost all regions in Great Britain and the Benelux countries to some regions in Eastern France, Switzerland, Austria and Slovenia and Croatia, including also Budapest and Stockholm. It consists of eighty-two NUTS 2 regions, thereby forming the largest cluster in this sample, and is characterized by an average vulnerability towards all three issues of demographic change. In contrast, the second type in this group faces one specific drawback: In the cluster '**balanced demographic regions ageing**' there is an increased vulnerability due mostly to an ageing population. This cluster comprises fifty-four regions covering large parts of Germany, Finland and Sweden, as well as parts of Belgium, France and Austria. The other key issues show average vulnerability.

Map 17 Cluster analysis indicating the vulnerability for the demographic change challenge (following page)

Demographic change - Integrated vulnerability



Type of Regions

Demographic high-performers

- Western demographic high performer
- Turkish demographic high performer

Migration destinations

- Metropolitan immigration destinations
- Moderate-growth immigration destinations
- High-growth immigration destinations

Balanced demographic regions

- Balanced demographic regions growing
- Balanced demographic regions ageing

Migration origins

- Eastern migration sources and Iceland
- Central Turkish migration sources

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

ÖIR Map developed by ÖIR

Regional Challenges in the Perspective of 2020

The final two clusters represent the main origins of migration in the study area. The '**eastern migration origins and Iceland**' cluster can be identified as relatively stable. This cluster comprises sixty-two NUTS 2 regions, which encompass large parts of the New Member States, Iceland and some regions in Greece and Turkey. It has a slightly below average performance in integration issues; however, at present this does not represent a major vulnerability problem, as exposures are low. Nevertheless, it may pose a problem in the future when migration streams increase. These regions have a tendency to shrink, on account of many people moving to Western Europe since their accession, but on the other hand they are also characterised by a favourable age composition. The final regional cluster – '**central Turkish migration origins**' – comprises ten NUTS 2 regions located in central Turkey. This cluster is characterized by a heterogeneous performance of its exposures over all three key issues: While vulnerability is low compared to the European average in societal ageing and integration, the vulnerability towards shrinking population is significantly higher because of emigration. However, it is offset to some extent by a favourable demographic composition.

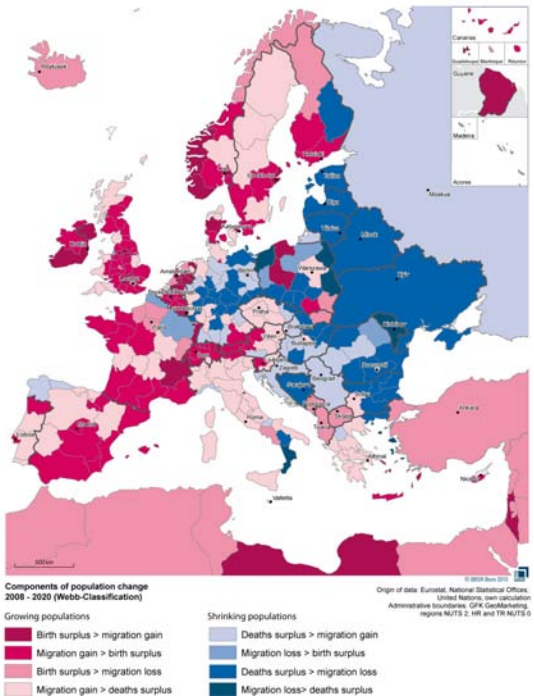
Mid-term scenarios

The processes of population dynamics are slow and therefore inflexible in the short term, since the natural changes in population follow the rhythm of individuals' lives. The spatial movements are more dynamic and do trigger changes in the short term. This has immediate effects on the size of the population, on its composition by age and sex, and particularly on spatial distribution. Migration flows respond faster and more immediately to changes in certain basic conditions. The causes for migration may lie in the regions of origin (so-called push factors) or in the regions of destination (so-called pull factors). As both push and pull factors usually exist in the regions of origin and destination, their relative regional differences determine the cause of migratory movements. However, projections regarding the population can – by varying the assumptions of migration – produce no profoundly different results within such a short period of time (until 2020).

The most recent 2008-based regional population projections *Europop2008* (Eurostat 2010) show that population may increase in two out of three regions between 2008 and 2030. While the EU population is projected to rise by 5% between 2008 and 2030, there is considerable variation between the 281 regions in the study area. Population may increase in Cyprus, Luxembourg and Malta and in all regions in Belgium, Denmark, Ireland, the United Kingdom, Norway and Switzerland by 2030. Similarly, the most heavily populated regions of Austria, the Czech Republic, Spain, Finland, France, Greece, Italy, the Netherlands, Portugal, Sweden and Slovenia are projected to increase in population over the period. Estonia, Latvia and Lithuania and the majority of regions in Bulgaria, Romania, Germany, Hungary, Poland and Slovakia are expected to have a lower population by 2030. According to Europop2008, the regions with the highest population increase (more than 30% over the period 2008-2030) are in Ireland (the Border, Midland and Western region; and the Southern and Eastern region); the two Spanish coastal regions, the Algarve as part of Portugal; Cyprus and Oslo. The regions with a projected population decrease of more than 20% are Severozapaden in Bulgaria and Chemnitz, Sachsen-Anhalt, Dresden and Thüringen in Germany.

However, Eurostat's projections scenario is only one of several possible population change scenarios at the regional level based on certain assumptions concerning fertility, mortality and migration. As a result of the economic and sovereign debt crisis, such assumptions may prove futile. For instance, during the recent period of economic growth Ireland changed from an emigration to an immigration country in only a short period of time. The country was hit by the crisis very early and heavily, therefore migration flows quickly changed diametrically: foreign workers left the country; young, skilled Irish went , too; and older, less-educated people from abroad returned to their home countries. In terms of demography, it was almost a return to the starting point. Based on the Europop2008 projections the Webb classification has been recalculated for the year 2020 (Map 18). As can be seen it is probable that many regions in Central Europe, especially Western Germany, will switch from a growing to a shrinking population. The second notable change to the status quo is a growing population in most Northern regions. The degree of economic recovery is the main determinant of the scenarios. The dynamics of economic growth are reflected directly in the production process and in the utilization of the production factors. For example, by keeping the capital intensity constant, the scenario of sustainable recovery is associated with the strongest additional demand for labour.

Map 18 Europe and its neighbourhood: Components of population change 2008-2020 (Webb Classification)



Calculations: BBSR

The sluggish recovery with a low demand and the lost decade scenario would be attributed to stagnation or a decline in the labour market. The active population, as potential suppliers of labour, will react to this additional demand because of changing factor prices. Migration may be such a response. If migration will reduce an oversupply of labour in the regions of origin and, at the same time, will accommodate a demand in the regions of destination, migration will result in a win-win situation for both regions. If there are plenty of job opportunities in all regions, the regions will start competing for workers, with the result that the most prosperous regions will attract young, skilled workers with offers of higher wages and exacerbate shortage of workers in the regions of origin. This would worsen economic and territorial cohesion. A truly integrated growth would therefore require the possibility of opening the EU labour markets to the supply and demand from outside the EU so that skilled workers from non-EU countries may be recruited. However, with the lessons learned from the crisis, interpolations of future growth have to be interpreted carefully. The crisis hit the EU countries and regions in different ways, and any demographic effect related to the crisis will hit with a notable time delay and might be counterbalanced by new, unknown economic drivers until 2020, as the Irish example shows.

Table 10 gives a qualitative overview of the most probable demographic developments according to the three scenarios. From the “lost decade” to the “sustainable recovery”, it is the degree and the duration of the economic downturn that matters most for migration issues and which may then result in shrinking or growing regions. The natural development, in contrast, will not be notably influenced until 2020.

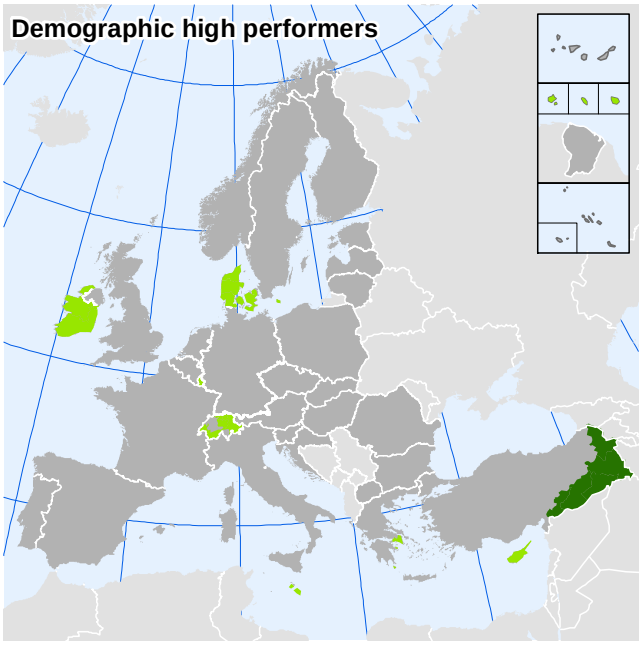
Table 10 Scenario overview for the demographic change challenges

scenarios	trends ↗ situation improves ➔ situation stable ↘ situation worsens	groups of regions ‘demographic high-performers’	‘immigration destinations’	‘balanced, demographic regions’	‘migration origins’
General demographic development					
Sustainable recovery	Depending on the countries’ speed of recovery, the return to the migration flows – especially the flow from Eastern to Western European countries – might start again. The UK regions might again become a main destination. This may also be the case for Germany, as the industrial effects of the crisis were limited there in comparison to other regions. In Ireland and Spain the construction industry which was hit by the real estate crisis probably remains weak. After the crisis, those regions might re-establish their role as migration destinations. Short term economic effects might reverse migration flows in the short term, the questions remains whether those will keep on or will change again with re-established economic development again.	↗	↗	➔	↘
Sluggish recovery	The remigration of foreign workers from Eastern Europe will last longer than in sustainable recovery and the countries and industrial sectors that formerly provided jobs are not able to create enough job opportunities in the mid-term. This may result in increasing unemployment in the home countries. The potentially reinforced territorial and regional disparities will in this case lead to an increased movement from the countries that are lagging behind towards those countries potentially able to offer job opportunities, depending on whether national economies will recover and if so, at what speed.	➔	↗	➔	➔
Lost decade	The remigration flows to the countries of origin in Europe might in general remain stable. National and regional disparities will increase due to a selective economic recovery in only certain countries. Selected countries suffering mainly from the export-based economic crisis, such as Germany, might recover to a certain extent in an otherwise challenging European economic situation. As a result, they might come into the spotlight as the remaining target countries for job-seekers. Countries which suffered considerable losses in the finance, real estate and sovereign debt crises might be potential areas of emigration in the case of overstrained labour markets and social systems.	➔	↘	➔	↗

Map 19 Mid-term scenarios for the demographic change challenge (following page)

Scenarios for the demographic change challenge

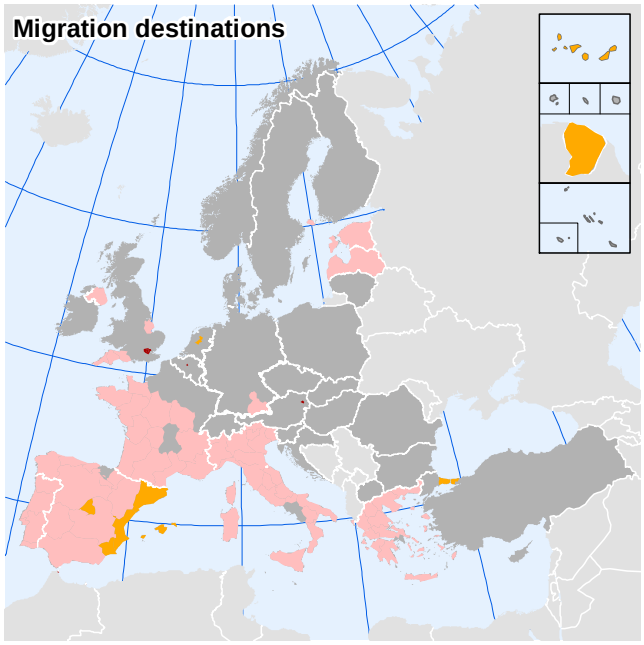
Demographic high performers



General demographic development

Western demographic high-performer
Turkish demographic high-performer
Other Group of Regions

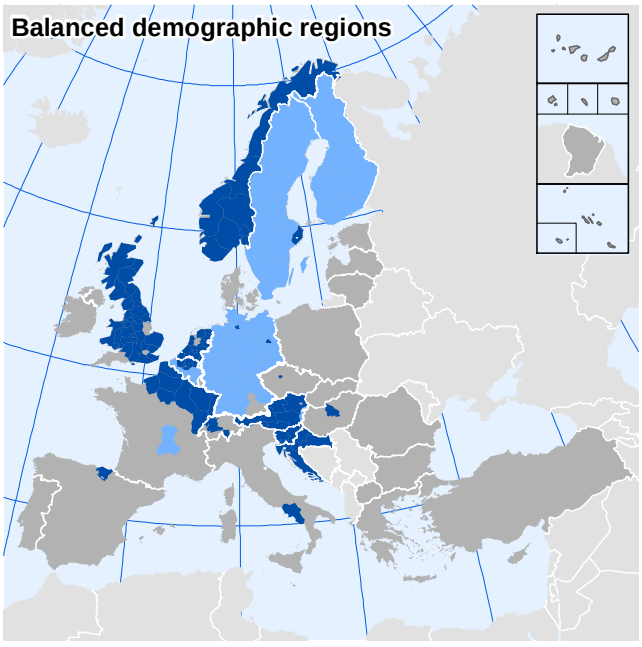
Migration destinations



General demographic development

Metropol. immigration destionations
Moderate-growth migration dest.
High-growth immigration dest.
Other Group of Regions

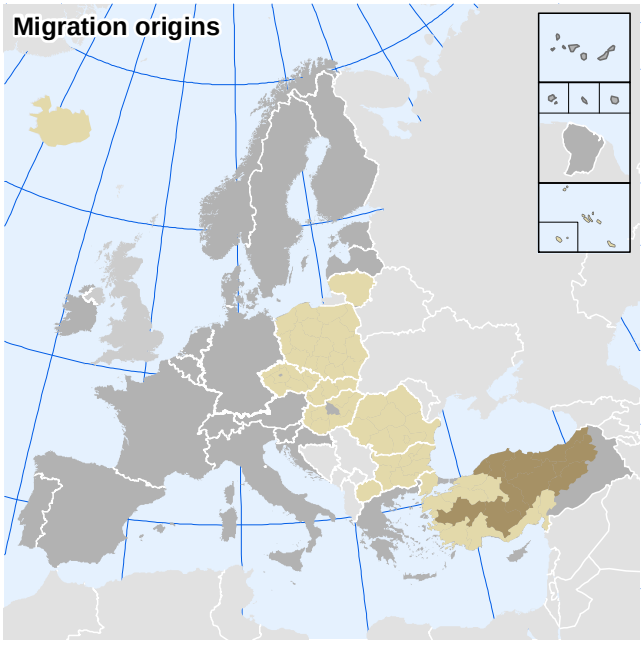
Balanced demographic regions



General demographic development

Balanced demographic regions ageing
Balanced demographic regions grwoing
Other Group of Regions

Migration origins



General demographic development

Easter migration sources and Iceland
Central Turkish migration sources
Other Group of Regions

Prospects 2020

Trends	Scenarios: Sustainable recovery	Sluggish recovery	Lost decade
Challenge increases	↗	↗	↗
Challenge constant	→	→	→
Chellenge reduces	↘	↘	↘
Unknown	?	?	?

Type of Region

Type of Region
Other Group of Regions
Neighbouring Countries

Kilometres
0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

Map developed by ÖIR
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Regional Challenges in the Perspective of 2020

The challenge of demographic change in a nutshell

- *Many regions in Western Europe have positive population developments; however, these are mainly due to migration flows from Eastern Europe, some, mainly in the Mediterranean countries, also to immigration from third countries which may result in increasing social polarisation. Sweden and Eastern Germany are threatened the most by shrinking populations.*
- *Ageing society remains one of the main threats Europe is facing in the mid-term. With only a few exceptions (eg. Ireland), the EU 12 will be facing severe problems in financing pension systems and supply infrastructures for the elderly if structural reforms will not take place. In the New Member States, age composition is more favourable today, but demographic projections show that similar problems will arise there with only a time lag. The increasing life expectancy, albeit a very positive development from a public health point of view, adds to this threat.*
- *Eastern European countries are the main sources of migration flows to the EU, albeit most of them still have a positive age composition. On the other hand, many Western European countries, most significantly France, Germany, Italy, Greece, Sweden and Finland, face severe challenges stemming from their ageing populations and will be confronted with high social and economic costs if they are not able to maintain their present workforce into the future.*
- *In the past, the closer European neighbourhood served as a migration source. Today it is different on account of a paradigm change in migration policies (and because of the new sources created by the recent enlargements). However, if further paradigm changes occur, these flows could be re-established.*
- *In the mid-term, natural population development will not change significantly in relation to post-crisis recovery. The situation is different for migration flows; for example, flows which until recently went from East to West have changed direction since the beginning of the crisis. This is a result of the fact that living and working in countries hit by the crisis has become less attractive. If the unfavourable economic situation persists, these backward streams will probably continue.*

6. Climate change

In contrast to the first two challenges analysed, climate change does not only influence the human sphere but the entire global ecosystem. It is a global threat the importance of which grows over time, as long as green house gas (GHG) emissions are not reduced to permissible limits. The effort needed to reach the goals indicated by climate science is enormous and the main burden lies in the hands of the industrialised countries. Mitigating climate change therefore requires significant contributions from Europe and its regions. Ongoing and future climate change affects Europe in many different ways and in all economic sectors. Exposures and impacts differ by region, but all regions need to adapt to inevitable changes. Many of the impacts are detrimental in most regions and need to be alleviated, but some offer new chances for some regions. However, even adapting to threats can offer chances for new jobs, products or services. Thus the climate change challenge consists of two main parts: the challenge to mitigate and the challenge to adapt. The European Union has addressed both challenges in a series of papers and policies. Among the most important are “Europe's Climate Change Opportunity” (COM/2008/0030) and “Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community’s greenhouse gas emission reduction commitments up to 2020” on the mitigation side and the EC White paper on adaptation “Adapting to Climate Change: Towards a European Framework of Action” (COM/2009/147) on the adaptation side. First steps towards establishing a Climate Change Adaptation Clearing House are underway.

Climate change includes gradual climatic changes like increases in mean and maximum temperatures, changes in precipitation amounts and patterns, and rising sea level, as well as the frequency and intensity of extreme events like droughts, heat, floods or mass movements (e.g. mud slides, avalanches) and storms. Gradual climate change will not be of very high relevance for Europe until 2020, and confidence in the related scenarios is higher than for the extreme events. Most model results indicate that the present character of climate change will continue to the middle of the century. Therefore, even if not dramatic within the time frame addressed in this study, indicated trends in the following sections give a feeling for the trends to be expected beyond 2020. The issues treated in the chapter “Climate Change” are adaptation issues. Mitigation is covered by the challenge sustainable, secure and competitive energy: *Energy demand*.

Primary climatic stimuli affect different natural and human systems to a varying extent. Climate change impacts directly on natural as well as human systems, whereas human systems are also frequently influenced indirectly by the impacts on natural systems (e.g. glacier melt or forest dieback). Topics frequently addressed in adaption research are biodiversity, forestry, agriculture, fisheries, tourism, insurance, energy, water management, human health, urban and coastal areas, mountain areas and the cryosphere. It is often impossible to draw a precise line between these sectors. In carefully selecting key issues to be analysed in this study, four essential aspects were taken into account: the importance for the survival and wellbeing of humanity, the relevance from the economic point of view, the sensitivity towards climate change and the availability of sufficiently acceptable data. These criteria resulted in the selection of the topics elaborated below.

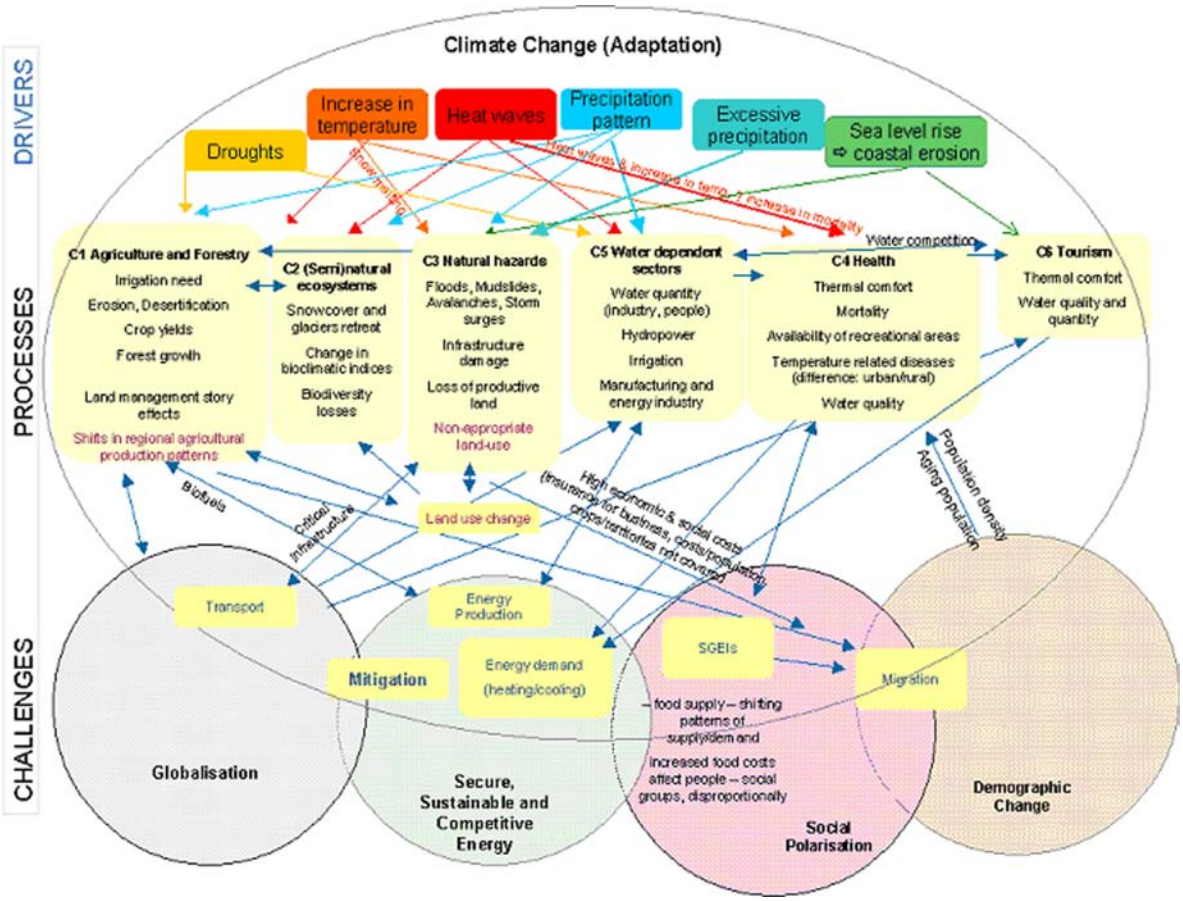
Two key issues that describe the change of biological systems have been included. Although only a small sector of the economy in the EU, **agriculture and forestry** feed the world and are gaining importance in the fibre and energy sector. Biomass production as a parameter to define the health of managed ecosystems is thus an important parameter. Biomass production is highly sensitive to climate change: scarcity of green water – the portion of rainwater that infiltrates into the soil and that is effectively used for crop and forest growth (Falkenmark, 1993) –already makes it costly to sustain agricultural production in some southern regions. Recently a study on a safe operating space for humanity (Rockström et al. 2009) showed that the extent of biodiversity loss in **natural and semi-natural ecosystems** probably poses one of the most serious threats to the global ecosystem. Although the value of ecosystem services does not show up explicitly in standard economic parameters, a UNEP report on The Economics of Ecosystems and Biodiversity indicates that – on a global scale – the value of biodiversity is roughly equivalent to the entire annual Gross World Product ($58 trillion in 2008). Climate change and poorly considered efforts to mitigate it can considerably enhance biodiversity loss.

Natural hazards caused by excessive precipitation and coastal threats such as floods, and hail are central in the public perception of climate change. They also can have considerable economic impact. Taken account of in this study are increasing frequency of floods, mud slides, inland storms and storm surges due to sea level rise. Small scale events, such as hailstorms or tornados cannot be reliably addressed at the European scale. A special case of natural hazards are **heat waves**. They range amongst the most consequential events concerning human comfort and sustained health over larger areas and longer periods of time and are expected to become more important with climate change.

Even though all climate change impacts have indirect economic effects, the direct impact on secondary and tertiary economic activities is given special consideration. **Water dependent sectors** are closely linked to climate change. While scarcity of green water impacts on vegetation, scarcity of blue (surface) water poses problems for irrigation as well as industrial processes and domestic supply. For instance, in the very hot and dry year of 2003 power plants were forced to shut down due to lack of cooling water. Weather changes have a push and a pull function on **tourism**. With climate change both the tourist push from the northern regions and the pull of the southern regions in Europe will decrease.

Climatologic indicators suited to describe climate change exposure for the different challenges is difficult to select, if the number of indicators is to remain small, the quality of the data is to be high and data are to be available across all regions. This might be the reason why many previous studies essentially did not make use of any direct climatic data. In this study the attempt was made to use climatic indicators, taking account of the above requirements. Some of the indicators proposed are direct meteorological parameters, such as temperature or precipitation changes, others are indicative of climatic conditions, such as crop yield variance and the occurrence of forest fires.

Figure 10 Systemic overview of climate change issues



Agriculture and forestry conditions

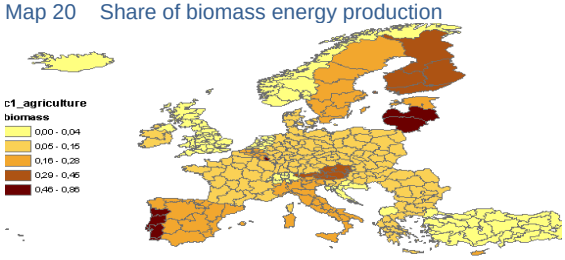
Agriculture is our source of food and an important economic factor in some regions of Europe and its neighbouring countries. However, in most regions the employment and GVA produced by agriculture and forestry are more dependent on global commodity markets and policies than on climate. Both agriculture and forestry are gaining importance in the fibre and energy sector and both are highly sensitive to climate change. Agriculture and forestry are directly exposed to climate change, e.g. temperature increases or shifts in precipitation patterns. The sensitivity of the region depends on the importance of these sectors for that region. Adaptive capacity depends on the willingness and capacity to respond to climate change, i.e. the possibility of changing or diversifying the cultivation. Growing urbanisation, as a consequence of globalisation, can lead to loss of land for agriculture and cheap food imports can trigger the abandonment of agricultural land. On the other hand, high energy prices and transportation costs can boost regional production and employment in agriculture and forestry.

The indicator system for regional vulnerability

A multitude of meteorological parameters would be needed to explicitly describe the **exposure** of the numerous crops produced in the European regions. However, the indicator chosen, *variability of crop yields,* which is defined as the standard deviation of agricultural yields 1998-2008, is an integrative indicator for the effects of climate change. It is independent of the choice of cultivar, way of cultivation and resilience of cultivated landscape. The hypothesis behind this is that plants react more strongly to inter-annual variability of weather the farther they are from their climatic optimum. A further climate shift will put them at higher risk. An appropriate indicator for exposure of forestry would be forest growth rates. However, these data are not available regionally. Nor are appropriate drought indices available. Therefore a less direct indicator was chosen: *forest fire hazard*. This indicator was based on a classification created by the ESPON project 1.3.1. This ordinal classification displays forest fire hazard as a combination of the natural forest fire potential (derived from bio-geographic regions) and actually observed forest fires (satellites).

The biological **sensitivity** of crops is implicitly included in the indicator chosen for exposure; therefore only economic indicators are addressed. The *number of people employed in agriculture* and the *share of agriculture and forestry in the GVA* indicate the economic and social sensitivity. The *share of biomass energy production* of the total energy production addresses the specific importance of biomass production as energy carrier and thus is an important development aspect of these sectors. In this study the indicator *farmers with other gainful activity* is used for **adaptive capacity** as a measure of how easily farmers can switch to other activities. On the whole, the more important a sector is for a region, the more likely support for adaptation measures will be made available. On the other hand, it is often the agricultural areas that lack the financial background to give the necessary support. Improved indicators for the vulnerability of agricultural and silvicultural systems with regard to climate change might be found in the ongoing study 'Impacts of Climate Change on Agriculture' presently being realised by DG Agriculture and in the final report of the project 'Silvistrat'. Also, the reports on the implementation of European policies for soil protection—the Soil Thematic Strategy COM/2006/231and the Soil Framework Directive COM/2006/232—could deliver useful indicators in the future.

Map 20 Share of biomass energy production



Source: Primes (2010)

Table 11 Indicators used for 'Agriculture and forestry conditions' vulnerability in NUTS 2 regions

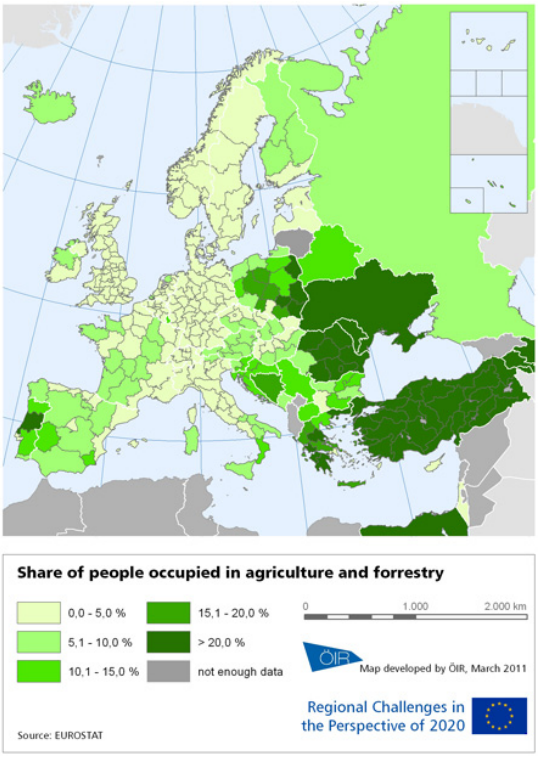
	Indicator	minimum	mean	maximum	SD.
Exposure	Inter-annual variability of crop yield	0.00 (Região Autónoma da Madeira, PT)	5.64	42.87 (Provincia Autonoma Bolzano/Bozen, IT)	4.24
	Probability of forest fire hazard	1 (various regions)	2.24	5 (various regions)	0.96
Sensitivity	Share of employment in agriculture and forestry %	0% (various regions)	7.70%	43% (Nord-Vest, RO)	8.50
	Share of agriculture and forestry in GVA	0.02% (Région de Bruxelles, BE)	3.44%	16.98% (Severozapaden, BG)	3.29
	Share biomass energy production	0% (Malta, MT)	15.56%	86.24% (Latvia, LV)	13.99
Adaptive capacity	Farmers with other gainful activity	0% (Prov. Hainaut, BE)	36.96%	81% (Zahodna Slovenija)	13.35

Neighbouring countries and cross-border effects

In the closer European neighbourhood, there are many regions where agriculture is of more importance for the national GDP than in most EU regions (cf. Map 21). In some areas, particularly in Europe's southern neighbourhood, it is projected that agricultural and silvicultural production will be threatened by increases in temperatures and declines in fresh water resources. Many of these countries' agricultural sectors are already experiencing significant pressures on account of water scarcity.

Regarding specific crop yields, studies indicate that the impacts of climate change will have different effects both regionally and across species. For instance, some countries in Eastern Europe and in the Caucasus expect to benefit in part from warmer temperatures. But consequences of climate change also include the likelihood of damages caused by storms, destruction caused by forest fires, and drought. Precipitation levels are expected to decline, but also to increase in intensity. Changes in the soil on account of the changing climate will lead to increased erosion, which will further negatively impact agriculture.

Map 21 Europe and its neighbourhood: share of agriculture and forestry in employment



Desertification will increase in many regions: e.g. in the Middle East and North Africa, as well as parts of Georgia, Armenia and Azerbaijan and will also affect some EU member states such as Spain. In Egypt, the fertile Nile Delta also faces salinisation due to sea level rise. Egypt's fast demographic growth increases the need for agricultural products, while at the same time the reduction of arable areas aggravates the dependency on food imports and causes a rise in food prices, a reason for ongoing social unrest. Due to reduced income from oil exports, government subsidies can no longer compensate for these rises. For climate change issues one cannot expect that developments in neighbouring countries' primary sector will affect European regions. It is much more likely that migration pressure from some of these countries will increase (cf. section 'demographic change').

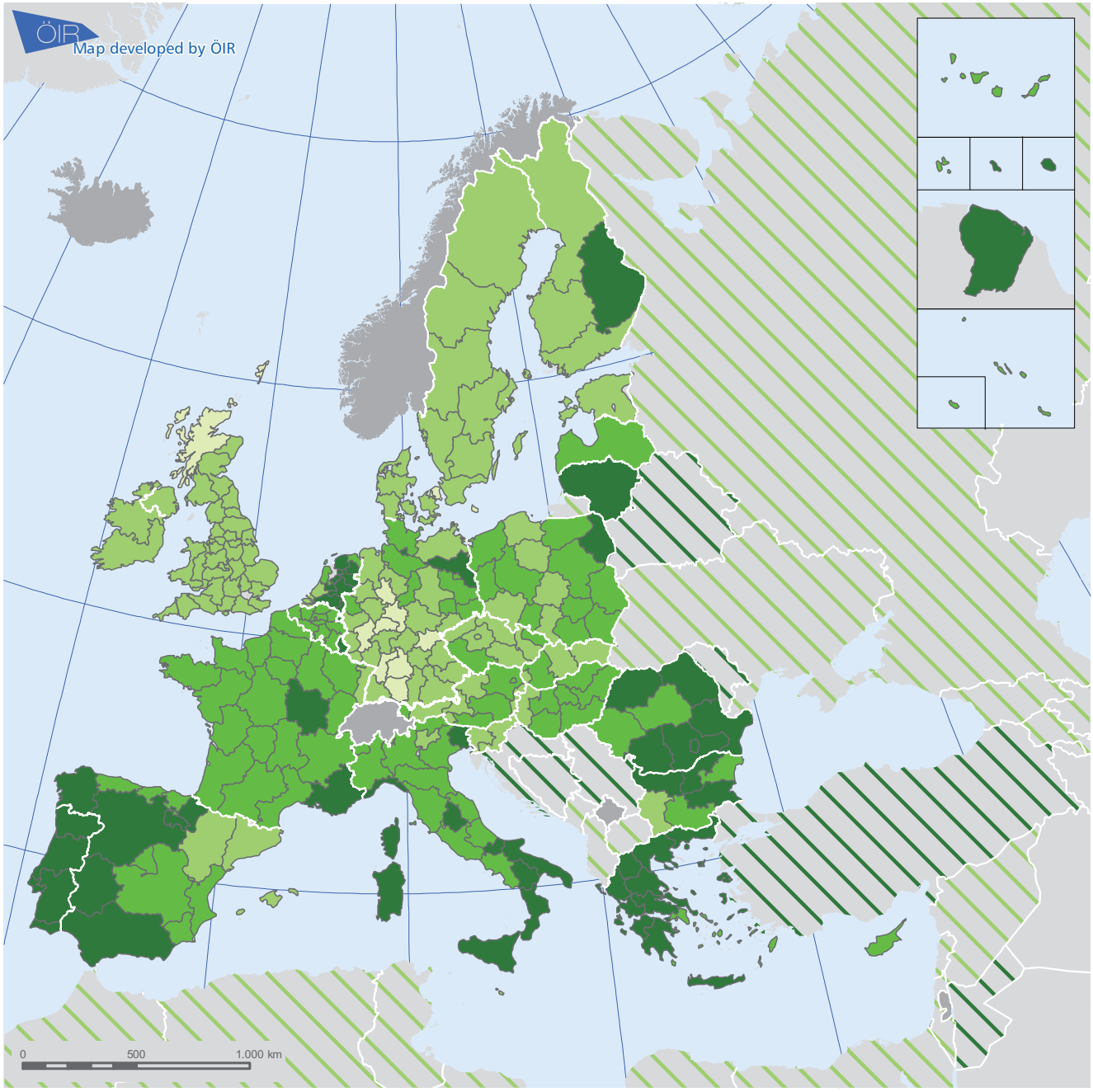
The vulnerability map

As is indicated in Map 22, the Southern and Eastern regions are most affected in terms of agriculture and forestry. The high impact is mainly due to the higher proportion of agriculture in the local employment structure and income of the affected regions. In the south and south-east a mixture of high climate change impacts and the relative importance of agriculture is the trigger. The high forest fire risk in the South poses an additional risk to these regions. Other vulnerable regions include Flemish, Dutch and French regions where very industrialised and specialised agriculture prevails. This specialisation leads to higher sensitivity towards any external shock (especially technological hazards). It is also observable that regions with high economic progress and insignificant agricultural production like parts of Western Germany or the UK are less challenged. The high vulnerability of Lithuania, Latvia and Luxembourg is due to their high percentage of biomass energy production of total energy production.

The agricultural and silvicultural sectors of Europe's neighbours are generally speaking more sensitive to the impacts of climate change than their European counterparts. This is partly due to pre-existing conditions that will worsen with climate change, e.g. water scarcity in the Maghreb, desertification and increasing erosion. In addition, a large portion of the neighbourhood is characterized by lower GDP levels and larger population segments that are dependent on agriculture for their livelihoods.

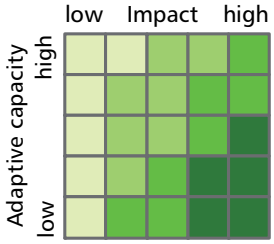
Map 22 Key vulnerability 'Agriculture and forestry conditions' (following page)

Agriculture and forestry conditions - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Interannual variability of crop yield
- Probability of forest fire hazard
  (Source: ESPON 1.3.1., GTK) Indicators describing sensitivity:
- Share of employment in agriculture and forestry
- Share of agriculture and forestry in GVA
- Biomass energy production (Source: Primes)

Indicators describing adaptive capacity:
- Farmers with other gainful activity (Source: DG AGRI)

Neighbouring Countries
(simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Interannual variability of crop yield

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

Natural and semi-natural ecosystems

The extent of biodiversity loss probably poses one of the most serious threats to the global ecosystem. Ecosystem functions are an important asset for economy, even if generally not considered explicitly in economic theory. Natural and semi-natural ecosystems are threatened by climate change mainly when changes in precipitation and vegetation periods occur. Natural systems are influenced by practically all aspects of climate change, but some, such as reduced precipitation in certain seasons, changes in annual temperature and changes in days that allow plant growth might be more general in their effect than others, such as duration of heat waves or storm frequencies. The effects are changes in size, distribution and quality of habitats as well as shifts in the phenology of plants and animals. Sensitivity again has the two components, the biological and the economic one.

The indicator system for regional vulnerability

The indicators used in this study are based on past climate change, assuming that trends give an indication also for future climate change until 2020. For **exposure**, the *difference of summer to annual precipitation ratio* (1961-1990 mean to 1980-2009 mean) was chosen to indicate the availability of water during the growing season. The *change in vegetation days* and the *30-year mean temperature difference* (1961-1990 mean to 1980-2009 mean) are also indicators of gradual change rather than the increase of extreme events. Longer term averages (30 years) of observed data are used to eliminate short term fluctuations. The *loss of natural, extensive to artificial, intensive areas* is depicted by the percentage of country surface changing from the Corine land cover code 231-523 (water bodies, wetlands, forest and semi-natural areas, heterogeneous agricultural areas and pastures) to 111-223 (permanent crops, arable land and artificial areas). The *loss of vegetated surface* to urban areas, roads and other infrastructure, etc. is described by the percentage of surface changing from the Corine land cover code 144-523 (water bodies, wetlands, forest and semi-natural areas, agricultural areas and artificial, non-agricultural vegetated areas – green urban areas and sport and leisure facilities) to 111-131 (urban fabric, industrial, commercial and transport units, mines, dump and construction sites). In both cases the land use changes observed between 2000 and 2006 were used. These land-use changes are neither climate change driven, nor do they necessarily have an impact on the climate change sensitivity of a region. As a rule, however, managed ecosystems tend to be less resilient than natural ones, e.g. natural forests have a high capacity to store water and therefore reduce risk of flooding in case of heavy precipitation. Land use change also affects GHG emissions, as the change from forests to pasture and from pasture to ploughed fields generally reduces the carbon stored in the soil, especially if conventional fertilizers and pesticides are applied.

There is no suitable indicator to measure the biological **sensitivity** regarding climate change for the wide range of different ecosystems and exposures. The relevance of climate or land-use-change induced changes in natural and semi-natural ecosystems increases with the amount of mostly undisturbed, semi-natural or natural land. This is characterized by the *share of Natura 2000 areas*. Where this data has not yet been officially delivered to DG Environment, nationally available information about Natura 2000 areas is used.

The *sufficiency index* describing the state of progress in reaching the Habitat Directive is used as an indicator for **adaptive capacity**.

Other possible indicators might refer to Natura 2000 targets, the convention of biodiversity, environmental impact assessment (EIA) and strategic environmental assessment (SEA). However, none of those available now are considered more suitable than the two that were selected.

Table 12 Indicators used for 'natural and semi-natural ecosystems' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	Difference of summer to annual precipitation ratio	-0.86 (Antalya, TR)	-0.02	0.25 (Voreio Aigaio, GR)	0.10
	Vegetation days change	-11.83 (Balikesir, TR)	7.51	15.39 (Western, IE)	5.36
	30-year mean temperature difference	-0.16 (Kirikkale, TR)	0.57	0.86 (Prov. Limburg, BE)	0.18
	Loss of natural, extensive to artificial, intensive area	0.00 (various regions)	128.45	35,572.94 (Melilla, ES)	1,995.04
	Loss of vegetated surface	0.00 (various regions)	14.99	359.67 (Melilla, ES)	30.69
Sensitivity	Share of Natura 2000 areas	0% (various regions)	14%	74% (Canarias, ES)	13
Adaptive capacity	Sufficiency index	16.98 (Podlaskie, PL)	89.05	100 (various regions)	20.31

Neighbouring countries and cross-border effects

Countries in the Maghreb expect a shifting of ecosystems towards the north on account of increasing temperatures and the progressive desertification of territory, which will also affect some southern EU member states (e.g. Spain) as well as neighbouring countries to the East (e.g. Armenia). An increase in the occurrence of wildfires will have consequences for a number of ecosystems in all of Europe's neighbouring countries. Moreover, climate change will lead to an increase in parasites and pests, which will render certain ecosystems more vulnerable. Some countries, such as Turkey, are expecting an increase not only in plant pests, but also in animal diseases. In Armenia, forests will be affected to varying degrees; however, an overall reduction in forest areas is expected. Forest ecosystems in South-Southeast Europe, for instance in Bosnia and Herzegovina, will sustain direct climate change impacts through temperature and precipitation changes increased atmospheric concentrations of CO2—which can affect tree growth and water use—, altered fire regimes, and changes in the range and severity of pest outbreaks. Low coastal areas of neighbouring countries, e.g., coastal sands and estuaries, will be directly exposed to the impacts of sea level rise. Coastal and marine ecosystems, including river deltas, on the Black Sea will also be adversely affected by sea level rise. As is the case in other mountain regions of the world, rising global temperatures are contributing to the retreat of the Caucasus glaciers. This process is reflected in the Georgian glaciers of Kvemo Svaneti, which is causing changes in river run-off.

In general, all of Europe's neighbours in the scope of this study will be impacted to varying degrees by accelerated and high rates of evaporation, surface erosion caused by water, landslides and soil salinisation. Europe's neighbours on the southern and eastern shores of the Mediterranean, already exposed to varying degrees of desertification and soil salinisation, are particularly sensitive to increases in these processes. Egypt, with a population of more than 80 million, the majority of which depend on the Nile River, faces serious challenges due to sea level rise and/or decreasing discharge of the Nile. Adaptive measures needed to maintain ecosystems will require both material and knowledge resources. Efficient, integrated water management, adaptation of agricultural management practices, and pest and disease control are some of the measures necessary. However, in many cases research experiments and new knowledge will be needed to address the issues at hand. Due to the neighbouring regions' lower levels of income and limited research capacities; it will be difficult for them to meet the myriad challenges facing their ecosystems. In addition, some changes cannot be halted through adaptation measures, but rather through worldwide mitigation of climate change (e.g. glacial retreat in the Caucasus and changes in snowpack and snowmelt in the Atlas Mountains).

The vulnerability map

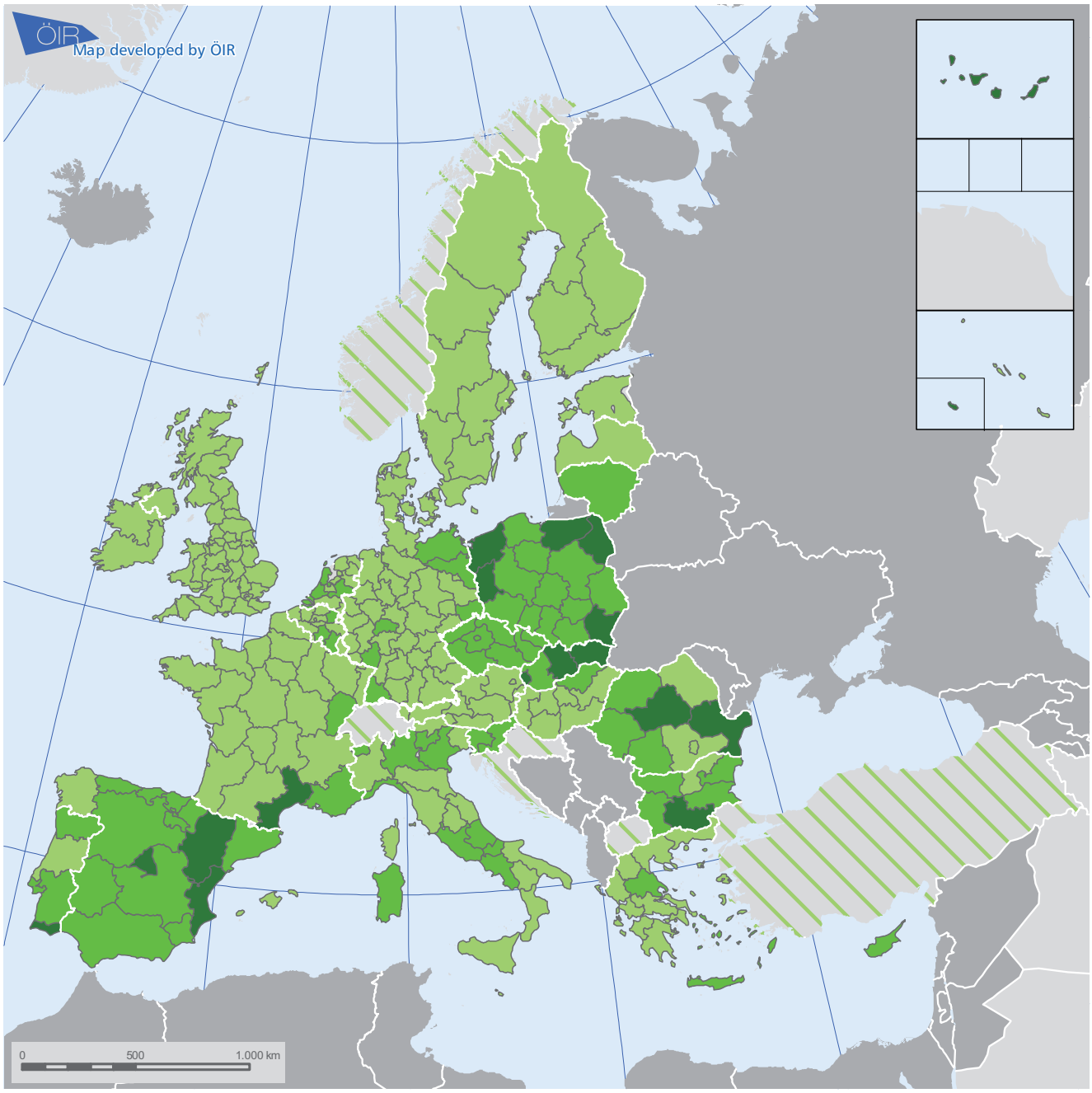
As the indicators for (semi)natural ecosystems are very diverse and their distribution varies greatly, most of them are not dominant in the combined indices for impact and adaptive capacity. The change of summer to annual precipitation ratio varies only very slightly across Europe – from higher exposures in the South to a relaxation in the North. The increase in vegetation days shows a different picture: central Spain as well as Central Europe up to the North Sea, including Denmark and even the British Islands, record the highest change in vegetation days. Annual temperature increase affects most of Europe in a very complex pattern. Loss of natural land is happening most intensely and widespread in Ireland, Spain, West of France, Turkey, Hungary, South of Finland and many other more distributed regions in the rest of Europe. Loss of vegetated surface is happening mainly around existing urban agglomerations like Istanbul, Madrid, Paris, Budapest and Lisbon and densely populated areas like in the Netherlands, around Valencia and Portugal.

Combined, all these indicators result in low impacts only in the UK, Latvia and Southern parts of Sweden and Finland. These are counterbalanced, however, by a relatively low adaptive capacity (as defined by the selected indicators). Climate change in this key issue mostly affects regions that are characterised by large changes of annual temperature and amount of vegetation days in the last several decades, such as the Mediterranean regions. Regions with large percentages of Natura 2000 areas, such as Spain, and parts of Poland, Bulgaria; Romania and the Western Mediterranean coast, are more sensitive to these exposures and reinforce the impact.

In the vulnerability map, the neighbourhood policy countries could not be included because of a lack of reliable long-term climate data.

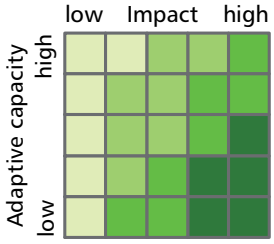
Map 23 Key vulnerability 'Natural and semi-natural ecosystems' (following page)

Natural and seminatural ecosystems - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Difference of summer to annual precipiation ratio (Source: E OBS)
- Vegetation days change (Source: E OBS)
- Annual mean temperature difference (Source: E OBS)
- Loss of natural, extensive to artificial, intensive area (Source: Corine)
- Loss of vegetated surface (Source: Corine)

Indicators describing sensitivity:
- Share of Natura 2000 areas (Source: DG Envi)

Indicators describing adaptive capacity:
- Sufficiency index (Source: DG Environment)

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Difference summer/annual precipiation ratio (Source: E OBS)

Regional Challenges in the Perspective of 2020

Natural hazards and coastal threats

In this part of the vulnerability analysis the extreme weather events that tend to become more frequent and/or more intense with climate change are addressed, focusing on the increasing frequency of floods, mud slides, inland storms and storm surges due to sea level rise. Floods can be triggered by excessive precipitation due to local thunderstorms, larger scale frontal passages or typical weather patterns, such as the Genua cyclone that deposits moisture from the warm Mediterranean along its path from Northern Italy to Poland and Germany.

Rising temperatures can enhance flood risks, as the rising snow line means that a larger portion of the precipitation will fall as rain and produce almost immediate run-off in the valley that would otherwise only have reached the water bodies gradually. There is still some debate on the long-term change in frequency of winter storms and storm surges and their relation to climate change, but the general expectation is that these kinds of event will occur more frequently as climate change progresses. Extreme events generally affect infrastructure and also frequently cost human lives. The damage of critical infrastructure by natural hazards can affect transport and therefore supply chains across regions, countries or considerable parts of Europe.

The water dependent sectors can also suffer infrastructure damage or at least loss of productivity due to the necessity to take protective measures. In regions with severe and frequent damage, the high economic and social costs of having insurance to cover the damage on crops, houses and infrastructure could trigger regional or supra-regional migration. However, most natural hazards are not only an effect of climate change. Inappropriate and careless land use, like the allocation of building land in areas endangered by river or coastal flood and landslides, sealing of unsealed areas, deforestation of protective forest areas on steep slopes or cultivation of monocultures greatly enhance the risk of natural catastrophes occurring. This shows that there are generally at least two components to exposure: weather situations and the characteristics of the affected area.

The indicator system for regional vulnerability

The events mentioned and their causes have been analysed in the ESPON 2006 project 1.3.1. European regions where classified in categories of natural disaster hazard. The categories of *occurrence of landslides*, *storm surges*, *winter and tropical storms* in Europe are used as a part of the indicator system for **exposure**. Inland floods and coastal floods are more relevant in densely populated areas. Therefore an integrated flood indicator is used which includes the flood risk and the population density in the affected areas: *physical exposure to floods* from UNEP (*GIS processing UNEP/GRID-Europe, with key support from USGS EROS Data Center, Dartmouth Flood Observatory* 200)"[3]

Some regions have already implemented *coastal protection measures* (e.g. sea walls in the Netherlands, London or Venice). Additionally some urban agglomerations that are endangered to be affected plan the construction protection measures. The GIS data set of existing embankments and dykes produced by the project Eurosion was integrated as indicator of (reduced) **sensitivity** in this study. The Flood Directive 2007/60/EC calls for a preliminary flood risk assessment to be produced by the EU member states by 2011, which will be succeeded by flood risk maps by 2013 and flood risk management plans by 2015 in EU member states. Once available, these data will be valuable as indicators for sensitivity to river floods.

The *disposable income* is used as indicator for the **adaptive capacity** on regional level, especially for private adaptive capacity. It is assumed that regions with high disposable income can more easily afford private adaptation and protection measures. Additionally the *GDP* is an important indicator for the funds available for public investments. Other indicators concerning the implementation of EU policies like the floods directive (2007/60/EC) and marine strategy framework directive (2008/56/EC) or information about how land use planning would be useful, but data are not available yet.

[3] *It is based on four sources: 1) A GIS modelling using a statistical estimation of peak-flow magnitude and a hydrological model using HydroSHEDS data set and the Manning equation to estimate river stage for the calculated discharge value. 2) Observed flood from 1999 to 2007, obtained from the Dartmouth Flood Observatory (DFO). 3) The frequency was set using the frequency from UNEP/GRID-Europe PREVIEW flood data set. In area where no information was available, it was set to 50 years returning period. 4) A population grid for the year 2007, provided by LandScanTM Global Population Database (Oak Ridge, TN: Oak Ridge National Laboratory). Unit is expected average annual population (2007 as the year of reference) exposed (inhabitants). This product was designed by UNEP/GRID-Europe for the Global Assessment Report on Risk Reduction (GAR) and modelled using global data.*

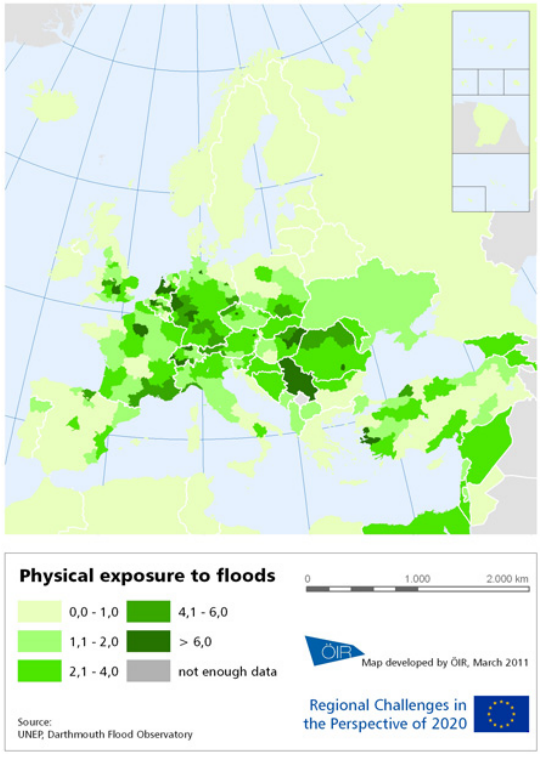
Table 13 Indicators used for 'natural hazards and coastal threats' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	Winter and tropical storm hazard potential	1 (various regions)	3.17	5 (various regions)	1.59
	Physical exposure to floods	0.00 (various regions)	2.37	36.91 (Zuid-Holland, NL)	3.67
	Occurrence of landslides	0 (various regions)	0.59	1 (various regions)	0.49
	Occurrence of storm surges	0 (various regions)	0.61	5 (various regions)	1.48
Sensitivity	Existing coastal protection measurements	1 (various regions)	2.32	5 (various regions)	0.96
Adaptive capacity	Disposable income of households, net (uses)	1,651.70 (Severozapaden, BG)	14,589.99	46,708.12 (Nordwestschweiz, CH)	7,387.25
	GDP per capita	2000.00 (Van, TR)	23,805.14	96,000.00 (Inner London, UK)	14,279.77

Neighbouring countries and cross-border effects

Europe's neighbours will be affected to varying degrees by a range of natural hazards, including dangers of floods (see Map 24), droughts, wildfires, avalanches and landslides, desertification and storms. Those hazards caused by excessive precipitation and/or coastal threats will be present in all neighbouring countries, however their effects will differ. Periods of excessive precipitation are expected to cause occasional flooding in the Maghreb – Morocco, Tunisia and Algeria – and in Turkey. The flooding, coupled with the otherwise higher average temperatures, will contribute to increasing erosion, which will result in, for example, the acceleration of processes of desertification as well as damages to agriculture.

Map 24 Europe and its neighbourhood: Physical exposure to floods



Egypt expects that an increase in the intensity and frequency of extreme events will *"affect the coastal zones […] and extend over the whole country as well as across the Mediterranean" (Egypt's Second National Communication to the UNFCCC, p. 88).* An increase in Saharan dust and heat is also expected, as well as in the intensity and frequency of marine storms.

Neighbours to Europe's East and South-Southeast will face similar challenges. Both Georgia and Albania must expect a rise in the occurrence of droughts and heat waves, while in Moldova and Bosnia and Herzegovina more flooding will probably be experienced. Many of Europe's neighbours, particularly in rural regions, currently lack the infrastructure to deal with many of these hazards. With this in mind, Europe's neighbours will potentially face considerable impacts in the areas of health, agriculture, the economy and rural and/or socially marginalized communities.

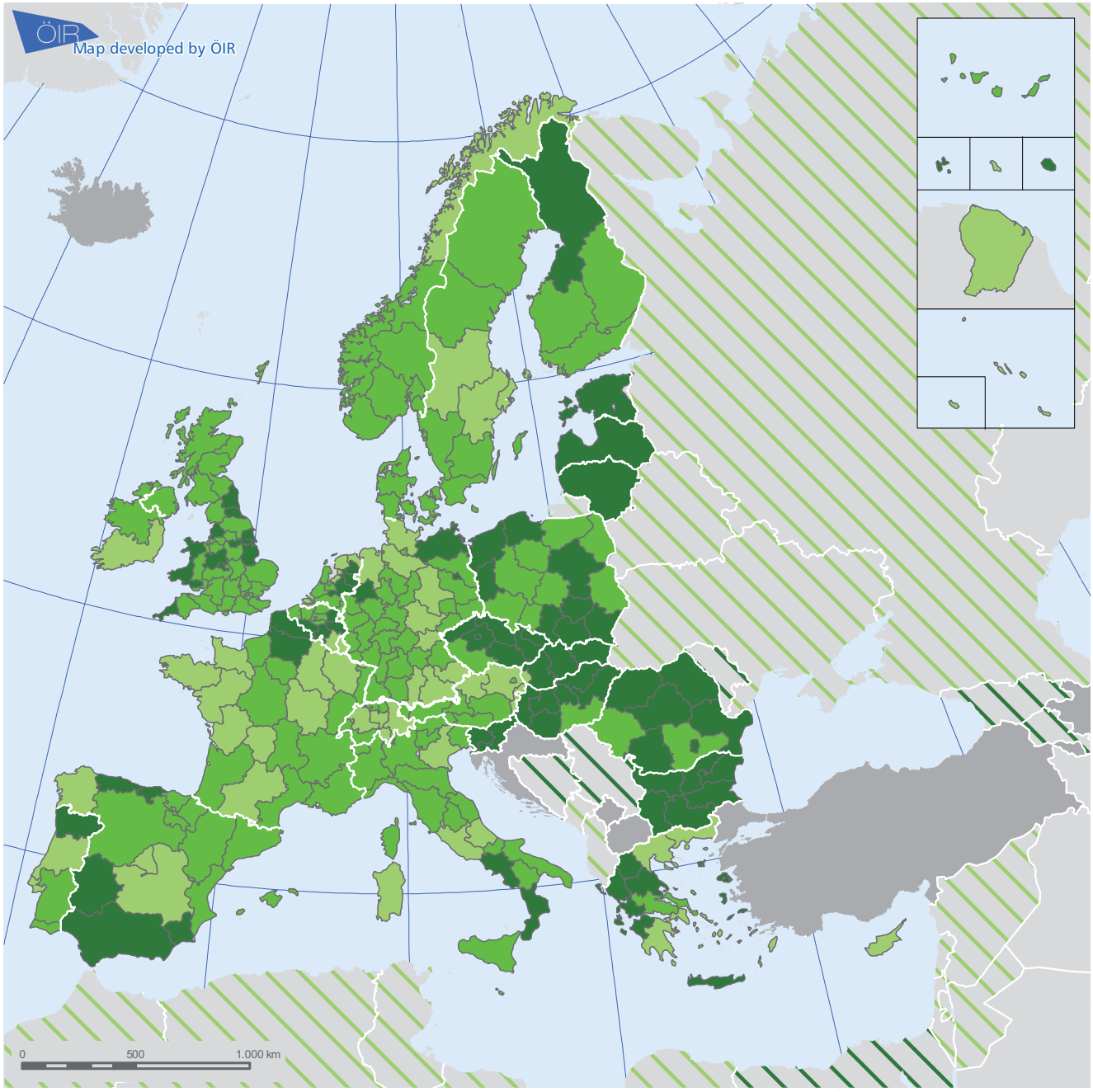
The vulnerability map

Presently the flood risk is highest along the Rhine valley and the border between Hungary and Romania. Winter and tropical storms have their highest probability in the north-western regions (British Isles and beginning from the whole European Atlantic coast north of Portugal, regions in Northern Germany and Poland bordering the Baltic Sea). The winter storm probability is slowly declining from the North-West towards the South-East, with still medium probability in, for example, the Provence and Vienna.

Storm surges can occur on the east coast of Great Britain and in most regions bordering the North and Baltic Sea, and the north coast of Sweden and Finland bordering the Gulf of Bothnia. Also Liguria, Veneto, Friuli-Venezia Giulia, Istria as well as central Portugal are threatened. The occurrence of landslides is scattered over all of Europe, depending on topography, land use and precipitation patterns.

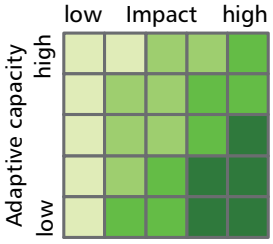
Map 25 Key vulnerability 'Natural hazards and coastal threats' (following page)

Natural hazards and coastal threats- Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Occurrence of winter or tropical storms (Source: ESPON 1.3.1)
- Physicial exposure to floods (Source: UNEP)
- Occurrence of landslides (Source: ESPON 1.3.1)
- Occurrence of storm surges (Source: ESPON 1.3.1)

Indicators describing sensitivity:
- Existing coastal protection measurements (Source: Eurosion)

Indicators describing adaptive capacity:
- Disposable income of housholds, net (EUROSTAT)
- GDP per capita (EUROSTAT)

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Physical exposure to floods (UNEP, Darthmouth Flood Observatory)

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

Figure 11 Damaged road surface near Petrosani, RO

Source: DG Regio

The aggregated vulnerability has no clear regional focus. Most countries have at least one region that is affected by some form of natural hazard. Coastal regions tend to be more exposed to natural disasters as well as rather densely inhabited mountainous regions and flood plains. On the British Islands and in Norway, the winter storms and additional landslides are causing the main threats. The North Sea regions suffer from storm surges and winter storms. North and South of Sweden and Finland, Estonia and the German and Polish Baltic sea regions, Central Portugal and Liguria suffer mainly from storm surges. The many vulnerable regions in Eastern Europe are, except for the main river basins that are exposed to floods, vulnerable due to their weak adaptive capacities.

The neighbouring countries' vulnerability score is only of limited validity due to lack of reliable data on extreme events. Only the exposure to floods is included (cf. Map 24), in which the Caucasus and Egypt are the more exposed countries.

Health and heat waves

There are many ways in which climate change affects health: the WMO differentiates between direct effects, especially heat and cold, and indirect effects, e.g. due to changes in habitats of vectors of diseases or effects of extreme events. Indirect effects, with few exceptions, are not yet sufficiently researched to allow for regional mapping across Europe, suitable indicators do not exist. Therefore this section focuses on the increasing thermal stress caused by climate change and urban heat islands. The corresponding reduction of risks due to less frequent cold periods must be taken into account when interpreting the results. Heat wave vulnerability is strongly connected to 'Access to SGEIs' in the challenge social polarisation. It is influenced by demographic developments (e.g. population density or share of elderly that can aggravate the effects of thermal stress) and will result in higher energy demand for cooling.

The indicator system for regional vulnerability

Exposure consists of elements of climate itself as well as some consequences of climate change.

As explained in the introductory section, the analysis concentrates on heat indicators. The rising number of *heat days* (air temperature rises above 30°C) and *tropical nights* (minimum air temperature does not drop below 20°C during the night) in vast areas of Europe cause heat stress and heat mortality during the summer months in many regions. The lack of cooling during the night aggravates the heat stress of the day. However, temperature increase also can be considered to be a proxy for increased risk of infections not explicitly addressed in this study. Gradual climate change influences health through changes of habitat of vectors bearing diseases. The frequently cited northward move of the mosquito-borne infectious disease malaria, wide-spread in tropical regions, is a good example for vector-borne diseases. Rising winter temperatures also reduce winter kill for many disease carriers, thus allowing for systematic increases of their population, but they also reduce the risk of cold induced infections or even deaths due to freezing.

Table 14 Indicators used for climate change challenge 'health and heat waves' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	days over 30°C per year	0.00 (various regions)	11.62	82.88 (Extremadura, ES)	15.26
	tropical nights per year	0.00 (various regions)	2.76	35.55 (Sicilia, IT)	6.39
Sensitivity	population density	3.00 (Ísland, IS)	346.63	9,443.00 (Inner London, UK)	873.33
	share of population over 65y	3.27% (Van, TR)	16.41%	26.78% (Liguria, IT)	4.11
Adaptive capacity	physicians or doctors per 100.000 capita	69.80 (Voreio Aigaio, GR)	303.41	996.80 (Kriti, GR)	109.25
	health care expenditures in % of GDP	5.24% (RO)	8.96%	11.00% (FR)	1.48

For the analysis of **sensitivity**, densely populated areas with little space for recreation are more likely to be thermally uncomfortable in summer and therefore put strain on the inhabitants' health. This situation is depicted using the *population density*. High population density can be found in dense settlement structures where increased thermal mass and reduced humidity lead to heat island effects which are detrimental to health during heat waves. Apart from that, the sheer number of people living in an exposed area makes it sensitive. To refine this sensitivity, the *share of population over 65 years*, the group most sensitive to heat stress and most endangered by dehydration, is considered, as older people have more difficulties adapting to heat and proved to be the population group affected most during the very hot summer of 2003.

In the long term, an increase in temperature can be adapted to through urban planning by allowing more vegetation in built up areas and by climate proofing of buildings through climate adapted architecture. On a shorter time scale, the insulation can be improved and shading facilities installed that prevent the heat from entering the buildings. No systematic data is available to indicate efforts of the regions in this direction. The ability to cope with extreme events on short term can be enhanced by warning systems and operative health plans, systems that have already been implemented by some cities after the hot summer of 2003. Comparable data does not exist on the number and effectiveness of such emergency plans. However, in a broader sense, regions with a higher *number of physicians per 1000 inhabitants* can be assumed to have a better **adaptive capacity** towards health related climate change issues. Countries with high *health expenditures* relative to the GDP show greater priority of a healthy society and therefore can be expected to be more willing to adapt to climate induced health stresses.

Neighbouring countries and cross-border effects

Climatic exposure in terms of an increase in the occurrence of heat days and tropical nights is of special importance in areas already suffering from heat, as in North Africa, for instance. On the other hand, these regions already have experience with coping with hot conditions unlike more temperate and northern regions that have neither the individual nor the collective knowledge of how to cope with heat waves.

Increased annual and seasonal variability, elevated mean temperature, and extreme weather events may facilitate the spread of existing vectors and the establishment of new invasive ones. Decreased availability of fresh water and the increased emergence of water and vector borne diseases will probably also challenge health in the EU Mediterranean neighbourhood. Many of Europe's southern neighbours are already affected by water scarcity and will be further impacted and face both water shortages and issues related to water quality and poor infrastructure. This will contribute to an increase in vector-borne diseases and digestive illnesses, such as diarrhoea, dysentery and cholera.

Practically every neighbouring country expects climate change to contribute to increased occurrences of both communicable diseases – such as parasitic, bacterial and viral diseases – and non-communicable diseases – such as cardiovascular and respiratory diseases and cancers. Certain areas will be affected more than others.

For example, according to the IPCC Report 4, part II, Asia, (p. 50) in Central and West Asia the human health sector is considered to be highly vulnerable to the impacts of climate change. For both Israel and Jordan probable increases in the occurrence of further water-related epidemics, such as malaria, West Nile virus, giardiasis, and bilharzia are reported. In the case of Jordan, it is not ruled out that diseases may emerge, that were previously unknown in the country, such as dengue fever or Rift Valley fever.

The vulnerability map

Presently the most exposed regions regarding heat during the night time are the regions on the Mediterranean coast line. Due to the warming of the Mediterranean Sea, this situation will be aggravated in the future. The increasing day time temperature also affects the South of Europe, but rather than the coast lines, inland regions are affected most (Central Iberian Peninsula, North of Italy, the Balkans and Turkey). Regions closer to the sea suffer reduced thermal stress due to the high heat capacity and low heat conductivity of the Mediterranean water masses during the daytime, whereas they prevent the cooling process at night.

The southern regions are most vulnerable where geographical Southern position coincides with high population density (the Region of Valencia, Andalusia, Istanbul, and Izmir) or the adaptive capacity is low, such as the Spanish Extremadura. The vulnerable regions in the UK and the New Member States are due to below average adaptive capacities. In other words, they will suffer less from impacts on account of heat waves, but due to

their limited health care system, health issues might still arise; especially in urban agglomerations this trend is most likely to be aggravated.

In Europe's neighbourhood, the days >30 were used as an indicator for increased vulnerability. The Mediterranean basin and Ukraine are the most exposed countries in this respect.

Water dependency

Increase in scarcity of water (green and blue) is one of the most serious consequences of climate change in the southern and eastern parts of Europe, while e.g. in Scandinavia overabundance of water is becoming an issue in some cases. Households only use a minor part of the total available water directly, the main water consumption and need is associated with energy production, industries and agricultural production. As described above, it is blue water that is of interest in this key issue. Competition for water of different water dependent sectors can influence the development of regions and thus the globalisation (global demand for electricity, food and goods) and the energy challenges (hydropower plants).

The indicator system for regional vulnerability

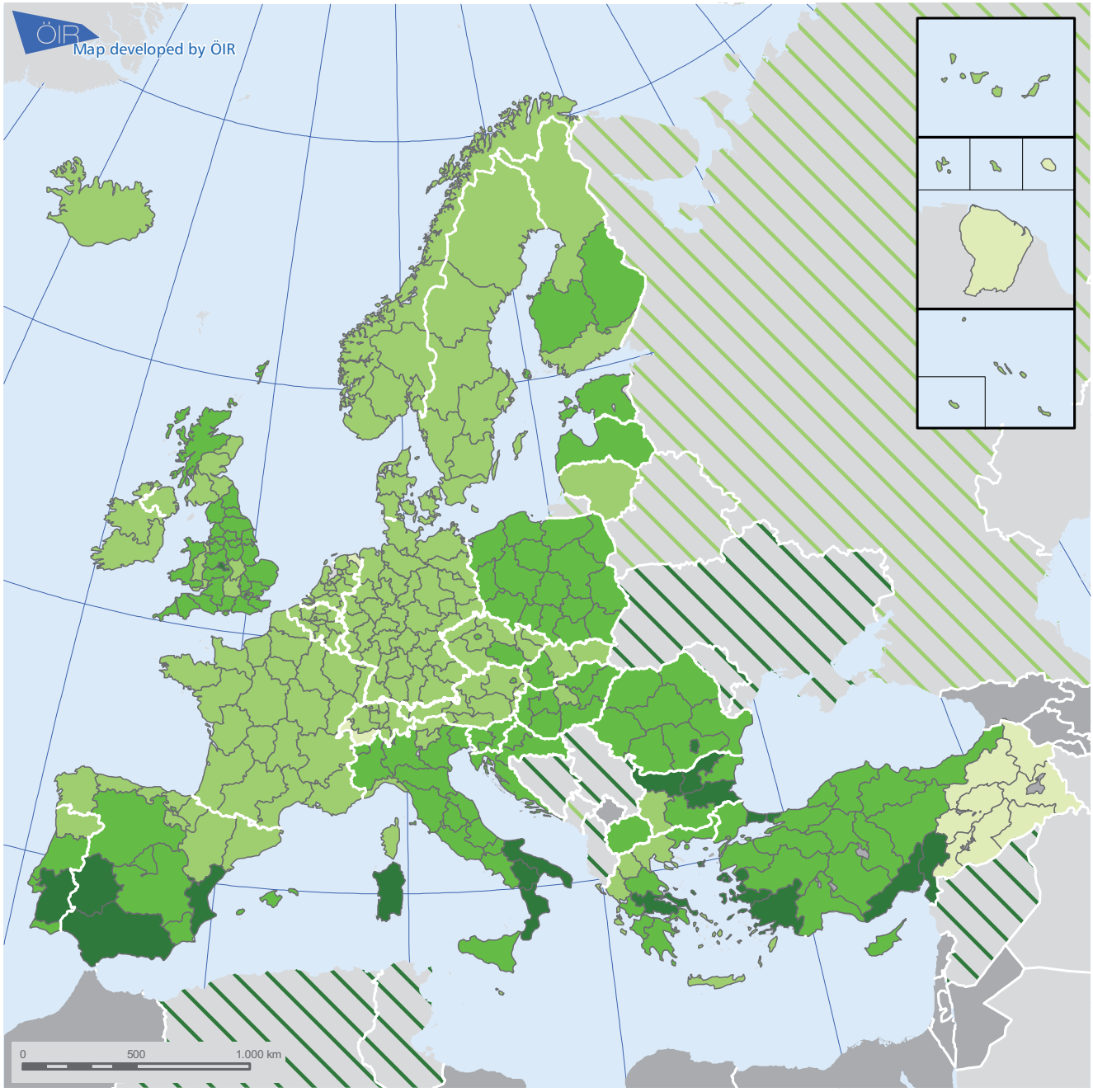
Exposure in this case is described by the availability (or lack of) blue water and the security of the water supply. The use of old, not readily renewable groundwater is unsustainable and should therefore not be included in considerations of water availability. Availability of blue water initially depends on rainfall, but it becomes useful as run-off in rivers and streams and in lakes and through high or at least stable groundwater levels. *Annual precipitation* data are accessible and used as an indicator, but runoff data are not sufficient to create a consistent map of mean river runoff at the NUTS 2 level. Groundwater levels also are not available spatially inclusive and comprehensive. Therefore an indicator created by the EEA depicting water exploitation was used as a proxy: the *water exploitation index* (WEI) is defined as the annual total water abstraction per year as a percentage of available long-term freshwater resources. The change in the indicator calculated for 1990 (or near that year if 1990 was not available) and the latest year available was used. The data set was produced by EEA-ETC/WTR based on the latest available data from Eurostat data tables (extracted on 06/2008): renewable water resources (million m³/year), long term annual average (LTAA) and annual water abstraction by source and by sector (million m³/year), total freshwater abstraction (surface and groundwater; see www.eea.europa.eu/data-and-maps/indicators/water-exploitation-index-1). In view of the fact that the scarcity problem is presently of more consequence than the abundance problem, this second aspect is not addressed in the indicators.

There was some debate during the methodological development on whether water prices could be an indicator for exposure to the water challenge. In view of the many determinants of water prices that have no connection with the water challenge, prices were not considered to be a sufficiently reliable indicator.

Regions with high water demand have a higher **sensitivity** to scarcity, even though there might be room for more efficient water use. Agriculture and industry are two of the main consumers of blue water. The *share of irrigated land* is a good sensitivity indicator for blue water usage in agriculture. The *industry share of GVA* is used as an indicator for industrial water use, as almost all industries need considerable amounts of water, either for cooling or for technical or chemical processes. There are temperature thresholds regarding abstraction and reversion of river water for many industries as well as thermal power plants. Lack of cooling water caused power plants to shut down during the summer of 2003 thus reducing electricity production at a time of high demand (for cooling). The *share of hydropower production in total energy production* is intended to represent water use for energy production. This is not fully satisfying, as thermal and other power production systems also have high water demand, but this might be considered to be covered by the industry share in GVA.

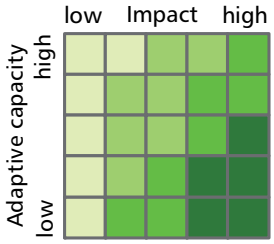
Map 26 Key vulnerability 'Health and heat waves' (following page)

Health and heat waves- Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Days over 30°C per year (Source: E OBS)
- Tropical nights per year (Source: E OBS)

Indicators describing sensitivity:
- Population density
- Share of population over 65y
  (Source: European Spatial of the BBSR)

Indicators describing adaptive capacity:
- Physicians or doctors per 100.000 capita
- Health care expenditures in % of GDP

Neighbouring Countries
(simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Days over 30°C per year (Source: E OBS)

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

Table 15 Indicators used for 'Water dependency' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	annual precipitation difference	-0.46 (Provincia Autonoma Trento, IT)	-0.01	0.26 (Agder og Rogerland, NO)	0.12
	water exploitation index	0.00 (Ísland, IS)	0.17	0.45 (Kybros/Kibris, CY)	0.09
Sensitivity	Share of irrigated land	0% (various regions)	7.03%	72.10% (Região Autónoma da Madeira, PT)	11.41
	industry share of GVA	7% (Inner London, UK)	28%	50% (Zapadne Slovensko, SK)	8
	share of hydropower production in total energy production	0% (various regions)	5%	31% (Wien, AT)	7
Adaptive capacity	implementation of Water Framework Directive 1	1 (various regions)	3.42	6 (various regions)	1.34
	implementation of Water Framework Directive 2	1 (various regions)	1.52	3 (various regions)	0.82

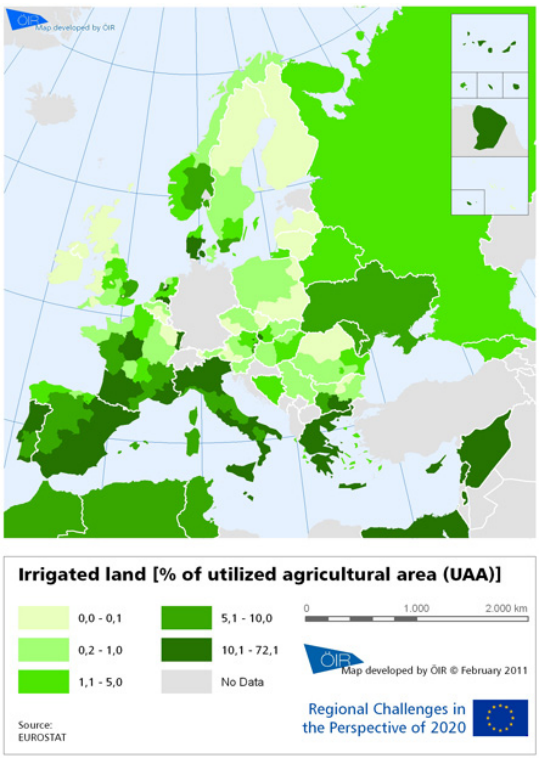
As the amount of rainfall cannot be influenced directly, the **adaptive capacity** is limited to influencing runoff without increasing vulnerability towards floods or detracting green water needed by vegetation and agriculture. Also, handling water scarcity by either more efficient use or better management of attribution between competing demands is important. No direct indicators for these options are available. But the willingness and ability to adapt can be approximated by the implementation of water related policies making water use more sustainable. The *implementation of the water framework directive 1 and 2* was therefore used as indicator of adaptive capacity: the creation of programs for monitoring water status on the one hand and the adoption of river basin management plans on the other. The official communication regarding water scarcity and drought of 18th July 2007 (EC2007b) which aims to further develop measures could be helpful in future studies.

Neighbouring countries and cross-border effects

Europe's neighbours already face considerable challenges related to water. For example, Morocco's water resources are characterized by both their scarcity and their temporal and spatial irregularity and are under growing pressure due to an increase in water needs. Irrigation alone accounts for 83% of available (blue) water used. Egypt irrigates nearly 80% of its agricultural areas, followed by Jordan (43%), Azerbaijan (30%) and Syria (23%) (Map 27). Furthermore, changing spatial and temporal availability of water will create the potential for floods, droughts, erosion, and desertification which will adversely affect agriculture, human health and tourism. In the case of the Nile River, discharge has been shown to be extremely sensitive to any change in climate. Any change could have devastating consequences for much of Egypt's population. Also, snowlines may rise in mountainous regions such as the Caucasus and Atlas and the seasonal patterns of snowfall are likely to change with the snow season beginning later and ending earlier. As a consequence, spring runoff is expected to decline noticeably, thus affecting water availability in the hotter and drier summer months.

Many countries with coasts will be directly impacted by sea-level rise, which can cause inundation of lowlands and wetlands, coastal erosion, increased storm flooding and damage, increased salinity in coastal aquifers and estuaries, and rising coastal water levels. As a consequence, people and production areas will be displaced. Moreover, the ground water supply will be affected by decreased percolation of water due to decreases in the amount of precipitation and stream flow and loss of soil moisture due to increased evapotranspiration. All countries depend on their water resources for drinking water and irrigation, with some, for example in the Caucasus region, depending on it also for hydro power.

Map 27 Europe and its neighbourhood: share of irrigated land



The impacts of climate change on water supply will be among the most felt, particularly by the more marginalized segments of society. Owing to the fact that countries cannot significantly increase the amount of water available in their territories, they will be forced to compensate by improving efficiencies. Only more developed countries, which have already been living in regions with relatively scarce water resources, such as Israel, have a culture of developing methods to improve efficiency. The potential impacts on EU member states will primarily occur in border areas where water sources and watersheds are shared by both member and non-member states. In such areas conflicts that arise concerning the use and management of water resources will pose political challenges as well as provide opportunities to stimulate cooperation between EU member states and non-member states in areas of resource management.

In the event that thresholds are crossed regarding water supply covering basic needs in neighbouring countries, the EU may decide to get involved to help avoid humanitarian crises. If human need outstrips water supply, this could lead to migration. European plans to develop energy production in Northern Africa might meet difficulties with regard to water availability, even for solar projects such as Desertec, and thus might become more involved in water issues in these regions.

The vulnerability map

In the last decades a clear trend of reduced precipitation in the most Southern regions and a gain in many Northern regions was observed and is expected to continue. The warning threshold for the water exploitation index, which distinguishes a non-stressed from a stressed region, is around 20% (Raskin et al. 1997). Severe water stress can occur where the WEI exceeds 40% (Alcamo et al., 2000), indicating unsustainable water use. In Europe there are nine countries that can be considered water-stressed based on the Eurostat data available for the period 1997-2005: Germany, Cyprus, Spain, Belgium, Bulgaria, Italy, England and Wales, Malta and the FYR of Macedonia, representing almost half of Europe's population. Based on the 2005 available data Cyprus (45%) and Bulgaria (>38%) have the highest WEI. However, it is necessary to take into account the high water abstraction for non-consumptive uses (energy cooling water) in Germany, England and Wales, Bulgaria and Belgium. Most of the water abstracted in the remaining five water-stressed countries (Italy, Spain, Cyprus, FYR of Macedonia and Malta) is for consumptive uses (especially irrigation) and there is therefore higher pressure on water resources in these five countries. The WEI decreased in 21 countries over the last 10-15 years, representing a decrease about 10% in total water abstraction. Most of the decrease occurred in the new EU Member States, as a result of the decline in abstraction in most economic sectors. However, seven countries (The Netherlands, the UK, Greece, Finland, Slovenia, Spain and Turkey) increased their WEI during the period 1990 to 2005 because of the increase in total water abstraction. (www.eea.europa.eu)

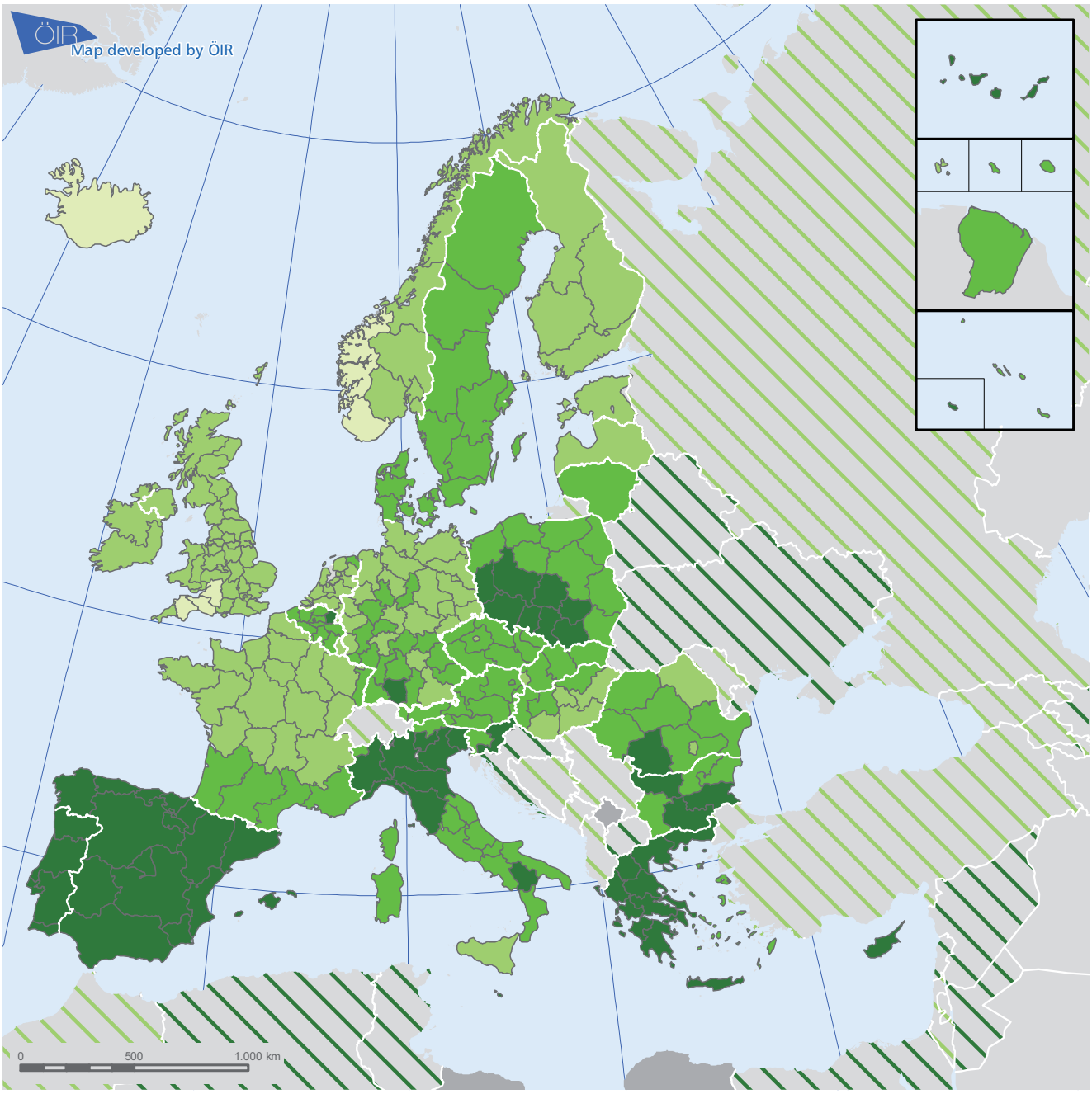
This is reflected in the vulnerability map (Map 28). Most irrigated areas are found in Spain, Southern France, Italy, Greece and Cyprus and the neighbouring countries. Also Central Europe, Sweden, Finland and Lithuania are marked as vulnerable. As opposed to the South, where the reason can be found in the decreasing amount of rain combined with intensive water use in agriculture, in Rumania and Bulgaria there is still considerable water usage by industry, whereas in all mountain regions, such as the Alps, Tatra Mountains, the Carpathians, Apennine Mountains, the Pyrenees, Scandinavia, as well as the Baltic regions and Portugal hydropower production is strong.

The implementation of the Water Framework Directives is weak in Spain, Portugal, Greece and Lithuania where it would probably be desperately needed. Norway, the British Islands, the Netherlands, Northern France and Germany are very well prepared regardless of the weak exposure they are facing whereas Northern Italy and Central Europe as well as Romania, Bulgaria and Sweden might improve their water management in order to mitigate the high impact.

In the neighbouring countries, the annual precipitation difference was used as an auxiliary approach for the vulnerability to changes in the water regime. Of the countries where it was available, Algeria, Tunisa, Egypt, Jordan, the Lebanon, Syria, Ukraine, Azerbaijan and Belarus are the more vulnerable.

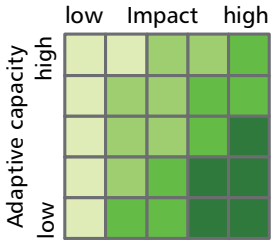
Map 28 Key vulnerability ‘Water dependency’ (following page)

Water dependency - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Annual precipitation difference (Source: E OBS)
- Water exploitation index (Source: EEA)

Indicators describing sensitivity:
- Irrigated land
- Industry share of GVA
- Hydropower production (Source: Primes)

Indicators describing adaptive capacity:
- Implementation of Water Framework Directive 1 (Source: DG Envi)
- Implementation of Water Framework Directive 2 (Source: DG Envi)

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- irrigated land [in percentage of utilized agricultural area (UAA)]
- industry share of GDP (without construction)

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

Summer tourism climate

Climate influence on tourism is a complex matter as was already indicated in previous sections. The focus of the vulnerability analysis will be on the changing climatic outdoor comfort, a precondition for summer tourism. Summer tourism is strongly connected to the topics of heat waves, as well as water availability, through thermal comfort and the quality and quantity of water. Winter tourism is dominant in some of the mountainous regions of Europe and the future prospects of this sector have been widely discussed, for example as concerns the Alpine Regions. Snow cover data could form the basis for a winter tourism indicator, but these data are not very reliable and only few regions are affected. Any indicator irrelevant for most regions smoothes out the regional differences of other factors. Therefore winter tourism is not explicitly treated in this study.

There is a strong link between tourism and the challenge “secure, sustainable and competitive energy” concerning transport costs and energy demand for cooling. Transport of tourists and goods as well as accessibility of regions also links the challenge to the globalisation challenge. Increased social polarisation tends to decrease the number of tourists.

The indicator system for regional vulnerability

Exposure in the case of tourism can be any aspect of climate change that influences the push criteria in the regions of origin of tourists and the pull criteria in their destinations. The *tourism climate index* (TCI) used for part of the exposure dimension is based on the notion of “human comfort”. It was developed by Mieczkowski and used in the Tourism study of the Peseta project. It consists of five sub-indices, each represented by one or two monthly variables and weighted: 1, daytime comfort index (max. daily temperature and min. daily relative humidity); 2, daily comfort index (mean daily temperature and humidity); 3, precipitation; 4, sunshine; 5, wind. This index is considered useful for overall tourism – although it only indicates potential, not actual tourism activities. The spring, summer and autumn TCI is used as well as the *difference between the 1970 and 2020 TCI*. The implementation of the bathing waters directive can be seen as indicator for the *quality of bathing waters (coastal and inland)* as well as the willingness of a country to maintain outdoor recreational areas clean. A dataset created by DG Environment from annual Member State's reports is used to determine the percentage of EU coastal bathing waters meeting guide levels of the directive for the year 2006 (national level).

Sensitivity depends on the climate and weather responsiveness of the predominant leisure activities (cultural activities e.g. are less influenced by meteorological factors than most sport activities) and on the importance of tourism for the regional economy. Europe-wide indicators were only found for the economic aspects: The *share of employment in tourism* and the *number of overnight stays* give a good indication of the importance of the sector for a region.

Adaptive capacity is partly an individual matter (how much are private citizens or companies able and willing to invest in adaptive measures for their tourist related businesses?) and partly a sovereign matter, e.g. installing water quality or flood protection measures. It can include the possibility to change offers, such as shifting from winter to summer tourism, adapting tourist infrastructure to climate changes (artificial snow) and training of the personnel for new activity fields. These changes are more easily accomplished if more money is available in the region in general (*regional GDP*) and in the private households (*disposable income*).

Table 16 Indicators used for ‘Summer tourism climate’ vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	Tourism Climate Index 1970	26.18 (Provincia Autonoma Bolzano/Bozen, IT)	55.45	87.43 (Notio Aigaio, GR)	12.91
	Tourism Climate Index difference	-47.68 (Malatya, TR)	1.35	55.06 (Região Autónoma dos Açores, PT)	12.54
	quality of coastal bathing water	22.50 (BE)	79.47	99.00 (CY)	18.91
	quality of inland bathing water	20.00 (LU)	55.51	90.20 (DK)	18.02
Sensitivity	overnight stays	187,306 (Liechtenstein, LI)	8,516,748	85,015,211 (Canarias, ES)	11,234,056
	share of employment in tourism	1% (Nord-Est, RO)	5%	19% (Notio Aigaio, GR)	2
Adaptive capacity	disposable income of households, net (uses)	1,651.70 (Severozapaden, BG)	14,589.99	46,708.12 (Nordwestschweiz, CH)	7,387.25
	GDP per capita	2000.00 (Van, TR)	23,805.14	96,000.00 (Inner London, UK)	14,279.77

A further possible indicator would have been tourism income as a share of GDP following the assumption that regions with a large touristic offer will invest money to maintain it. Already built infrastructure and invested capital will keep tourism centres in place for a while even if the climatic situation deteriorates. However, this is not necessarily true for regions that are highly dependent on transport like islands that are mainly accessible via air connection: economic shocks (recent crisis), high energy prices and dwindling attractiveness can combine to downturn tourism.

Neighbouring countries and cross-border effects

For many of Europe's neighbours tourism constitutes an important and growing sector of their economy (see Table 17). Tourism will be impacted by climate change in these countries in a number of ways, including, for example, through increasing temperatures and forecasted occurrences of heat waves. Egypt, for example, expects heat to reduce the attractiveness of its beaches for vacation during the summer months. This may, however, also lead to a shift from visits in the summer months to the autumn and spring. Not only the EU, but also the neighbouring Mediterranean coastlines will face increasing challenges posed by climate change, sea level rise being a major challenge as already described in the water dependency section (saltwater intrusion into coastal regions' drinking water). Additionally, increasing temperatures and lack of freshwater will impact basic amenities that tourism destinations strive to provide tourists with, such as water for showers, cleaning, swimming pools and irrigation around hotel areas.

The coasts are, however, not the only regions that may experience spatial and temporal shifts in tourism patterns. The aesthetic value of certain ecosystems as destinations will be put at further risk. Coral reefs, for example, which attract countless tourists to the Red Sea, are endangered due to a combination of climate change, pollution and natural calamities (e.g. sand accumulation).

Table 17 European neighbourhood: tourism

country	overnight stays per year
Armenia	515.500
Belarus	380.300
Algeria	5.346.500
Egypt	258.468.000
Israel	53.466.400
Lebanon	1.452.000
Morocco	16.462.000
Occupied Palestinian Territory	1.127.000
Tunisia	38.112.000

In many of the EU's neighbours, agriculture, fisheries, water resources, human settlements and human health are most vulnerable to climate change.

The tourism sector has strong forward and backward linkages with all of these affected sectors. Furthermore, for some countries tourism represents thousands of jobs. In 2001, the Moroccan tourism sector employed around 366,000 people. As a result, the impacts of climate change have the potential to affect large parts of neighbouring countries' populations as well as their economies. Due to the low overall economic performance and the high degree of dependence on foreign investments (see also the globalisation section) alternatives to tourism are scarce in many neighbouring countries. However, it must be taken into account that investors have an interest in the success of their ventures and are generally insured against disasters. With that in mind, the adaptive capacity in the tourism sector will to a certain degree be divided between those involved with deep pockets (foreign investors and wealthy locals) and local, family-run businesses that are unable to undertake the necessary structural changes and get under pressure.

The vulnerability map

The TCI values for summer tourism are very favourable for most parts of Europe in the baseline period. However, they are underperforming in a couple of relatively dispersed regions, for instance in Turkey, the UK, Belgium and Italy. Despite the significant improvement in bathing water quality, 12% of Europe's coastal bathing waters and 36% of Europe's inland bathing beaches still did not meet guide values in 2006. This is probably because the achievement of the guide levels would entail considerably more expenditure by Member States for sewage treatment and the control of diffuse pollution sources. As for the mandatory standards, there was a decrease in the compliance rate with the guide level between 2003 and 2005 in inland waters, as new EU10 Member States together (in general) have lower compliance than the former EU15 Member States. In 2006, the decrease stopped.

The compliance rate in coastal waters has stabilised in the last four years. In coastal waters, Belgium, Poland and Estonia score lowest. As with coastal waters, in general, the guide levels were met in far fewer inland bathing waters than the mandatory standards. 90.2% of Denmark's inland bathing waters met the guide levels (the

highest result). In 2006 more than an 80% compliance rate in regard to the guide limit values was also reported by Estonia. Less then 50% compliance rates were found in Lithuania (45.8%), Slovenia (44.4%), Belgium (44%), Spain (40.9%), Poland (34.4%), the United Kingdom (27.3%), and—at the end of the list—Luxembourg with only 20% (EEA).

In these exposed regions the vulnerability map (Map 29) clearly highlights regions that have a strong tourism sector. These regions are found along the Mediterranean coast and on its islands, the Baltic Sea Coast, the French West Coast, the Alps and a couple of cities (Venice, Paris). The most vulnerable include the Algarve, the Baleares, Andalusia, Catalonia, Dalmatia and the Greek Archipelago. As mentioned, many British regions appear vulnerable because the guidelines of the bathing water directive could not be achieved. On the other hand, the New Member States and regions in Turkey where the tourism sector is of lesser importance appear as vulnerable because of their low adaptive capacities.

As the availability of climate data for Europe's neighbourhood countries was very limited, these countries could not be included in the map. Please refer to the section on neighbouring countries for qualitative information and tourism statistics.

An integrated picture of the climate change challenge

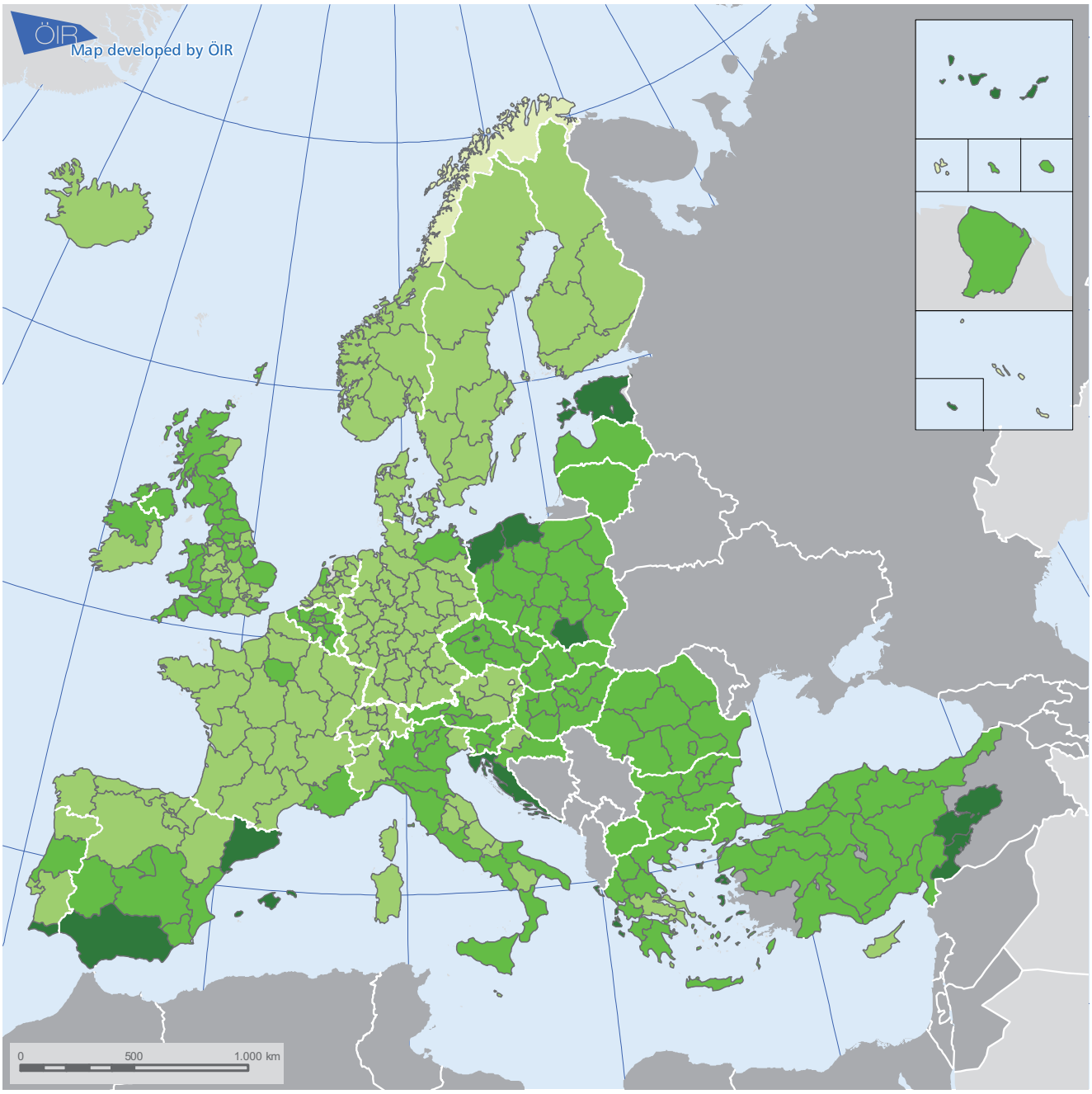
As for the previous challenges, the multiple climate change challenges have been cast into a typology by use of a cluster analysis. For climate change, the indicators that proved to be most significant for the cluster analysis have been the territorially most differentiating ones. The results are ten types of regions that can be roughly divided into four groups of similar characteristics, even though this aggregation is not ideal in all respects

The first group "Regions prepared for climate change" includes the '**atlantic regions prepared for climate change and Switzerland**', which comprise fifty-six NUTS 2 regions, including the UK, Ireland, Iceland, Luxembourg, Norway, parts of Finland and Switzerland. The type is characterized generally by above average adaptive capacities mainly owed to the high economic prosperity (before the crisis). This results in a comparatively low overall vulnerability with respect to climate change. Only the tourism climate challenge has a moderately increased vulnerability, which is mainly owed to water quality issues in the UK, Ireland, and coastal Finland. Somewhat related, the '**mainland regions prepared for climate change**' comprise eighty NUTS 2 regions and represent the largest cluster in this set. It covers large areas in France and Germany, Denmark, inland regions of the Netherlands and – apart from some rather dispersed regions – the three CEE capitals Prague, Bratislava and Budapest. This cluster essentially represents the European average of climate change vulnerabilities. The only aspects of higher vulnerabilities are to be found in the higher exposure of agriculture and forestry, which points at the fact that these regions cover the most intensive farm land in Europe.

The second group of regions has in common the vulnerability in a specific issue: water. The '**hydrologically affected inland regions**' cluster comprises twenty NUTS 2 regions in Sweden, Austria (apart from Vienna) and Slovenia and is characterized by an above average sensitivity in the issue water dependency (mainly owed to the high importance of hydropower production and a relatively high industry share in general). In other words, these regions are not prone to water shortages at present, but if shortage occurs, the overall vulnerability would be high. Additionally, they have in common strong adaptive capacities in agriculture, since farmers usually have other gainful activities. The other type is facing very different water issues: the '**hydrologically affected waterside regions**' include ten regions which cover coastal regions of the Atlantic Ocean and North Sea (in Belgium, the Netherlands, Germany), around Bordeaux and – as the only inland region – Vienna. Their specific mutuality is on one hand a high exposure to natural hazards (e.g. storm surges and floods) and on the other a high exposure of ecosystems towards climate change. Vienna is part of this group due to an overrated indicator – a fairly high loss of vegetated surface. This is one example of the weakness of a clustering mechanism that is a purely statistical tool without content judgement.

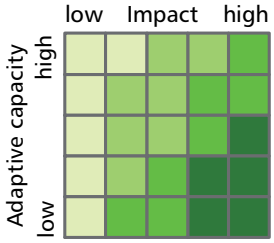
Map 29 Key vulnerability 'Summer tourism climate' (following page)

Summer tourism climate - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Tourism Climate Index 1970 (Source: Peseta)
- Tourism Climate Index difference (Source: Peseta)
- Quality of coastal bathing water (Source: DG Environment)
- Quality of inland bathing water (Source: DG Environment)

Indicators describing sensitivity:
- Total overnight stays
- Share of employees in tourism

Indicators describing adaptive capacity:
- Disposable income of households, net
- GDP per capita

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
-

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

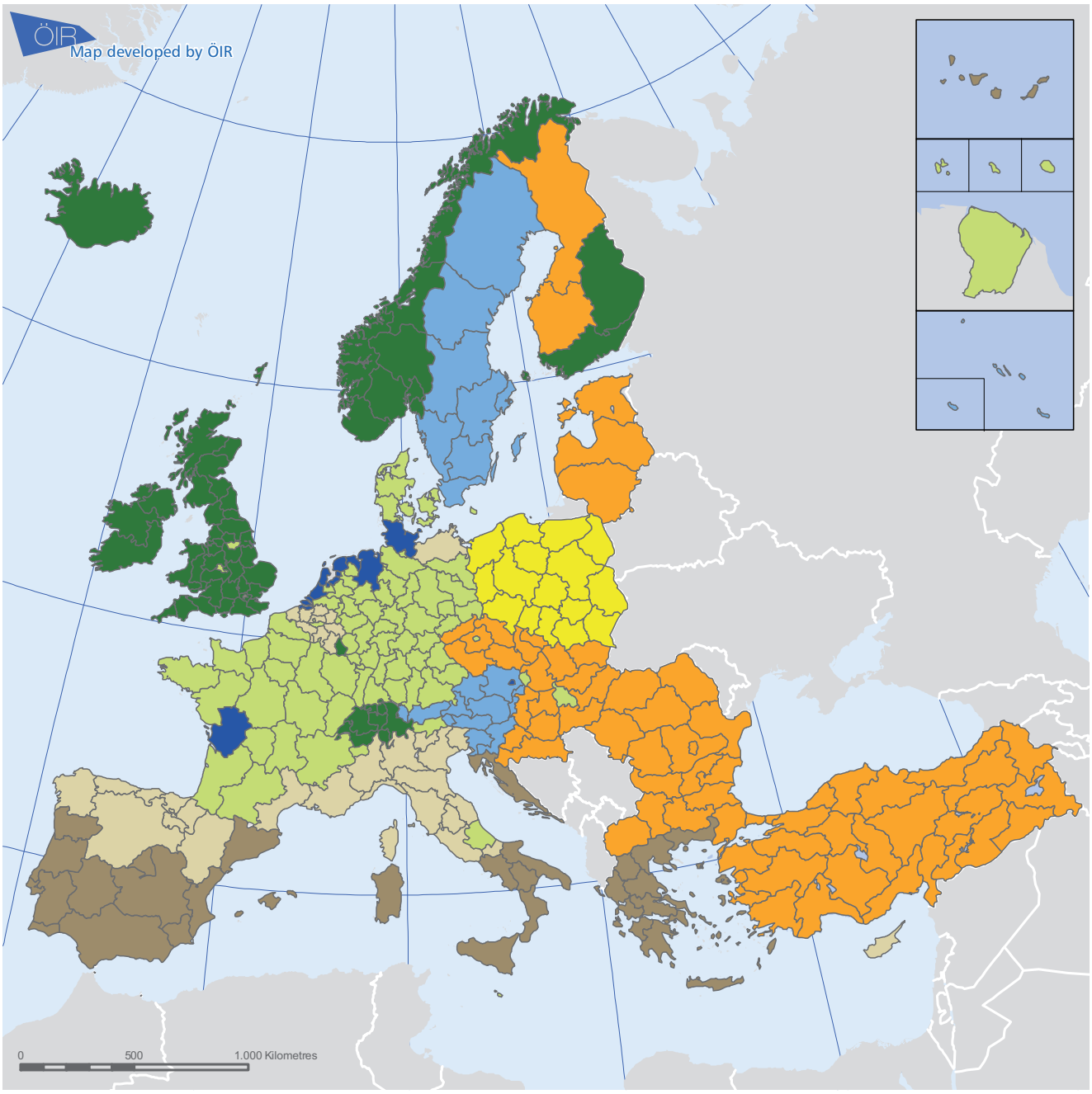
The third group of regions can be found in the New Member States and Candidate Countries, their basic similarity being the low adaptive capacities mainly owed to their lagging economic performance compared to the European average. The cluster '**Polish regions with deficits to adapt to climate change**' covers all of Poland. Poland is unusual on account of its low sufficiency index describing the state of progress in reaching the Habitat Directive compared to the other Eastern European countries, but at the same time it has a large portion of Natura 2000 areas. Poland is also more exposed in the area of tourism, because of poorer bathing water quality (according the same named indicator submitted to the DG Environment), than are other New Member States. These deficits are not compensated by better summer tourist weather. The two indicators differentiating the Polish regions from the others are not sufficient and the cluster shows that the methodology can still be improved. These '**other eastern regions with deficits to adapt to climate change**' include no less than sixty-four regions and thereby all of Turkey, Bulgaria, Romania, the Baltic countries and most of Hungary, Slovakia, the Czech Republic, Croatia and parts of Finland. The cluster is characterized by general below average performances in adaptive capacities, once again reflecting the lag in their national economies compared to the EU average. The difference to the Polish regions of a similar kind is the better performance in natural and semi-natural ecosystems. Still there are huge differences within this cluster regarding climate. The thermal and hydrologic situation in Finland, for example, is not comparable to that of Turkey. From the point of view of climate adaptation policies, these regions would not be considered to belong to one cluster.

As was already argued in most of the single issues of climate change, the Southern European regions are already and will further be affected most by climate change. In the cluster analysis, two 'belts' of regions that are to face multiple climate change challenges could be distinguished. The '**regions of high multiple climate change vulnerability**' include thirty-seven NUTS 2 regions, which cover the Northern parts of Italy and Spain, Cyprus and the Mediterranean coast of France, but also coastal regions in Germany and parts of Belgium. These regions face above-average vulnerabilities in most climate change issues with the exception of health and heat waves. This is the most significant distinction to the final type of regions, the '**regions of very high multiple climate change vulnerability**'. These include thirty-four regions covering the very Southern periphery of Europe – Southern Spain, Southern Italy, Greece and Dalmatia. This cluster probably shows the highest vulnerability vis-à-vis climate change, owing to the fact that a number of vulnerability scores are below the EU average. Most of these regions are dependent on irrigated agriculture, have considerable areas of natural ecosystems, are increasingly faced with heat waves, are extremely dependent on water supply and frequently are prominent tourist resorts. As opposed to other regions challenged by one or two specific climate change issues, these regions certainly will have to be dealt with on a strategic level, as rising temperatures might undermine their entire development base.

These aggregated vulnerability maps capture some of the essential features of relative vulnerability in European regions. However, there are also a number of inconsistencies that are primarily due to the need to compromise in defining indicators that are suitable as well as available across all regions of Europe and weighting them reasonably.

Map 30 Climate change types of regional vulnerabilities (following page)

Climate change - Integrated vulnerability



Type of Regions

Regions prepared for climate change

- Mainland regions prepared for the challenges of climate change
- Atlantic regions prepared for the challenges of climate changeand Switzerland

Regions hydrologically affected

- Hydrologically affected inland regions
- Hydrologically affected waterside regions

Regions with deficits to adapt to climate change

- Polish regions with deficits to adapt to climate change
- Other eastern regions with deficits to adapt to climate change

Regions of high multiple climate change vulnerability

- Regions of high multiple climate change vulnerability
- Regions of very high multiple climate change vulnerability

Regional Challenges in the Perspective of 2020,
Vulnerability Indices Indicator data source Eurostat except were indicated

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Regional Challenges in the Perspective of 2020

Mid-term scenarios

Climate change is real, it is happening around us and it has consequences that will become more visible. Impacts will be felt more strongly as time progresses. The climate development until 2020 has been determined by our past emissions and cannot be influenced in such a short term, no matter what measures are taken. However, if GHG emissions are not reduced, climate change will accelerate and irreversible changes to our global ecosystem endangering humanity will be triggered (tipping points). Although EU mitigation goals for 2020 might be achieved without deep-cutting changes, the reduction of GHG emissions by 80% by 2050 can only be achieved if structural changes and changes in mindsets are introduced within the coming years. This short-term necessity must be reflected in every scenario that claims to be in line with EU climate policy and in every challenge and in every economic sector. The headline targets of Barroso's *Europe 2020* clearly encompass all three pillars of sustainability and are valid for all three scenarios defined in the paper. The differences relevant for climate change with regard to the three scenarios can be found in the political determination and the speed with which the ecological sustainability aims are attained. The decoupling of economic growth from resource use (part of the headline targets) implies emphasis on the quality of life rather than on resource-intensive production. This includes improved and more education, intelligent innovation and new skills and jobs.

The three scenarios *Sustainable recovery*, *sluggish recovery* and *lost decade* could be defined to reflect these policy aims.

Figure 12 Environmental restoration of storm water drain and creation of nature reserve, MT

Source: DG Regio

However, they can also be interpreted to describe the result of the interplay of market forces only, and in the present legal and policy framework, without policy intervention. It had been understood by many before, but the Stern Review on the Economics of Climate Change 2006 explicitly spelled out that the challenge of climate change cannot be met without policy intervention. The European Union acknowledged this by agreeing on climate and energy policies that require considerable national policy interventions. It must therefore be understood that, based on a purely market oriented interpretation, none of the three scenarios describes a development to explicitly meet the climate change challenge.

What is called 'sustainable recovery' is business-as-usual economic growth, but faster. Therefore the term 'sustainable' is misleading as the scenario is certainly not sustainable in the ecological sense and therefore also not sustainable in the economical sense in the long-term. 'Sluggish recovery' also implies that society is heading back to its old ways, not towards a new, sustainable economy. In the case of the 'lost decade' the environment is given a brief respite as the economy flounders, but the cut is probably not deep enough to trigger the change of mindset necessary for a sustainable economy. In all scenarios economic activity increases and basically continues to be based on fossil fuels. Without GHG policy, even very high energy prices might not accomplish a switch. Thus none of the scenarios, as described in the methodological remarks, is focussed on meeting the climate challenge in terms of mitigative actions.

As climate change will progress within the next ten years independent of economic development, adaptation needs will rise, irrespective of scenario. The essential question is whether the economic situation will strengthen or weaken sensitivity and adaptive capacity.Table 18 gives an overview on the expectations in this regard for each of the key issues discussed in the climate change challenge. They are illustrated in Map 31. On this rough level of analysis, the most important differences between regions are due to economic strength, offering or prohibiting adaptation and single or multiple climate change vulnerabilities (mainly connected with reduced precipitation and increasing heat in the south). Many of the most affected regions are also convergence regions.

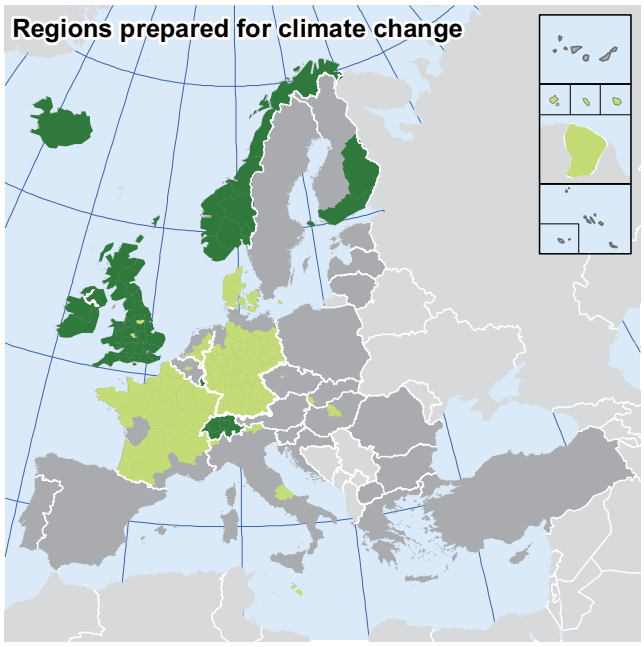
Map 31 Mid-term scenarios for the climate change challenge (page after the following)

Table 18 Scenario overview for the climate change challenge

scenarios	trends ↗ situation improves ➔ situation stable ↘ situation worsens	groups of regions Regions prepared for climate change	Regions hydrologically affected	Regions with deficits to adapt climate change	Regions of high multiple climate change vulnerability
Agriculture and forestry					
Sustainable recovery	Global economic development and GDP growth will boost the agricultural and forestry sectors. High transport costs would favour regionally produced products. Adaptive measures become affordable in many regions.	↗	↗	↗	➔
Sluggish r.	Regions with adaptive capacity weakness and threatened primary sector will not have a notable upswing.	↗	↗	➔/↘	↘
Lost decade	Pre-crisis trends would continue, with lack of adaptive measures especially in the southern regions.	➔	➔	➔/↘	↘
Natural and semi-natural ecosystems					
Sustainable/Sluggish r.	Economic growth will counteract policies to ensure the quality of the environment and therefore the adaptive capacity will decline (regulatory impact assessment, sufficiency index). Losses in natural and semi natural areas as well as vegetated surface will continue. There might be some relief for distant, not easily accessible areas.	↘	↘	➔/↘	↘
Lost decade	Losses in natural and semi natural areas as well as vegetated surface will continue, but at a slower pace. There might be some overall relief of intensive land use due to economic stagnation.	➔	➔	➔	➔
Natural hazards and coastal threats					
Sustainable r.	Rising GDP and income will maintain and enhance adaptive capacity in all regions. Thus increasing risks can be compensated	➔	➔	➔	➔
Sluggish r.	Rising GDP and income will not be able to maintain the adaptive capacity in all regions at a level that compensates for increasing risks.	➔	➔/↘	↘	↘
Lost decade	Due to the economic situation it will be more difficult to find public financing for important adaptation measures. Only private households with sufficient savings tend to protect their own property	↘	↘	↘	↘
Health and heat waves.					
Sustainable recovery	Adaptive measures such as investment in health related infrastructure or mechanical cooling in buildings can ward off severe consequences, although in urban areas of stronger exposure and in economically weaker regions these might not suffice. Without policy incentives to climate proof buildings and infrastructures the chance of mitigating GHG emissions, e.g. through reduced needs for cooling will not be made use of. Population density will increase in urban agglomerations in stronger regions but decrease in rural areas and therefore reinforce the urban overheating. The proportion of elderly will stay stable or decline due to migration. Expenditures in health care will rise in absolute numbers.	➔	➔	➔	↘
Sluggish recovery	Adaptive measures such as investment in health related infrastructure or mechanical cooling in buildings are restricted to the most vulnerable and the economically strong regions. Without policy incentives to climate proof buildings and infrastructures the chance of mitigating GHG emissions, e.g. through reduced needs for cooling will not be made use of.	➔	➔	➔/↘	↘
Lost decade	Reduction of public expenditures on social and health programs will aggravate health and sanitation problems. Adaptive measures such as investment in health related infrastructure are sluggish and mechanical cooling in buildings is restricted to the well-to-do. Without policy incentives to climate proof buildings and infrastructures the chance of mitigating GHG emissions will not be made use of. Population density will decrease in urban agglomeration but increase in rural areas, therefore dampening urban heat island developments. The proportion of elderly people is likely to rise, expenditures in health care will sink.	↘	↘	➔/↘	↘
Water dependency					
Sustainable recovery	Increased water demand due to CC and economic activity leads to scarcities and water use efficiency increases. Nevertheless, in some regions shortages occur that cannot sufficiently be compensated for through adaptation measures, as there are limits to physical availability. The water exploitation index will rise, due to insufficient counteractive measures. The irrigated agricultural area will increase in line with economic prosperity. The same could happen to industry. Hydropower electricity generation will be fully developed in capable regions. The implementation of the water framework directive will stagnate.	➔	➔	➔/↘	↘
Sluggish recovery	Increased water demand due to CC and economic activity leads to scarcities and water use efficiency increases. However, instead of far-sighted policies and integrated management, patchwork solutions and climate change adaptation measures responding to case specific needs are the rule.	➔	➔	➔/↘	↘
Lost decade	Increased water demand due to CC leads to scarcities but there is not much investment into water use efficiency and only patchwork solutions responding to case specific needs. Especially in more exposed and economically weaker regions water availability becomes a serious restraint; the water exploitation index will rise, due to the lack of counteractive measures; the irrigated agricultural area will decrease according to economic stagnation; the industry share will stabilize in most of Europe and increase in some regions; hydropower will not be fully developed due to lack of investment. The implementation of the water framework directive will stagnate.	➔	➔/↘	➔/↘	↘
Summer tourism climate					
Sustainable recovery	Higher fossil fuel costs will dampen the increasing trend of overall volume of tourism; the overnight stays and employment in tourism are strongly dependent on global changes and developments in the labour market. The rising regional GDP and disposable income will increase the adaptive capacity. Southern regions will loose attractiveness due to rising temperatures that can only partly be compensated for by adaptive measures.	↗/➔	↗/➔	↗/➔	↘
Sluggish recovery	With affordable fossil fuel costs and no CC policy measures to reduce GHG emissions the overall volume of tourism will remain rather constant. The Southern regions will loose attractiveness due to rising temperatures that resorts can not sufficiently adapt to.	➔	➔	➔	↘
Lost decade	High fossil fuel prices and increasing transportation costs without a corresponding increase in disposable income will reduce tourism significantly, except in the high cost segments and destinations. Low adaptive capacity and most vulnerable regions will have the most difficulties do adapt.	↘	↘	↘	↘

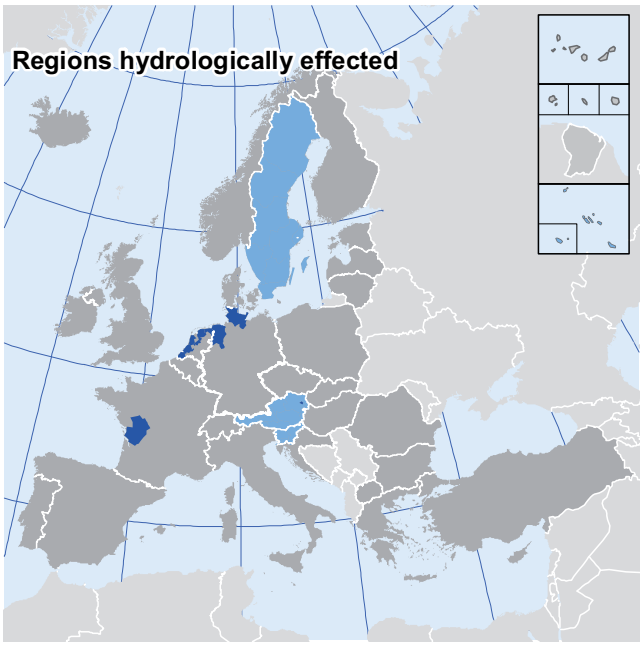
Scenarios for the climate change challenge

Regions prepared for climate change



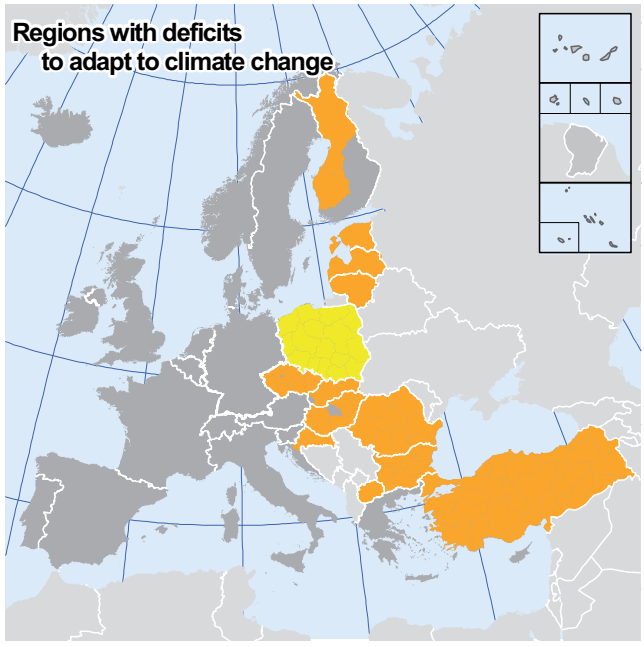
Agriculture&forestry conditions ↗ ↗ →	Mainland regions prepared for the challenge of climate change
Natural&seminat. ecosys. ↘ ↘ →	
Natural hazards → → →	Atlantic and swiss regions prepared for the challenge of climate change
Health and heat waves → → ↘	
Water dependency → → →	Other Group of Regions
Summer tourism climate → → ↘	

Regions hydrologically effected



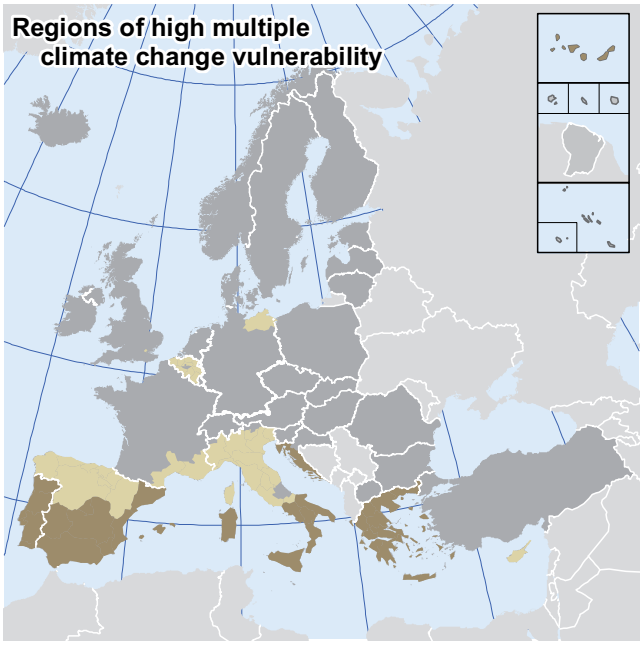
Agriculture&forestry conditions ↗ ↗ →	
Natural&seminat. ecosys. ↘ ↘ →	
Natural hazards → → ↘	
Health and heat waves → → ↘	Inland regions effected
Water dependency → → →	Waterside regions effected
Summer tourism climate ↘ ↘ ↘	Other Group of Regions

Regions with deficits to adapt to climate change



Agriculture&forestry conditions ↗ ↘ ↘	
Natural&seminat. ecosys. ↘ ↘ →	
Natural hazards → ↘ ↘	Polish regions with deficits to adapt
Health and heat waves → ↘ ↘	Other eastern regions with deficits to adapt
Water dependency ↘ ↘ ↘	
Summer tourism climate → → ↘	Other Group of Regions

Regions of high multiple climate change vulnerability



Agriculture&forestry conditions → ↘ ↘	
Natural&seminat. ecosys. ↘ ↘ →	
Natural hazards → ↘ ↘	regions of high multiple climate change vulnerability
Health and heat waves ↘ ↘ ↘	regions of very high multiple climate change vulnerability
Water dependency ↘ ↘ ↘	
Summer tourism climate ↘ ↘ ↘	Other Group of Regions

Prospects 2020
Trends

Scenarios	Sustainable recovery	Sluggish recovery	Lost decade
Challenge increases	↗	↗	↗
Challenge constant	→	→	→
Chellenge reduces	↘	↘	↘
Unknown	?	?	?

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Type of Region

- Type of Region
- Other Group of Regions
- Neighbouring Countries

Kilometres
0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

Regional Challenges in the Perspective of 2020

The challenge of climate change in a nutshell

- *There are no regions in Europe that could ignore climate change.*
- *In North Western Europe, it is often one specific aspect of climate change such as Atlantic storm surges, land slides or flooding that threatens regions. High adaptive capacities help to reduce vulnerabilities*
- *Large parts of the European mainland have average exposure, average sensitivity and considerable adaptive capacities for most climate change aspects, if viewed within the time range of this study, i.e. 2020. Therefore they are not especially vulnerable at present.*
- *In most regions of the New Member States exposures and sensitivities are within the European average. But as these regions generally have low adaptive capacities, e.g. because of low GDP levels or weak environmental policies, they nonetheless face increased vulnerabilities.*
- *The most challenged regions are the Mediterranean regions in Southern Europe that often face combined and serious threats such as the increasing frequency of heat waves, water scarcity, wild fires and the like. The threats concern basic sectors such as agriculture, tourism, health and natural environments. The numerous adaptive measures required can exceed existing adaptive capacities in terms of economic means but also technological possibilities.*
- *The closer European neighbourhood face similar problems as the neighbouring regions in Europe. However, adaptive capacities generally are lower, making especially the Mediterranean region and the Caucasus area highly vulnerable. These vulnerabilities will not have an immediate impact on the climate challenge in Europe – except possibly the spread of new pests and diseases not combated in neighbouring regions. But demographic trends coupled with effects of climate change could aggravate issues of social polarisation and migration pressure with possible repercussions on Europe.*
- *Agriculture and forestry is mainly threatened in the South due to heat waves, droughts and water scarcity in general. Natural hazards and pests may cause additional damage on stressed cultures.*
- *Natural and seminatural ecosystems face increasing pressure due to the coupled effects of land use and management changes and climatic changes such as higher variability in precipitation and increasing temperatures.*
- *Heat related health issues are expected in Southern regions due to high temperatures and in urban regions, where citizens and institutions are not sufficiently prepared for heat waves. City planners have to be aware of this future challenge and thoughtfully integrate water retention areas like unsealed surfaces and green roofs as well as provide shade through trees or architectural measures.*
- *Water dependent sectors will be affected by potential water scarcity in most regions except Northern Europe and western coastal areas. Existing facilities should reconsider their water management and move towards sustainable water usage.*
- *Summer tourism could profit in regions too cold at present, while existing tourism locations in Southern Europe would need to adapt their facilities to even hotter summers..*

7. Secure, sustainable and competitive energy

As was already intensively stressed in the sections on globalization and climate change, energy is one of the most crucial issues Europe is facing and will be facing in the future. Since 2008, European Regions have been challenged by various crises and changes in the energy markets: the oil price spike of July 2008 and the cut-off of the gas supply from Russia via Ukraine and Belarus had severe effects on account of the fact that Russia provides approximately 25% of the natural gas consumed in the EU. In January 2009, the Ukraine-Russia gas dispute grew from a simple business dispute into a transnational political issue to the point of cutting off the gas supply for twenty-two days. Eighteen Member States reported major falls or cut-offs of their gas supplies (Reuters, 2009). Additionally, extreme weather events such as the storm Kyrill in January 2007, but also generally increasing extreme high and low temperature periods, temporarily disabled energy infrastructures and energy supply.

The biggest challenge however was the economic and financial crisis, which has massively weakened the final energy demand. There is clear evidence that energy investments in most regions and sectors dropped sharply in 2009. Decrease in energy demand, especially in OECD countries, contributed to a decline in international prices of oil, natural gas and coal, and both supply and demand side investments are being affected. In the oil and gas sector, there are cutbacks in capital spending as well as delays and cancellations of refineries and pipeline projects. Power sector investment is affected by financing difficulties as well because the cost of capital has risen considerably. Lower energy prices and tighter credits make investments in clean energy technologies less attractive.

There was a positive (external) effect of the crisis: GHG emissions decreased due to economic decline. However, in the mid-term, the economic crisis may lead to higher emissions in a scenario of increasing reliance on fossil-fuel capacities. If a recovery takes longer than expected, a shift to coal- and gas-fired plants in addition to the prolongation of nuclear power plant operation (as already decided in France) at the expense of more capital-intensive options–such as renewables – is expected. Nevertheless, this will depend on the public support mechanisms in the EU27 Member States.

Cutbacks in investments in energy infrastructure will affect capacity with a time lag. In the short-term, weaker demand is likely to result in an increase in spare or reserve production capacity. But there is justifiable danger that sustained lower investment in supply could lead to a shortage of capacity and result in a severe increase of energy prices, just when the economy is on the road to recovery.

In light of this, it is expected that the effects of the crisis on investments in the EU energy sector, the EU's increasing dependence on fossil fuel imports from non-EU countries and extreme weather events will affect regional competitiveness and that some regions may be more exposed than others. Thus, the following three key issues will be covered in the vulnerability analysis (cf. Ecofys 2009):

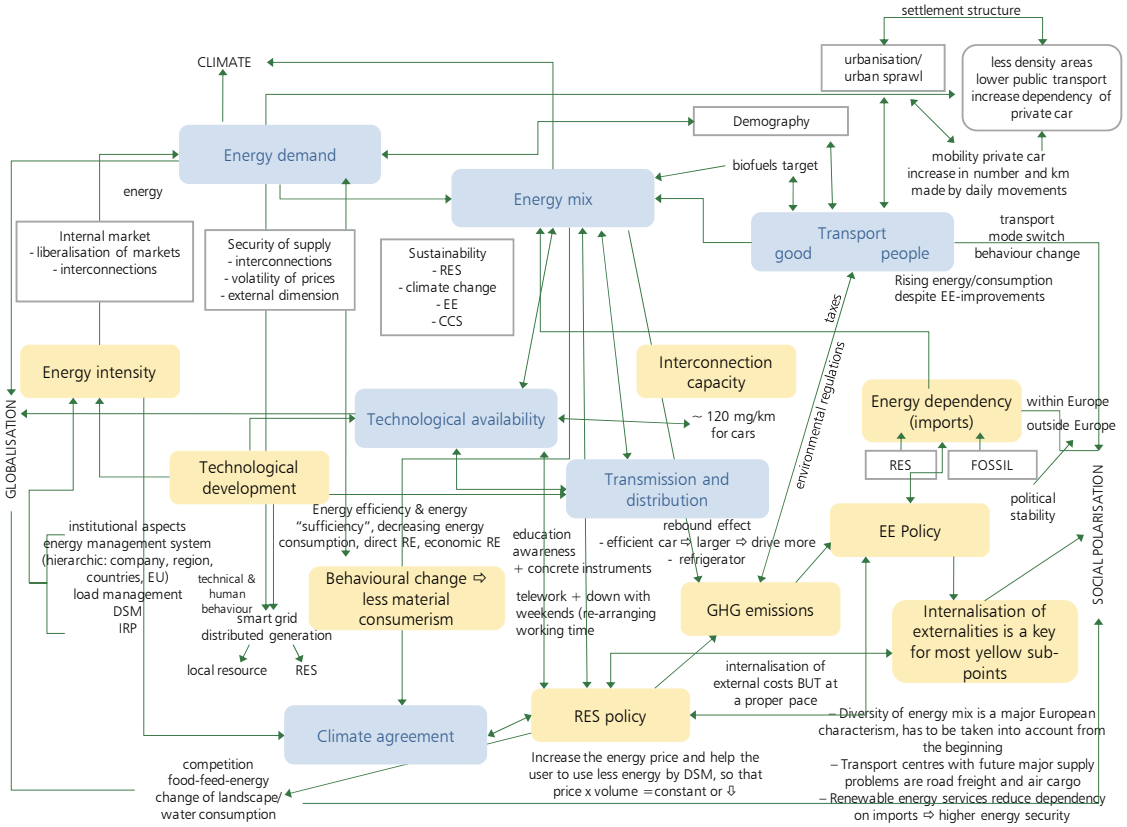
Insufficient investments in new **energy capacities**: Market structures which fail to generate timely investments in key energy system infrastructures can contribute to making the system more vulnerable and ultimately generate energy insecurity. The investments in new energy efficient and renewable energy capacity are also very much associated with climate change mitigation.

Fossil energy supply shortfall (and security): Due to the concentration of resources in certain regions of the world, exploration and production as well as transport of fuels are also concentrated and can create supply shortfall. This generates a certain degree of market power which can adversely affect energy systems. Reducing dependence on imported fuels and diversifying the EU's energy supply pool is a key option to help address increasing competition for scarce natural resources on a globalised stage. However, enhancing security of supply can have positive or negative effects on the environment, both within the EU and outside its borders, depending on which fuels are being replaced.

Peak energy demand (and security): Extreme weather events can temporarily disable energy infrastructures and the supply of energy. Examples are storms (disabling transmission systems), exceptionally cold or hot days (demand side) or on the supply side (e.g. reduced cooling water availability).

The systematic graph in Figure 13 covers other inter-linkages between the energy challenge and the other challenges.

Figure 13 Systemic overview of climate change issues



Energy capacities

Investments in new electricity generation, transmission & distribution capacities are in most cases dependent on decisions made on a commercial basis within the private sector, given the competitive nature of the EU electricity markets. In certain cases, it could lead to underinvestment. Thus, the main hypothesis of the first energy key issue is that there are insufficient investments in new capacities in the power sector. This is caused by weak electricity demand on account of the economic crisis as well as project financing difficulties due in part to a considerable rise in the cost of capital. In the long-term, insufficient investments in new capacities can result in severe increases in the electricity prices due to increasing energy demand in times of recovery from the economic crisis.

Companies with a strong balance sheet at the moment are still investing but some companies have announced a review of their investment strategies both in the EU and in producing countries. Several infrastructure projects have been delayed or cancelled. For renewable energy, new investment only rose by 2% in 2008 and it was expected that 10 to 15% of wind energy projects would be delayed or cancelled in 2009 (European Commission, 2010a). The extension of Germany's nuclear power plant operations for up to fifteen years beyond the scheduled phase is also a consequence of decreased investments in the power sector.

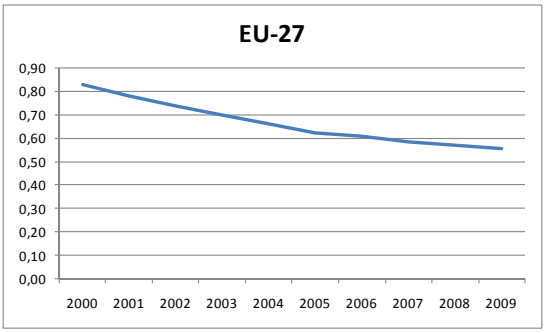
The indicator system for regional vulnerability

Indicators used to describe the **exposure** towards insufficient investment in new power capacity will be the average load factor as well as the flexibility margin. The *average load factor* is the average power divided by the peak power, over a period of time. The peak may be a theoretical maximum, rather than a measured maximum. In the case of a base load plant, revenues are determined by time-weighted average prices. In the case of a plant running at a lower load factor, e.g. a peak load plant, the volatile captured prices[4] is the determinant. Thus, as the load factor drops, the profitability of the power plant decreases and financing becomes more difficult. The *flexibility*

[4] Average of prices during the periods in which the plant is running

margin measures the ability of the power system to respond with sufficient quickness to increases in peak demand and/or reductions in intermittent supply (i.e. loss of wind generation). A decreasing flexibility margin increases the vulnerability of the energy system. Figure 14 shows the flexibility margin for EU27 which has been declining steadily since the year 2000. Figures above zero represent sufficient available flexibility. The decrease of flexibility margin is due to an increase of wind generation capacity – between 2000 and 2007 the installed wind energy capacity increased from around 13 GW to 57 GW with an annual growth rate over 20% – as well as an increase in peak demand, e.g. increased cooling in the summer (Eurostat, 2010).

Figure 14 Flexibility margin EU27 2000-2009



Source: Ecofys 2009

The **sensitivity** of regions will depend on the development of the *share of electricity in total final energy consumption*, *share of wind in net generation*, as well as the development of the *electricity market price*. The hypothesis behind this is that the higher these indicators, the more sensitive a region will be towards insufficient investments in new power capacity. More people combined with more electric household devices (modern flat screen TVs, computers), electric heating and low energy houses lead to higher demand for electricity. Erratic supplies from wind farms increase the need for balancing power (gas-fired) or storage capacity for intermittent renewable electricity. Imbalances on the electricity market with the supply not meeting the demand cause an increase of prices.

The *electricity intensity index*, showing the development in comparison to 1990, and the *GDP per capita* are used as indicators for the regional **adaptive capacity** towards the energy challenge. Low energy intensity and a high GDP will facilitate the adaptation towards the negative effects of this challenge.

The role of neighbouring countries and cross-border effects

The global economic crisis has resulted in a decrease in investment throughout the neighbouring countries and a fall in energy investment worldwide. In addition, disputable property ownership and a weak rule of law discourage domestic and foreign investments in the energy sector. This context contrasts with the needs for investment in renewable energies, energy efficient technologies and the expansion of the current UCTE synchronous area eastwards and southwards, in response to requests coming from other systems (e.g. Turkey, Ukraine, North Africa). The neighbouring oil and gas producing countries are being badly hit by three major shocks: the financial turbulence, which has greatly curtailed access to external funding; slumping demand from advanced economies; and the related fall in commodity prices, notably for gas and oil.

On the other hand, the DESERTEC project has to be mentioned. DESERTEC is a concept proposed by the DESERTEC Foundation for making use of solar energy and wind energy in the deserts worldwide. This concept will be implemented in North Africa and the Middle East by the consortium DII GmbH formed by a group of European companies and the DESERTEC Foundation. DESERTEC officials say the project could one day deliver 15% of Europe's electricity. According to the report by the Wuppertal Institute for Climate, Environment and Energy and the Club of Rome, the project could create 240,000 jobs and generate €2 trillion worth of electricity by 2050.

Table 19 Indicators used for 'Energy capacities' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	Average load factor	0.10 (Southern and Eastern, IE)	0.35	0.48 (Prov. Luxembourg, BE)	0.07
	Flexibility margin	-0.65 (Luxembourg, LU)	0.66	5.19 (Latvia, LV)	0.78
Sensitivity	Share of electricity in total final energy consumption	11.93% (LU)	20.04%	34.31% (SE)	3.81
	Share of wind in net generation capacity	0.00 (CY/SI/MT)	5.15	23.83 (DK)	6.13
	Electricity Market Price (Domestic)	0.09 (LV)	0.17	0.27 (DK)	0.05
	Electricity Market Price (Industry)	0.05 (EE)	0.10	0.15 (IT)	0.03
Adaptive capacity	Electricity intensity index	54.72 (Lietuva, LT)	438.73	118.57 (Luxembourg, LU)	29.21
	GDP per capita	2000.00 (Van, TR)	23,805.14	96,000.00 (Inner London, UK)	14,279.77

The vulnerability map

The energy vulnerability indicator for insufficient investment in new capacities shows that Germany, Sweden, coastal regions in Spain, Slovenia, as well as Denmark and Ireland have an above average vulnerability (see Map 32). Apart from Sweden and Slovenia, those regions have a particularly high share of wind in the electricity generation mix. South-Western Europe as well as Austria, Finland, Hungary, Slovakia, the Czech Republic and Bulgaria have an average vulnerability. Most regions in Poland, Romania, Greece as well as the Baltic States are below average. Regions with low adaptive capacity are located in the new EU member states as well as coastal regions in Spain, while the EU15 are characterized by average or above average adaptive capacity.

A simplified vulnerability of third countries is expressed by the electricity share in total energy consumption. The countries that show higher electricity demand than the European average are therefore most vulnerable to a drop in capacity. Affected are the more industrialised countries Switzerland, Norway and Israel plus Macedonia and the Lebanon.

Figure 15 Town heating pipes supplied by industrial plants and power stations, RO

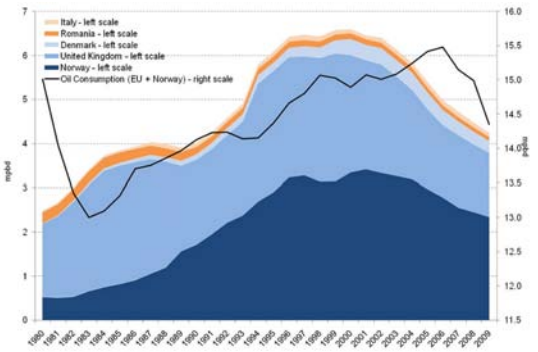
Source: DG Regio

Fossil energy supply shortfall

The concentration of energy resources in certain countries provides a form of market power. If countries with a high concentration of resources like the OPEC countries cooperate to coordinate and unify the petroleum policies to further enhance their position in the market, the possible energy security threats might be even greater. In the case of oil and coal, which are traded on international markets, market power may lead to uncompetitive behaviour, and in particular prices might be set above the competitive levels.

The current energy system within the EU is heavily dependent on imported fossil fuels (cf. Figure 16). Over 53.1% of primary energy consumption in 2007 was imported, and this dependence on imported fossil fuel has been rising steadily (from 51% in 2000). Dependency is increasing rapidly for natural gas and coal. Natural gas imports accounted for some 60% of the total gas-based primary energy consumption in 2007, while for hard-coal based primary energy, imports accounted for 58.5%. Oil imports accounted for as much as 82.6% in 2007 up from 75.9% in 2000 – driven by substantial increases in demand from the transport sector, reflecting a lack of real alternatives in this sector and the low EU oil reserves. Between 1997 and 2007, EU27 primary energy production recorded a 12% reduction due to a decrease in all fuels except for nuclear energy and renewables.

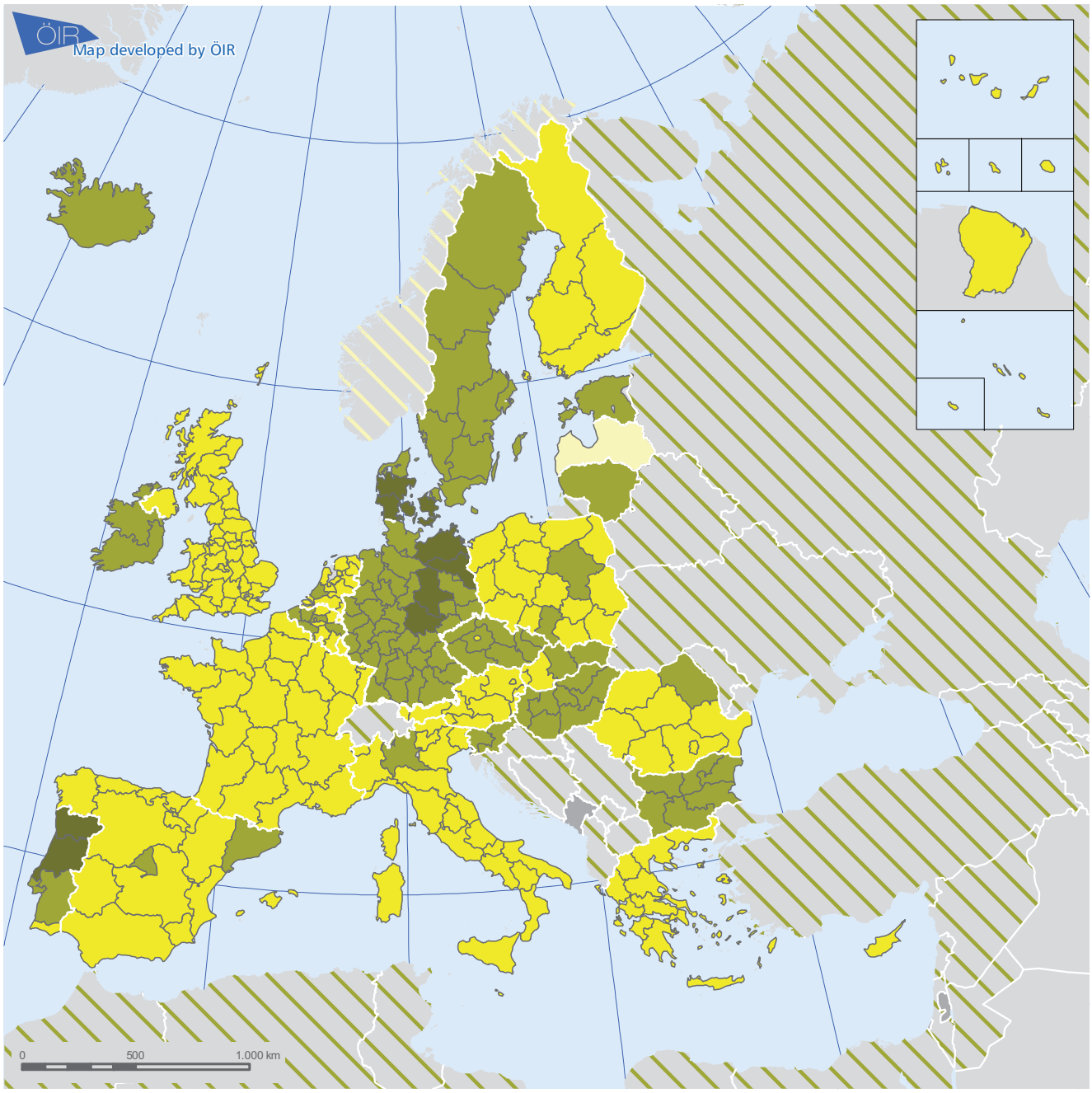
Figure 16 Oil Consumption in the EU and major production sources in Europe (million barrels per day)



Source: BP Statistical Review of World Energy 2010

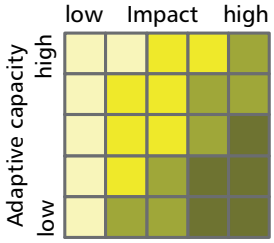
Map 32 Key vulnerability ‘Energy capacities’ (following page)

Energy capacities - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Average load factor (Source: Primes)
- Flexibility margin (Source: Primes)

Indicators describing sensitivity:
- Share of electricity in total final energy consumption
- Share of wind in net generation capacity
- Electricity market price, domestic
- Electricity market price, industry

Indicators describing adaptive capacity:
- Electricity intensity
- GDP per capita

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Share of electricity in total energy consumption

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

In contrast, the production of renewable energy showed a significant increase (50%) and in 2007 accounted for 16% of the total EU27 primary production.

As in 1997, in 2007 nuclear power was the most important primary energy resource (28% share of the total EU27 primary production), followed by natural gas (20%). The main energy producing Member State in 2007 was the United Kingdom with 174 Mtoe, in spite of a 34% drop in its production. Denmark is the only net exporter of crude oil in Europe, while the United Kingdom lost this status in 2006. Several other EU countries also have a notable domestic production of crude oil, such as Romania and Italy; however, this is not enough to cover domestic needs. In Poland, Greece, Estonia and the Czech Republic solid fuels represented over 70% of primary energy production (Eurostat, 2009).

The indicator system for regional vulnerability

The first indicator used for describing the **exposure** to the fuel market risk in question is the more complex *Resource Concentration Price Indicator* (RCPI). The RCPI is based on a measure of market concentration (ESMC) in each international fossil fuel market. For a given country, it weighs the relative importance of each ESMC value based on the exposure of the country to each fuel. The more a country is exposed to high concentration markets, the lower its energy security is. The international gas market in most cases is dominated by long-term, bilateral, oil-indexed contracts, thus removing the price mechanism. Physical risks remain as gas supply relies mainly on transportation and related infrastructure. Reasons for a shortfall of supply might be an unexpected rise in demand in the importing country (e.g. extremely cold winter) or a drop in supply in the exporting country, as shown by the Russia-Ukraine gas disputes. The *Resource Concentration Physical Availability Indicator* (RCPAI) is used to measure vulnerability towards supply shortfall in imports as a combination of the supply of gas imports based on regulated contracts from each country, the total regulated gas imports and a political risk rating for each country

The severity of the impact on supply shortfall in imports will depend on the **sensitivity**, which measures to what extent the supply shortfall can be compensated for by domestic production or increased imports from other countries. The penetration of renewable energies in the European Union will bring significant benefits and will undoubtedly lead to reducing vulnerability, in particular that related to energy import dependence. Thus, the *share of total oil and gas imports* and the *share of renewable energy sources* in the final energy demand have been used as indicators for sensitivity. In addition, the *gas price* is used as an indicator for measuring the vulnerability to rising gas prices. The hypothesis is that the higher the share of oil and gas imports and the lower the share of renewable energy sources in the final energy demand, the higher the sensitivity of the region towards shortfall due to resource concentration.

In line with the energy capacity analysis for **adaptive capacity**, *GDP per capita* has been used as an indicator for the ability of the regions to adapt to supply shortfall due to resource concentration, as well as *energy intensity*.

Neighbouring countries and cross-border effects

Member countries of the European Union import fossil fuels from different regions of the world, with countries of the Former Soviet Union (FSU) and the Middle East and North Africa (MENA) delivering the biggest part of the imported fuels (cf. Map 33). The largest single energy exporter to the EU is Russia, followed by Norway and Algeria. In 2007, 39% of the imported natural gas came from Russia, 26% from Norway and 16% from Algeria. Russia and Norway were the main crude oil suppliers of the EU27 and covered 33% and 15% of the total crude oil imports respectively.

Table 20 Indicators used for ‘Fossil energy supply shortfall’’ vulnerability in NUTS 2 regions

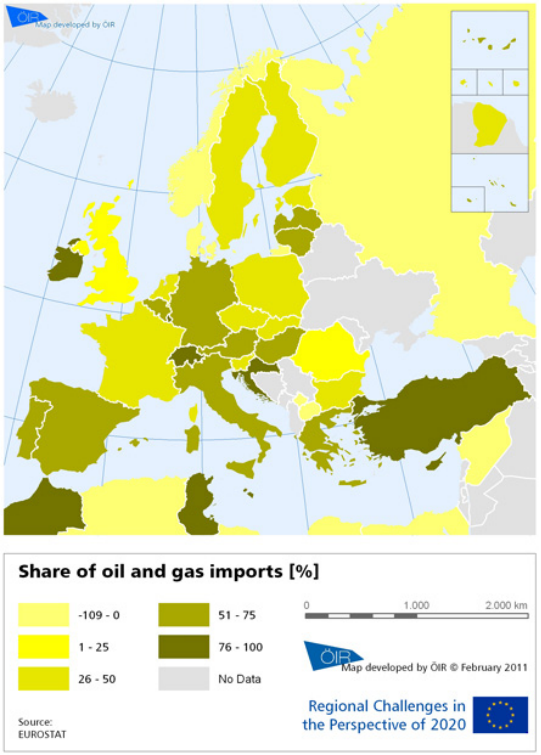
	Indicator	minimum	mean	maximum	SD.
Exposure	Resource Concentration Price Indicator fossil fuels	13.23 (C.A. de Melilla, ES)	894.79	11,361.68 (Luxembourg, LU)	1,489.62
	Resource Concentration Physical Availability Indicator gas	0.40 (Highlands and I., UK)	138.43	5,104.04 (Lietuva, LV)	411.92
Sensitivity	Share of oil and gas imports	-69.07% (DK)	44.05%	100% (MT)	28.03
	Share of renewable sources in final energy demand	0.37% (Luxembourg, LU)	5.32%	25.51% (Latvia, LT)	4.29
	Gas Price (Domestic)	0.03 (FI)	0.07	0.13 (PL)	0.03
Adaptive capacity	Energy Intensity	41.91 (EE)	82.46	105.59 (PT)	14.02
	GDP per capita	2000.00 (Van, TR)	23,805.14	96,000.00 (Inner London, UK)	14,279.77

Russia is also the most important supplier of hard coal with a share of 25%, an almost fourfold increase compared to 2000. In the case of oil, the majority of FSU oil exports to the EU come from Russia, which a considerable volume of oil being transported through the Druzhba pipeline to Central and Eastern European countries. Russia also uses its oil terminals in the Black and the Baltic Sea, from which it delivers the crude oil to the Mediterranean and Northwest Europe.

Besides Russia, other FSU countries such as Azerbaijan and Kazakhstan have also increased their exports to European countries in the last several years. According to BP, the FSU countries exported around 7 million b/d of oil to Europe[5] (incl. refined products) during 2009, which makes up around 52% of total oil imports. A large part of imported oil in Europe comes from the MENA region (Middle East and North Africa). The exports were estimated at around 3.7 million b/d in 2009 (BP data) with the majority of the flows coming from Saudi Arabia, Iran, Kuwait, Libya and Algeria, all being members of the OPEC. Considerable volumes of oil also come from West Africa (around 1 million b/d in 2009) and occasionally from Latin America (some 540,000 b/d in 2009), which is mainly processed in Western Europe or the Mediterranean. European countries import smaller volumes of oil from North America, which is currently mostly comprised of refined products (mainly diesel) flows from the US (see Map 34 on fossil fuel world trade).

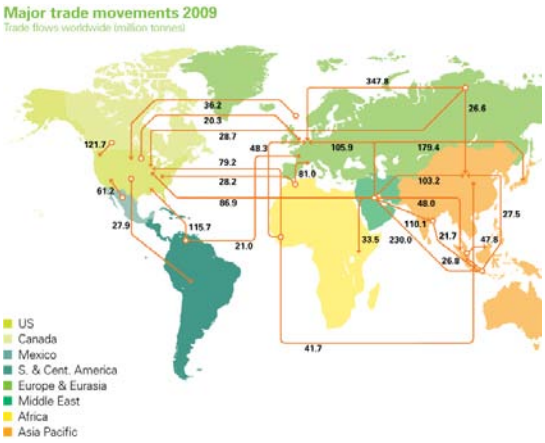
Due to declining production in the North Sea, the import dependency of European countries is expected to increase in the future. At the same time the major exporters are increasingly turning their attention to other regions of the world, predominantly Asia-Pacific and China, where a rapid increase in oil demand is expected in the future. In other words, European countries will have to compete for oil with rising countries in the east such as China. In order to access Asian markets, for instance, Europe's major oil supplier, Russia, has started work on the construction of the East Siberian Oil Pipeline (ESPO). One branch has the capacity of around 600,000 b/d to China (already completed) and the second branch of 1 million b/d going to the Pacific Ocean (1 mbpd).

Map 33 Europe and its neighbourhood: share of oil and gas imports



In 2007, the EU's gas imports comprised some 65% of its total consumption, with over 80% of those imports originating from only three large sellers: around 40% from Russia, 28% from Norway, and about 17% from Algeria. In 2007, the EU's gas imports comprised some 65% of its total consumption. At the same time, the crude oil exports in Europe are expected to decline gradually as the domestic oil demand in Russia rises while the domestic crude oil production is not expected to increase strongly in the mid- and long-term.

Map 34 Major fossil fuel trade movements



Sources: BP Statistical Review of World Energy 2010

[5] NB: Europe is defined as: European Union members plus Albania, Bosnia-Herzegovina, Croatia, Former Yugoslav Republic of Macedonia, Gibraltar, Malta, Serbia and Montenegro, while excluding Latvia, Lithuania and Estonia

Over 80% of those imports originating from only three large sellers: around 40% from Russia, 28% from Norway, and about 17% from Algeria. The Second Strategic Energy Review issued by the European Commission stresses the need for diversification and investment in infrastructure required to connect to new source countries. The Commission's publication "Towards a New Energy Strategy for Europe 2011-2020", suggests coordinated external energy policy to ensure improved security of supply for its Member States. Such a policy could help to "leverage the EU's buying power". Indeed, Russia, Algeria or Norway undoubtedly enjoys market power, but the large EU buyers are not mere price takers, they possess their own counterbalancing buyer power.

The vulnerability map

On the first view on the vulnerability Map 35 the impact of supply shortfall due to resource concentration appears only an "average" challenge for most of the regions in Western Europe. This is to some extent a result of a decrease of energy intensity in all EU Member States as well as the increased use of renewable energy sources. In the new EU Member States recent macro-economic reforms led to particularly strong shifting economy to les energy intensive activities. However, Europe produces less and less and imports more and more energy. Most regions with impact above average towards this challenge are located on the outskirts of Europe in Ireland, the Baltic States as well Bulgaria. Sweden and Poland are below average due to their high energy prices being an incentive for increased energy efficiency. Regions with low adaptive capacity are located in the new EU member states, while the EU15 show average or above average adaptive capacity.

The vulnerability map shows a clear distinction between Western Europe – with the exception of Ireland – and Eastern Europe. Most regions in Western Europe are prepared for fossil energy supply shortfall while in Eastern Europe the vulnerability is above average, Romania, the Baltic States as well as Ireland, as only Western European Country, being most vulnerable. GDP per capita is the driving factor for the vulnerability. High GDP stands for high adaptive capacity in Western Europe vs. low GDP in Eastern Europe and Ireland.

The simplified analysis for the neighbouring countries uses the share of oil and gas imports presented in Map 33 related to the European average as an approximation to fossil fuel supply vulnerability. As it can be seen, most countries show an increased vulnerability with the exception of the fossil fuel exporters Azerbaijan, Algeria, Egypt, Libya, Russia, and Syria. All other countries do not only have to import their fuel demand, but have to import even more than the European average region.

Peak energy demand

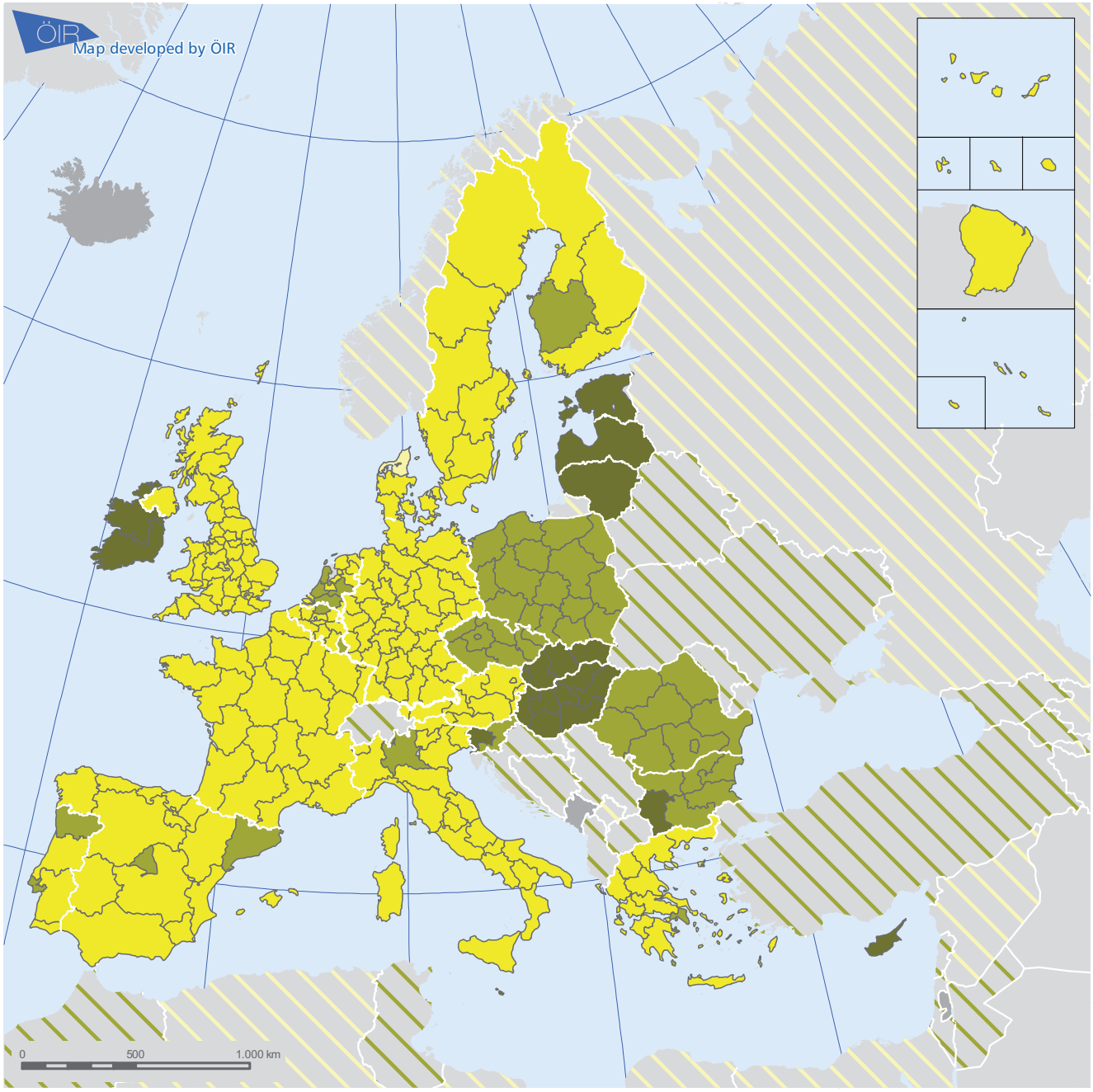
Extreme events (such as weather events, strikes, etc.) put exceptional strain on energy systems by creating a sudden imbalance between supply and demand. They are so rare and so severe that it is difficult for private agents to account from them appropriately and they may therefore lead to energy vulnerability. The supply, transmission, and distribution of energy will be affected by climate change, particularly as the region experiences more climate variability and increasing episodes of extreme weather, such as droughts and flash flooding. Rising temperatures will lead to changes in the level and timing of peak demand, resulting in a flattening of the electricity consumption profile across the year as demand for cooling energy rises and heat energy declines. For Europe, heating demand is projected to decline by 2-3 weeks per year and cooling demand to rise between 2-3 weeks (in coastal areas) and five weeks (in inland areas) by 2050. This represents a decrease in heat energy demand of up to 10%.

The indicator system for regional vulnerability

The indicators used for describing the **exposure** to extreme events in question are *heating and cooling degree days*. Heating degree day (HDD) are quantitative indices designed to reflect the demand for energy needed to heat a home or business. These indices are derived from daily temperature observations, and the heating requirements for a given structure at a specific location are considered to be directly proportional to the number of HDD at that location.

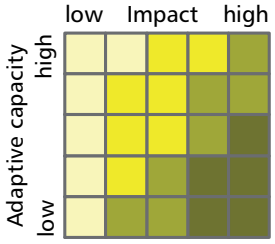
Map 35 Key vulnerability 'Fossil energy supply shortfall' (following page)

Fossil energy supply shortfall - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Resource Concentration Price Indicator fossile fuels (Source: ECOFYS)
- Resource Concentration Physical Availability Indicator gas (Source: ECOFYS)

Indicators describing sensitivity:
- Share of oil and gas imports
- Share of renewable sources in final energy demand
- Gas price, domestic

Indicators describing adaptive capacity:
- Energy intensity
- GDP per capita

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Share of oil and gas imports

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

Table 21 Indicators used for 'Fossil energy supply shortfall' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	Cooling Degree Days	0.74 (Highlands and Islands, UK)	174.33	1,078.61 (Sanliurfa, TR)	181.36
	Heating Degree Days	763.00 (Kypros/Kibris, CY)	4,762.37	6,996.02 (Pohjois Suomi, FI)	755.31
Sensitivity	De-rated electricity peak capacity margin	-0.71 (Luxembourg, LU)	0.00	0.93 (Lietuva, LT)	0.25
	Share of electricity in total final energy consumption	11.93% (LU)	20.12%	34.31% (SE)	3.63
Adaptive capacity	Electricity intensity index	54.72 (Lietuva, LT)	438.73	118.57 (Luxembourg, LU)	29.21
	GDP per capita	2000.00 (Van, TR)	23,805.14	96,000.00 (Inner London, UK)	14,279.77

A similar index, cooling degree day' (CDD), reflects the amount of energy used to cool a home or business. HDD are defined relative to a base temperature – the outside temperature above which a building needs no heating. HDD can be added over periods of time to provide a rough estimate of seasonal heating requirements. CDD provide a rough estimation of seasonal cooling requirements (e.g. the CDD for Düsseldorf is 111 whereas for 748 Extremadura). Thus, one can say that, for a given home of similar structure and insulation, around 7 times the energy would be required to cool the home in Estremadura than in Düsseldorf.

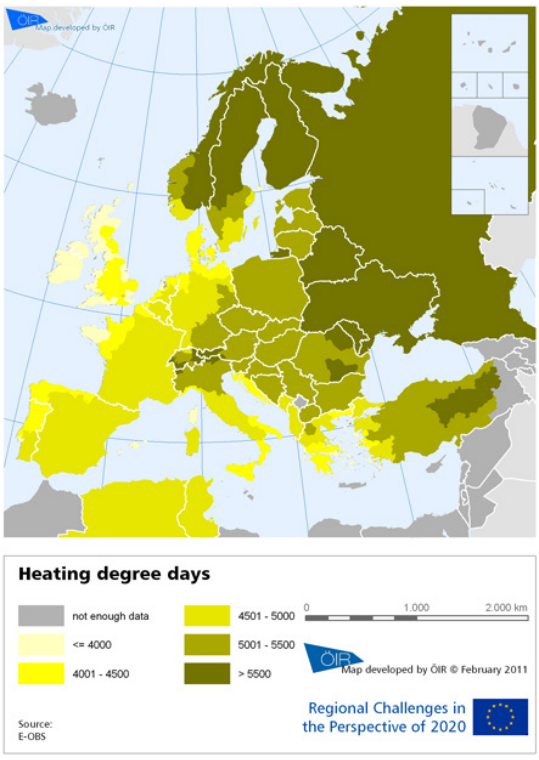
The **sensitivity** of the electricity system towards extreme events will depend on *de-rated electricity peak capacity margin* and the *share of electricity in final energy consumption*. The de-rated electricity peak capacity margin scales back nameplate capacity by the expected availability of each plant at peak demand, taking into account probability of forced outages and expected output from intermittent renewables. In line with the energy capacity analysis for **adaptive capacity**., *GDP per capita* has been used as indicator for the ability of the regions to adapt to extreme events. In addition, electricity intensity was used as second indicator for adaptive capacity.

Neighbouring countries and cross-border effects

Despite the financial crisis, it is estimated that there will be a rise of energy needs over the next 20 years in the neighbouring countries of the EU. Those countries are experiencing demographic growth and sustained urbanisation that involves more services, more infrastructures and, therefore, more energy consumption. The IPCC points out in its latest report that the Mediterranean is one of the most vulnerable to the consequences of climate change. Therefore, a very high growth in the consumption of fossil energies is an unsustainable future scenario given that the impact of pollution in the environment would be amplified and contribute to the acceleration of climate change. If the current energy model is continued, the CO2 emissions from the consumption of fossil energies could rise by 10% in the countries of the north and by 100% in the Mediterranean Countries from 2005 to 2030.

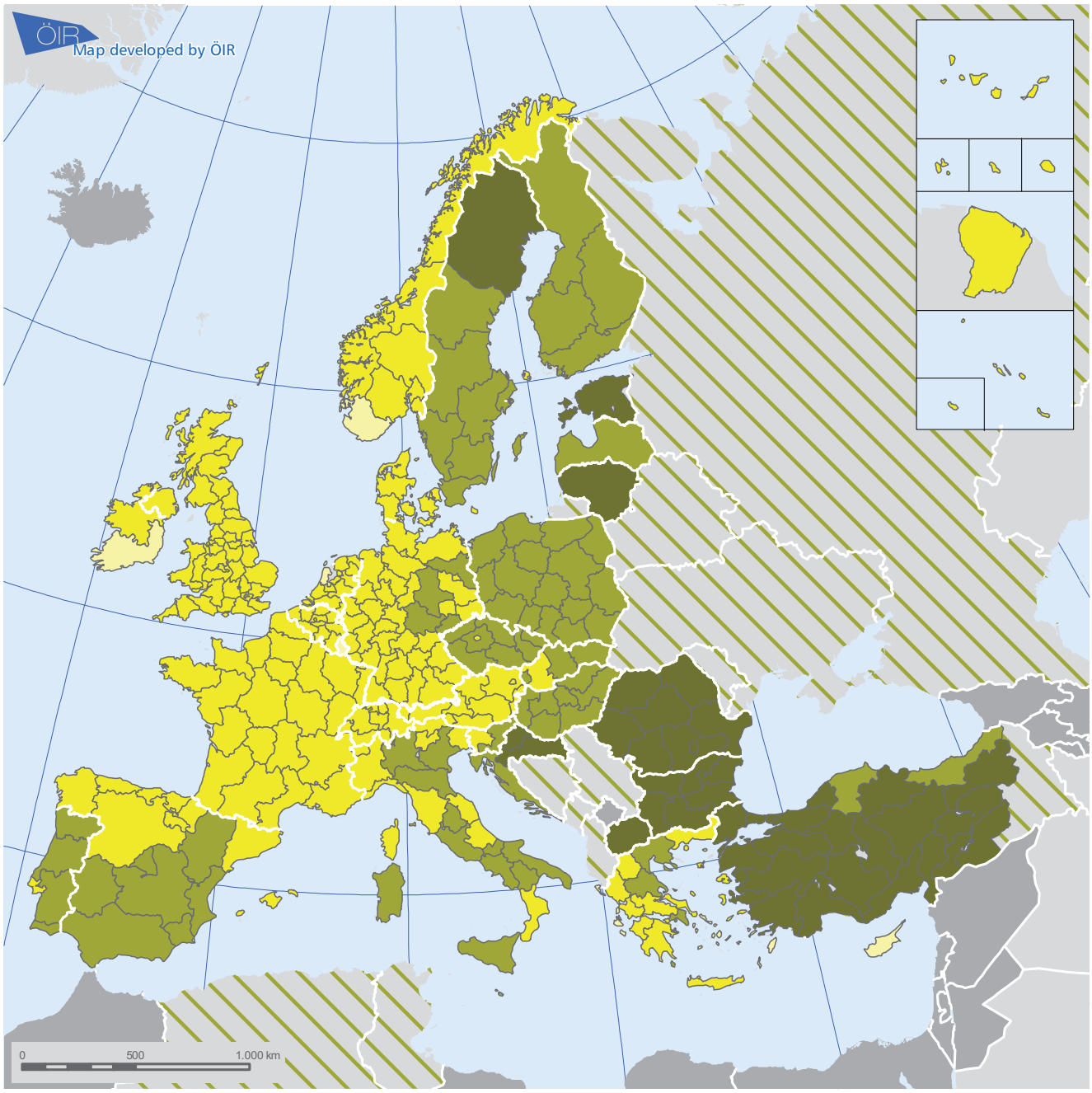
The exploitation of the renewable energy potential in the Mediterranean(e.g. DESERTEC) and energy efficiency in the Eastern Neighbouring countries might decrease the demand for domestic fossil energy resources (resulting also in generation of extra income from fuels export). In addition direct investment, the export of clean energy to the EU, the creation of jobs, the promotion of R&D and the transfer of technology and know-how are some of the benefits that the neighbouring could capitalize on without harming the environment.

Map 36 Europe and its neighbourhood: heating degree days



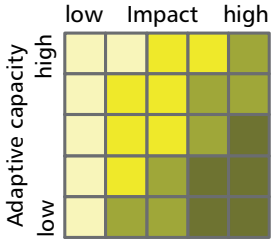
Map 37 Key vulnerability 'Peak energy demand (following page)

Peak energy demand - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- De-rated electricity peak capacity margin (Source: ECOFYS)

Indicators describing sensitivity:
- Cooling degree days (Source: E-OBS)
- Heating degree days (Source: E-OBS)
- Share of electricity in total final energy consumption (Source: ECOFYS)

Indicators describing adaptive capacity:
- Electricity Intensity
- GDP per capita

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Heating Degree Days (Source: E-OBS)

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

The vulnerability map

Map 37 shows the vulnerability results for this key issue. The regional impact of peak energy events on the energy system is high in the regions on the Southern and Northern edge of Europe, while in Central Europe the impact is average. In the United Kingdom, Ireland, Denmark Northern Germany ands well as Poland, Lithuania and Latvia the impact is even below average. Increasing numbers of CDD in Southern Europe will increase the demand of electricity during summer, thus increasing the vulnerability of the energy system in those countries. Vice versa in Northern Europe, namely Sweden and Finland a growing number of HDD will increase the energy demand in winter. In Central Europe, the impact of increasing number of CDD will be outbalanced by a decreasing number of HDD.

The regional vulnerability of peak energy events shows a similar picture as for the impact: regions at the Northern and Southern edge are (most) vulnerable regions. Due to the higher GDP per capita in central Spain the adaptive capacity decreases the vulnerability while low GDP per capita increases vulnerability in the Northern Regions of Turkey, Romania as well as Slovenia. The same applies for some regions in Poland as well as the Baltic States. Both countries also show an increase in electricity intensity resulting from growth in the usage of electric applications in the household sector.

The simplified analysis for the neighbouring countries uses the heating and cooling degree days, i.e. only the exposure indicators. All countries where indicators were available have either very high heating or cooling demand – or both – and appear therefore more vulnerable than the European average.

An integrated picture of the energy challenge

The regional dispersion for the energy challenge cluster typology shows a relatively nationally biased picture. This does not come as a surprise since supply grids, energy economics and energy policy are usually federally driven. The resulting Map 38 reveals some interesting deviations from the “usual” European pattern of a South-North and East-West divide. The similarities of regions point at “belts” of vulnerabilities across Europe: with a South-Western belt and North-Eastern belt showing similar characteristics, and an Eastern belt which can be distinguished from a South-Eastern belt. The Northern belt (Sweden, Denmark, Iceland and Ireland) complete the picture. In the following, the specific differences will be explained in more detail.

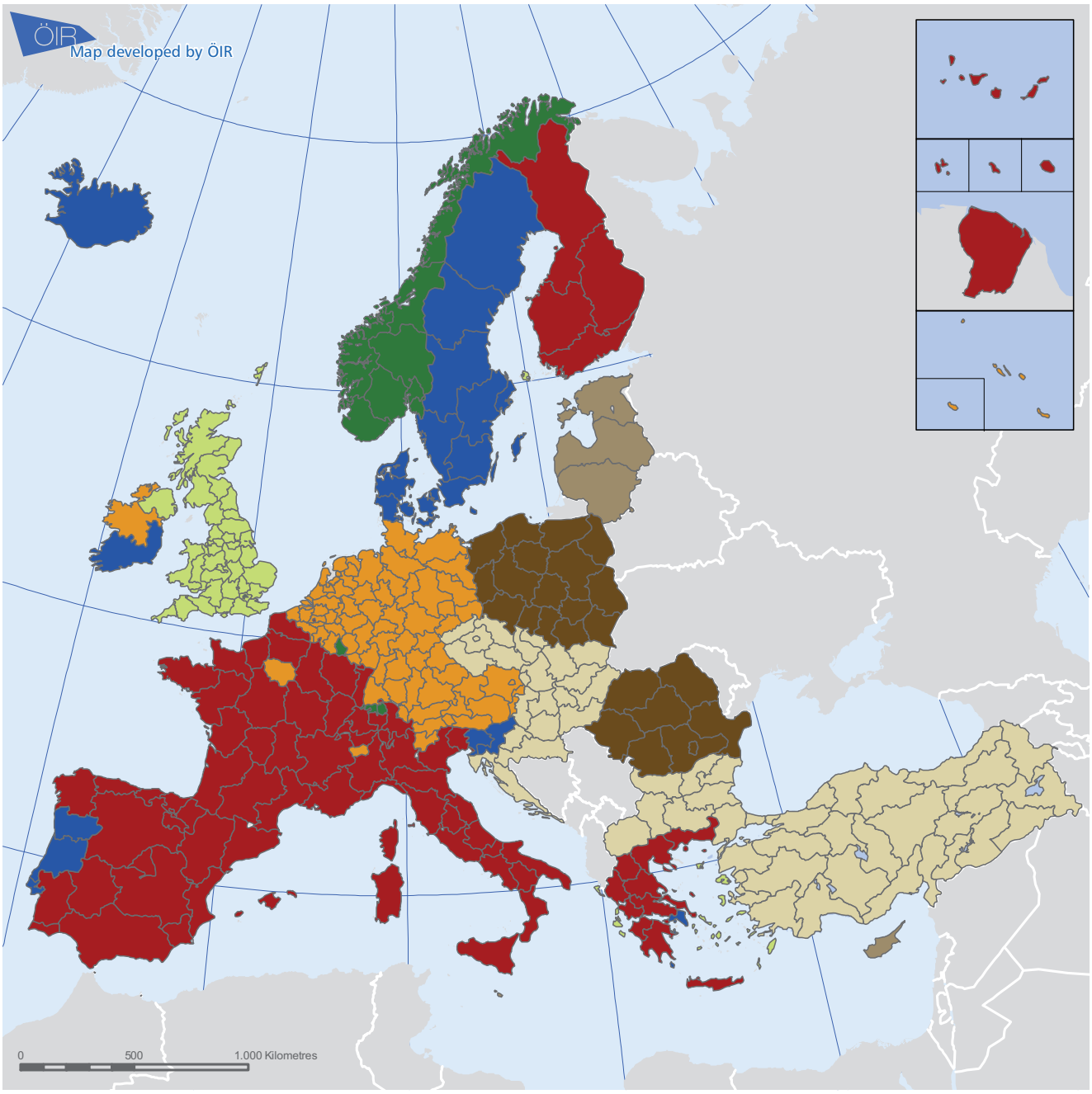
The first two types of regions have in common a low energy vulnerability. ‘**United Kingdom and islands**’ cluster consists of forty NUTS 2 regions, which cover Great Britain (including Northern Ireland) and islands in Finland and Greece. The cluster is characterized by an overall average performance of the vulnerability vectors in all key issues. The only exception is a well below average exposure in the key issue peak energy demand. In other words, these regions are far less vulnerable with respect to extreme energy events than the average European regions. A similarly good performance may be observed for the exposure in the key issue energy capacities, which may be an explanation for the overall low vulnerability of these regions vis-à-vis the challenge sustainable and competitive energy. The ‘**most ‘wealthy’ regions**’ cluster covers twelve NUTS 2 regions, which are found in Norway, Luxembourg, Switzerland and Liechtenstein. This cluster is characterised by relatively high economic wealth and thus the adaptive capacities in all three key issues are highly above average. Especially the adaptive capacities in the key issue energy capacities and peak energy demand are remarkably high. Thus, generally speaking, this set of regions is well guarded against the challenge of sustainable and competitive energy. However, this low vulnerability is highly dependent on the strong economic performance, which might be debatable as it relies fundamentally on energy as the primary input, so that in the long run the picture in these regions may change.

Figure 17 Offshore wind turbines Samsø, DK

Source: DG Regio

Map 38 Cluster analysis indicating the vulnerability for the energy challenge (following page)

Secure, sustainable and competitive energy - Integrated vulnerability



Type of Regions

Low energy vulnerability regions

- Low energy vulnerability - United Kingdom
- Low energy vulnerability - Most 'wealthy' regions

Regions with energy capacity deficits

- Regions with energy capacity deficits

Energy import dependent regions

- Energy import dependent regions with moderate vulnerability
- Energy import dependent regions with peak capacity vulnerability

Low energy efficiency regions

- Eastern and South-eastern low energy efficiency regions
- Baltic and Cypriotic low energy efficiency regions
- Polish and Romanian low energy efficiency regions

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

ÖIR Map developed by ÖIR
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Regional Challenges in the Perspective of 2020

Another group is the '**regions with energy capacity deficits**'. This cluster includes twenty-one regions, which cover Northern Europe and comprise Sweden, Denmark and Iceland as well as parts of Ireland, Portugal, Slovenia and Greece. The cluster is characterised by a relatively high exposure in the key issue energy capacities, which is accompanied by slightly increased sensitivity and around average adaptive capacity – thus in the end resulting in an increased vulnerability. For fossil energy supply on the other hand, the sensitivity is relatively low with a slightly increased exposure and slightly increased adaptive capacity – thus reducing the overall vulnerability of these regions. The key issue peak energy demand shows only an increased sensitivity with average adaptive capacity and exposure. Thus a slight increase in overall vulnerability stemming from this field might be considered. All in all, a moderate vulnerability of these regions can be observed due to their exposure vis-à-vis the energy capacities.

The '**energy import dependent regions with moderate vulnerability**' cluster consists of seventy-seven regions, which cover Central Europe (i.e. Germany, Belgium, the Netherlands and Austria) as well as urban regions in France and parts of Ireland. It is characterised by a generally average performance with respect to vulnerability vis-à-vis sustainable and competitive energy. The only weakness to be observed is in the key issue energy capacities, where an above average sensitivity and weak adaptive capacity compared to the EU average must be observed. The similar energy '**import dependent regions with peak capacity vulnerability**' cluster comprises eighty-three regions and is, therefore, the biggest cluster in this sample. The cluster covers most of the countries Spain, France, Italy, Greece and Finland and parts of Portugal, Switzerland and Belgium. The cluster is characterised by an average performance with respect to the vulnerability of regions. The only significant difference to the former similar cluster is its above average performance in adaptive capacity of the key issue fossil energy security. This performance is accompanied by a slightly underperforming sensitivity in this field. Another slightly higher sensitivity may be observed for peak energy demand, which is at least accompanied by a slightly above average adaptive capacity. In other words, energy intensity and the proneness to energy events are the Achilles' heel of these regions; however, their adaptive capacity seems high enough to respond to these challenges and maintain an average overall vulnerability.

The '**Polish and Romanian low energy efficiency regions**' are characterised by low adaptive capacities. However, unlike cluster 3 the South-Eastern belt, where similar traits are to be observed, the adaptive capacities are not that low and are not accompanied by increased exposures and/or sensitivities. The adaptive capacity in the key issue fossil energy security is relatively low compared to the EU average. Still, the sensitivity is significantly below average, thus resulting in only a moderate increase in the overall vulnerability of these regions. The same holds true for the key issue peak energy demand, where the adaptive capacity is relatively low. In this field the sensitivity is below average, but the exposure is slightly above average, thus resulting in a slight increase in overall vulnerability. Generally speaking, cluster 8 shows only a very slightly increased vulnerability for the challenge of energy. The '**Eastern and South-Eastern low energy efficiency regions**' cluster comprises fifty-five regions, which cover the South-Eastern periphery of Europe: the Czech Republic, Slovakia, Hungary, Croatia, Bulgaria and Turkey. The cluster is characterised by a comparably low level of adaptive capacities in all three key issues – i.e. generally weak adaptive capacities with respect to sustainable and competitive energy. Especially the adaptive capacity in the key issue fossil energy security performs below the EU average. This deficiency is accompanied by an above average exposure in this field – resulting in an increased vulnerability. The adaptive capacity in the key issue Peak energy demand is similarly low with an even higher exposure – thus increasing the overall vulnerability of these regions even more. The remaining '**Baltic low energy efficiency regions and Cyprus**' cluster only consists of five NUTS 2 regions, which include the three Baltic countries Latvia, Estonia and Lithuania as well as the islands Malta and Cyprus. The common features of this cluster are the diverse picture of the exposures vis-à-vis sustainable and competitive energy. While the exposure in the key issue fossil energy security is relatively high compared to the EU average, the exposures in the key issue energy capacities and peak energy demand due to climate change are comparably low. Specifically, this means that the supply with fossil fuels seems to increase the overall vulnerability of these regions. This fact is underlined by the relatively low adaptive capacity in this field. However, adaptive capacities are relatively low for all three key issues compared to the EU average. On the whole, this leads to an increased overall vulnerability for these regions – however limited to the specific case of fossil fuel supply.

Mid-term scenarios

Given the competitive nature of European energy markets, investments in new **energy capacities** mainly depend on decisions made on a commercial basis within the private sector. The economic crisis contributed to a decrease in energy consumption, leading to negative impacts on investment decisions at all levels – public, commercial and private. Thus, in 2009, as the financial and economic crisis unfolded, public expenditure interventions to facilitate investments in energy networks became necessary. EU institutions agreed on the creation of the European Energy Program for Recovery (EEPR), which allocates €3.98 billion to finance mature energy infrastructure and technology projects, e.g. CCS and offshore wind, during 2010 and 2011. As a result of the recession, planned projects were in danger of being delayed or withdrawn, which would have undermined the European Union's security of energy supply. The EEPR aims at stimulating recovery from the downturn that is affecting the EU economy while enhancing the achievement of the EU's energy and climate policy objectives. This unprecedented financial stimulus package was added to the various existing energy financing instruments. EEPR focuses on a relatively small number of highly strategic projects. EEPR funding shall have a catalytic effect in attracting co-financers and encouraging them to make investment commitments. This has made possible the launching of projects that otherwise could be delayed or abandoned due to funding constraints, which are particularly severe under the current economic circumstances. In the mid- to long-term, only a properly functioning internal electricity and gas market can send the right price signals to encourage investments.

The integration of the EU energy market is set to continue but it may take some time because the planning and building of relevant infrastructure involves long time horizons. In the case of electricity, for example,, according to ENTSO investment costs range between EUR 23 to 28 billion for the completion of transmission projects of European significance (in order to reach the objectives of the further integration of the internal market, RES integration and security of supply) within the period 2010-2014. The EU Energy Strategy 2011-2020 also encourages supply diversification with a focus on increasing imports from new suppliers for **fossil energy security**. Here the EU has been particularly active – as witnessed by the recent 200 million Euro support of the Nabucco pipeline project, under the Economic Recovery Package. Importers who contract with new exporters benefit from the expansion of opportunities to purchase gas. However, those buyers who are not engaged with the new suppliers will also benefit. They will find themselves in a better bargaining position vis-à-vis the “old” suppliers. To see this, consider the example of Italy investing in a pipeline to buy gas from a new supplier. Russia’s potential gains from trading with Italy will decrease if Italy can buy gas elsewhere. As a consequence, other buyers (such as Germany) also enjoy increased bargaining power when negotiating with Russia: the latter’s outside option of selling gas to Italy has become less valuable. This bargaining power effect warrants buyers’ cooperation in increasing import capacities beyond the individually preferred level.

Energy efficiency and changes in the electricity sector play major roles in the longer term on **peak energy demand**. These impacts will be felt differently between northern and southern Europe. To decrease the number of peak energy events, resulting from climate change, energy-related emissions of greenhouse gases, which are emitted as by-products in the combustion of fossil fuels, will ultimately have to be reduced to a fraction of current levels. Whether through the adoption of economic instruments – such as carbon taxes or emissions trading schemes – or more hands-on measures, emissions reductions can be achieved in a number ways, including end-of-pipe approaches such as improved end-use efficiency and, in the future, carbon capturing and sequestration, or more up-stream measures such as fuel switch from fossil to renewable energy. Consequently, policy implication actions are likely to overlap with those targeting fossil fuel energy supply shortfall. An early emphasis on technological change, rather than a narrow focus on cost effectiveness, would best serve the long-term goals of decreasing peak energy events due to climate change and of increased energy security.

Table 10 gives a qualitative overview of the most probable energy developments according to the three scenarios.

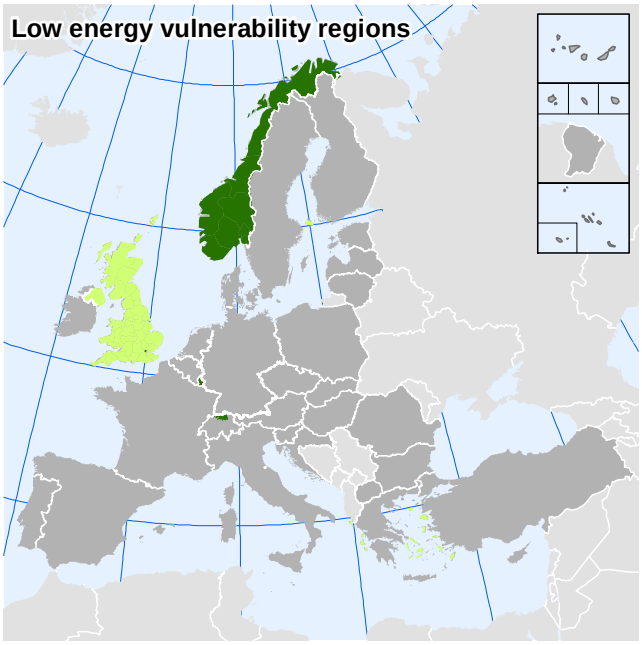
Figure 18 Scenario overview for the secure, sustainable and competitive energy challenge

scenarios	trends ↗ situation improves ➔ situation stable ↘ situation worsens	groups of regions low energy vulnerability regions	Regions with energy capacity deficits	energy import dependent regions	low energy efficiency regions
Energy capacities					
Sustainable recovery	Improving energy intensity. Growing share of efficient cogeneration in energy generation mix. Modest increase of renewables share in electricity generation.	↗	↗	➔	↘
Sluggish recovery	High net power capacity increase. High growth of renewable share in electricity generation.	➔	↗	➔	➔
Lost decade	Modest increase of power capacity. Stable share of fossil fuel power generation as well as cogeneration.	➔	↘	➔	↗
Fossil energy supply shortfall					
Sustainable recovery	Energy intensity improves due to structural changes. Import dependency increases. Growing share of renewable energy in final energy demand.	↗	↗	➔	↘
Sluggish r.	High oil price increase. EU is going to meeting 2020 renewable energy target.	➔	↗	➔	➔
Lost decade	Modest energy intensity improvement due to modest increase of oil prices. High growth of energy import dependency	➔	↘	➔	↗
Peak energy demand					
Sustainable recovery	Load factor for net electric capabilities increases slightly. Electricity intensity improves. Growing share of electricity in final energy demand.	↗	↗	➔	↘
Sluggish recovery	Decreasing load factor for net electricity capacity. Electricity generation from wind almost triples.	➔	↗	➔	➔
Lost decade	Slightly decreasing load factor. Wind energy generation doubles but EU 2020 renewable energy targets will not be met.	➔	↘	➔	↗

Map 39 Mid-term scenarios for the secure, sustainable and competitive energy challenge (following page)

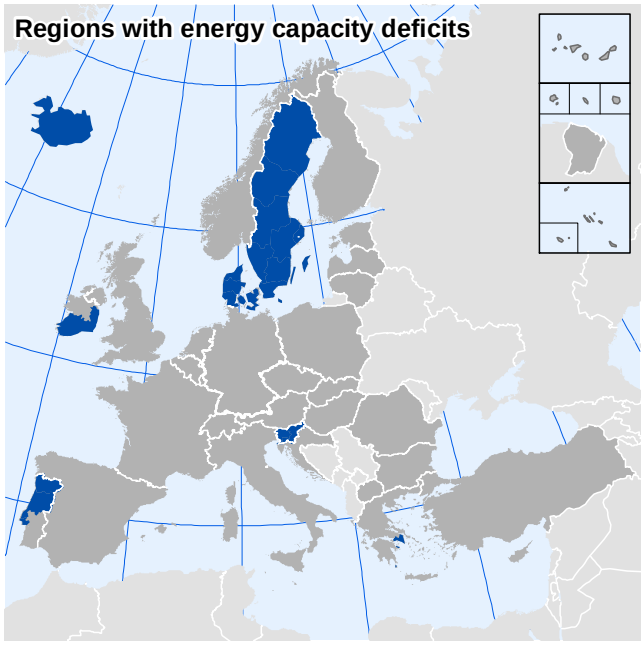
Scenarios for the energy challenge

Low energy vulnerability regions



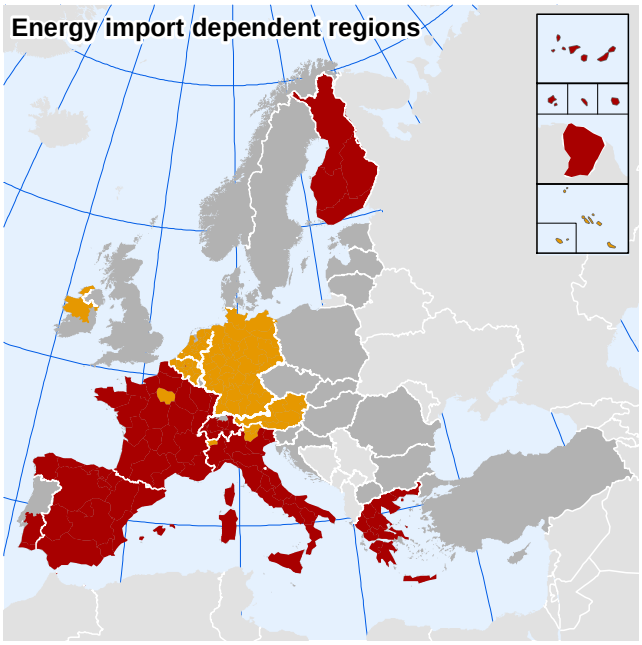
Energy capacities	↗ → →	Low energy vulnerability - United Kingdom
Fossil energy security	↗ → →	Low energy vulnerability - Most 'wealthy' regions
Peak energy security	↗ → →	Other Group of Regions

Regions with energy capacity deficits



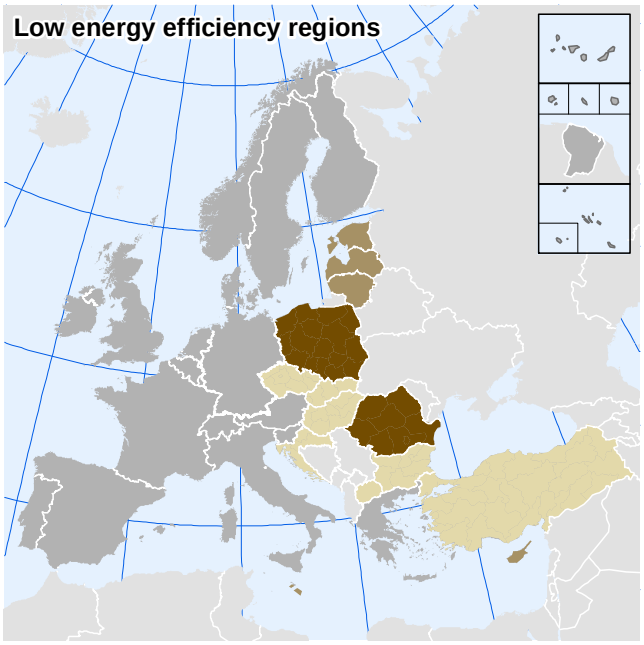
Energy capacities	↗ ↗ ↘	Regions with energy capacity deficits
Fossil energy security	↗ ↗ ↘	
Peak energy security	↗ ↗ ↘	Other Group of Regions

Energy import dependent regions



Energy capacities	→ → →	Energy import dependent regions with moderate vulnerability
Fossil energy security	→ → →	Energy import dependent regions with peak capacity vulnerability
Peak energy security	→ → →	Other Group of Regions

Low energy efficiency regions



Energy capacities	↘ → ↗	Poland and Romania
Fossil energy security	↘ → ↗	Eastern and Southeastern Europe
Peak energy security	↘ → ↗	Baltic States and Cyprus
		Other Group of Regions

Prospects 2020

Trends	Scenarios: Sustainable recovery	Sluggish recovery	Lost decade
Challenge increases	↗	↗	↗
Challenge constant	→	→	→
Chellenge reduces	↘	↘	↘
Unknown	?	?	?

Type of Region

- Type of Region
- Other Group of Regions
- Neighbouring Countries

Kilometres

0 1.000 2.000 3.000 4.000

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Indicator data source
Eurostat except were indicated

Map developed by ÖIR
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Regional Challenges in the Perspective of 2020

The challenge of secure, sustainable and competitive energy in a nutshell

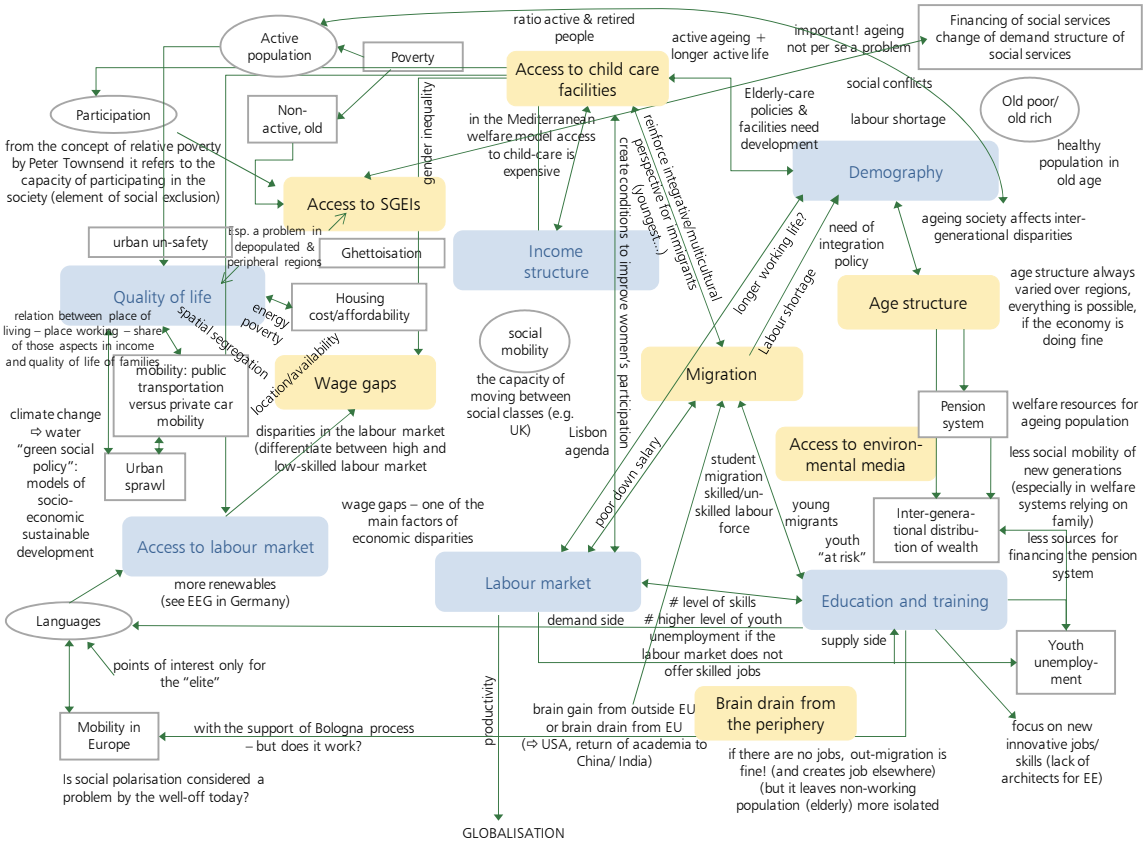
- *Generally, most European countries depend on imported fossil fuels. Only Norway, Denmark and the UK are able to cover most of their demand from own resources which makes them less vulnerable towards global developments.*
- *Denmark does have, however, capacity vulnerability in power production as do Slovenia, Sweden, Iceland, Portugal,*
- *The same can be said about countries with larger shares of renewables, i.e. Portugal, Austria, Romania, Finland and Sweden, but they might still be vulnerable towards climate change driven changes in water regimes if they depend on hydraulic power.*
- *All New Member states and the candidate countries still have notable deficits in energy efficiency.*
- *The closer European neighbourhood is an important source for fossil imports (mainly Russia, Algeria, Libya, Azerbaijan). They will play a strategic role at least in the mid-term to Europe's energy demands. These countries need to intensify their existing cooperation, addressing issues of mutual interest ranging from regulatory cooperation to infrastructure development and from promotion of sustainable policies to joint projects.*
- *In the mid-term, efficiency and availability of renewable energy sources will depend on the overall development; in the case of lost output levels it might take longer for renewable sources to succeed on the energy markets and the dependency on fossil imports will prevail. But also a sustainable revovery will lead to an incrasing demand that can probably not be met by higher efficiencies and increasing renewable production. Still, the EU needs a technological shift in order to reach its the 20-20-20 targets on greenhouse gas emissions, renewable energy and energy savings to decarbonise the electricity and transport sector.*
- *Other vital issues for the mid-term will be the completion of the internal energy market, achieving energy savings and promoting low carbon innovation. The diversification of the fossil energy supply is important in the short- to mid-term. However, as the current political developments in the Arab world illustrate, the situation in almost all major suppliers is fragile and the danger of shortfalls will prevail even if diversification is intensified. If Europe does not want to jeopardise its future supply the promotion of alternative and internal energy sources is crucial.*

8. Social polarisation

As an indirect effect of all other topics analysed in this report, the challenge of social polarisation heavily depends on economic progress influenced by globalised markets, changing natural conditions influenced by climate change, demographic aspects such as the workforce and its skills, and affordable and secure energy. Although a key political issue in the EU, there are still hardly any powerful common policy measures on the macro-level. The so-called European social model that was first mentioned in the Commission's 'White Paper on Social Policy' (COM (94) 333) consists of a multitude of national approaches, which are predominantly determined by national interests. The 'social protection and social inclusion process', an open method of coordination, is based on the voluntary commitment of Member States. The unequal distribution of material or immaterial resources in a society hampers equal access to public and private services and affects the opportunities to participate in society. This in turn leads to self-reinforcing social inequity which affects every sphere of socio-economic life. The complexity of this challenge is mirrored in an extensive systemic picture. Figure 19 illustrates the variety of interdependencies within the social polarisation challenge.

One cluster of parameters is woven into demography and its impacts on the labour market. While elderly but healthy people can prolong their work life, the young and/or unskilled workforce increasingly faces difficulties to enter the labour market. Labour shortages, which are countered by immigration, are another possible scenario. Furthermore, the trend of an increasing flexibility and destabilisation of the workers (higher probabilities of job loss during the working life cycle) has an effect on social polarisation. The right to work at the EU level guaranteed by the 'Charter of Fundamental Rights of the European Union' (Article 15) and mobility programs enable the educated elite to find jobs in economic growth poles. Regionally, this process may result in brain drain from the periphery, leaving the non-working or less skilled population behind in already lagging regions. These situations and its interrelations are captured in increasing **youth unemployment** and **labour market transformations**.

Figure 19 Systemic overview of social polarisation issues



The **income distribution** sticks out as another decisive factor. There are great disparities in wealth within societies, which depend on a person's sex, age group or skill level that he or she has attained. Wage gaps are one of the main factors contributing to economic disparities, the relocation of labour-intensive industries, which are characterised by low-level skill standards, to third countries with low wage levels is another major challenge that Europe is facing today. These factors correlate with labour market transformations; however, also the intraregional distribution of income and potentially compensating tax and transfer effects also play an important role.

Without doubt the quality of life has an impact on social polarisation. Safety, spatial segregation, participation, access to services of general economic interest, environmental media, transportation and energy are mentioned as important features. The list of aspects that are important for quality of life is endless and, unfortunately, impossible to operationalise in a statistical straightjacket. To cover at least a part of quality of life, the **accessibility of services of general economic interest** is used to assess the challenge it represents for a region in regard to social polarisation.

Accordingly, social polarisation relates strongly to the other challenges, especially to globalisation and demographic change. Climate change and the change of energy economics may have an increasing influence in the future, due to their macroeconomic costs and changes to the general living conditions. In addition, employment and household income dropped considerately in many regions due to the current economic crisis. The increasing pressure on social transfer payments due to increasing sovereign debts might also be a threat for any social policy in the new decade. Finally, social polarisation combined with demographic change is one of the major issues in the relationship between the EU and its neighbourhood. While in many European countries and regions there is a notable downwards trend in the economically active population due to the dynamics of the age pyramid, in many candidate and neighbourhood countries social conditions and the income situation are still unfavourable for large segments of the population.

Income distribution

Income inequalities arise between social groups and increasingly affect the youth and elderly. The theory of efficiency wages and social justice wages are connected to this field, contributing to the explanation of wage gaps and unequal household distribution. The income structure is strongly influenced by the international division of labour and also by the effects of an aging population. Hence, it is strongly connected to globalisation and demographic change.

The indicator system for regional vulnerability

The current income inequality as illustrated by the *Gini coefficient* distribution demonstrates the **exposure** of a region, while its **sensitivity** is reflected in the *disposable income per household*. In other words, if a region has a rather unequal distribution of wealth and income inequalities and poverty are rising, the wage gap will widen and leave the region lagging even more behind. The Gini coefficient is a function of income levels and the proportion of population reaching certain levels. A low coefficient reveals that incomes are distributed very equally but does not describe the level of income. This was therefore added to the index calculation as the sensitivity.

One way of adapting to this challenge is the redistribution of wealth by means of social transfers. Variables that indicate this redistribution were chosen for **adaptive capacity**. The higher the *ratio of disposable income to primary income*, which measures the redistribution of income inside one country and therefore 'penalises' the wealthier regions in most countries, the higher is the mitigating capacity of a region. This means that a region with a value of over 100% generates more income by redistribution than it generates economically itself. In addition, the higher the *GDP per capita in Purchasing Power Parities* (cf. Map 40) the higher is the redistributive potential without excessive cuts in higher incomes.

Table 22 Indicators used for 'Income distribution' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	Gini coefficient (inequality of income distribution)	23.70 (SK)	30.81	44.00 (Ezurum, Agri, TR)	4.00
Sensitivity	disposable income of households, net (uses)	1,651.70 (Severozapaden, BG)	14,589.99	46,708.12 (Nordwestschweiz, CH)	7,381.25
Adaptive capacity	disposable income of private households as % of primary income	59.07 (Ionia Nisia, GR)	89.66	112.92 (Nord-Est, RO)	8.62
	GDP per head in Purchasing Power Parities	3,500.00 (Van, TR)	23,387.10	95,250.21 (Liechtenstein, LI)	10,833.98

Neighbouring countries and cross-border effects

Economic wealth and incomes in Asian and African neighbouring countries are generally distributed much more unequally than in Europe. Map 40 illustrates the GDP per capita in Power Purchasing Parities, Map 41 gives an overview of the Gini coefficients in Europe, including its neighbourhood. The potential attractiveness of Europe for job seekers and poorer social classes from third countries can be spotted easily.

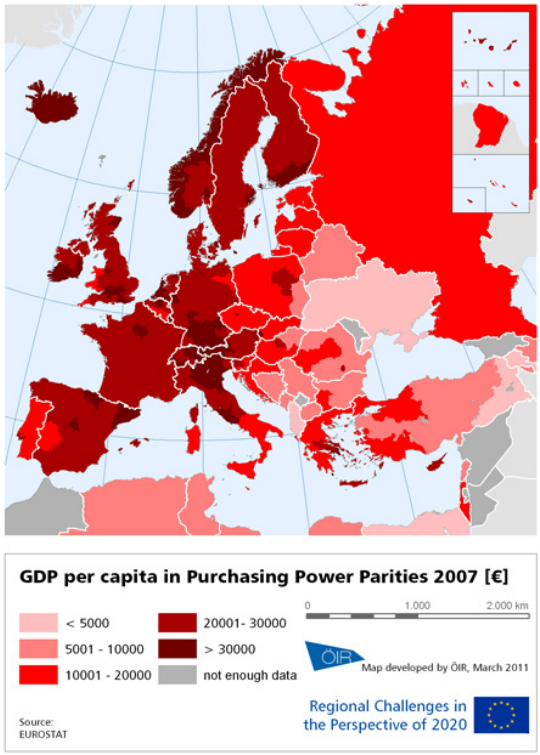
But although the general differences between the EU and its neighbouring countries are sharp, this cannot be directly translated into potential migration pressure. Social welfare is an important factor for immigration but other factors like the availability of jobs, the human rights situation or the existence of personal networks also play a major role if a person decides to leave his or her country. (this was examined in detail in the chapter on demographic change).

In contrast, cross-border flows within the EU can be analysed and predicted very clearly by interpreting the Gini Coefficient. Inner-EU migration concentrates on migration flows from countries with high coefficients (southern and eastern periphery) to Central Europe and partly to Northern Europe.

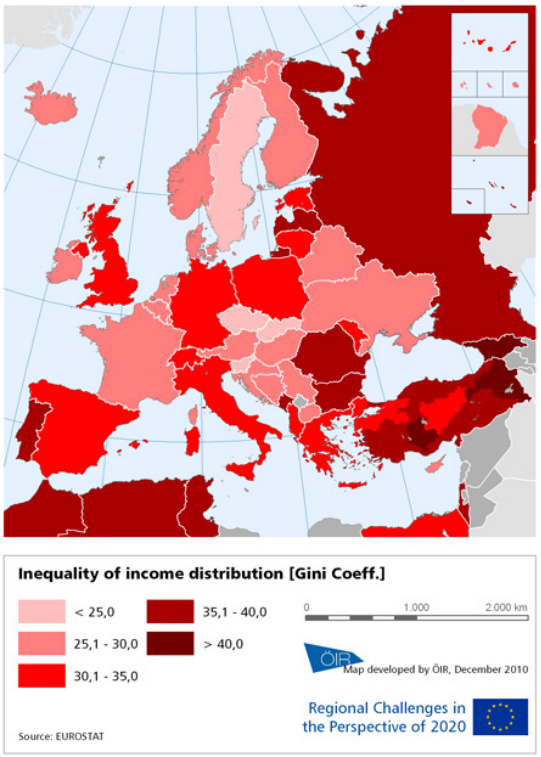
The vulnerability map

Europe has a long history of redistribution of wealth for the purposes of social justice, peace and equitable opportunities. Progressive taxation and welfare systems following the ability-to-pay principle have been developed already in the 19th century. The Nordic countries, but also nations like Germany, France and Austria have a strong tradition in redistribution of income organised by the government. This spirit is still alive today, however models are more diversified today including flat tax rates and private social security.

Map 40 Europe and its neighbourhood: GDP per capita in PPP



Map 41 Europe and its neighbourhood: inequality of income distribution



Compared to the rest of the word, one can still say that the redistributive effects of governmental regulations are very strong.

Table 23 illustrates the dispersed vulnerability of regions to this challenge that highlights the Scandinavian and central European countries mentioned above. At first glance, in terms of income inequalities, the "traditional" EU picture with an East-West divide becomes obvious. and The southern Member States Portugal and Greece also lag behind the rest of the older Member States.

Additionally, the map is very much determined by national borders. However, looking at the redistribution of income inside one country, there are notable national divides. In Germany (North and East vs. South) and Italy (Central Padan plain and the rest), which are balanced through the redistributive adaptive capacity index. The highest vulnerabilities in income distribution can be found in all New Member States apart from Slovakia, Slovenia and Eastern Hungary (again a West-East redistributive effect), Greece and Portugal and in all South-Western Candidate Countries. Sjælland, as the only Western European vulnerable region and the economically most powerful region in Denmark, is a special case and suffers from the high tax levels and the strong intraregional redistribution effects in Denmark.

Central Europe (France, Austria, Switzerland and Germany) have below average impacts and an above average adaptive capacity. Norway, Iceland, Luxemburg and parts of Sweden and Switzerland have the lowest impacts of all, due to high income levels and relatively balanced income distribution. The majority of European regions however appear to be prepared, having either a high adaptive capacity or are not prone to an increase in income inequalities.

Egypt, as the African neighbourhood's best performing country in terms of income distribution, is the only one of these countries reaching the European average. In the Eastern neighbourhood, Ukraine and Belarus show a comparatively equal income distribution statistically which might be a combination of generally low income and high tax levels.

Labour market transformations

A main driving force of social shifts is the transformation of labour markets following globalisation developments which redistributed the division of labour across the board. It can be observed in terms of new forms of labour (e.g. 'Mc Jobs') and the opening of new markets (e.g. renewable energies, creative industry). However, the off-shoring of activities, i.e. the relocation of a business process from one country to another, most often low-income regions in the New Member States or third countries, is also a frequently observed threat in many former industrial regions of the EU. Parallel to and interlinked with these changes, new regulations concerning, for instance, working hours or social security are coming into force, which in turn shape the labour market yet again.

The indicator system for regional vulnerability

The transformation of the labour market and the production structure is strongly linked to globalisation. If regions cannot compete internationally on globalised markets or find themselves a niche, labour markets come under pressure. The **exposure** is correspondingly expressed by a region's *unemployment rate*.

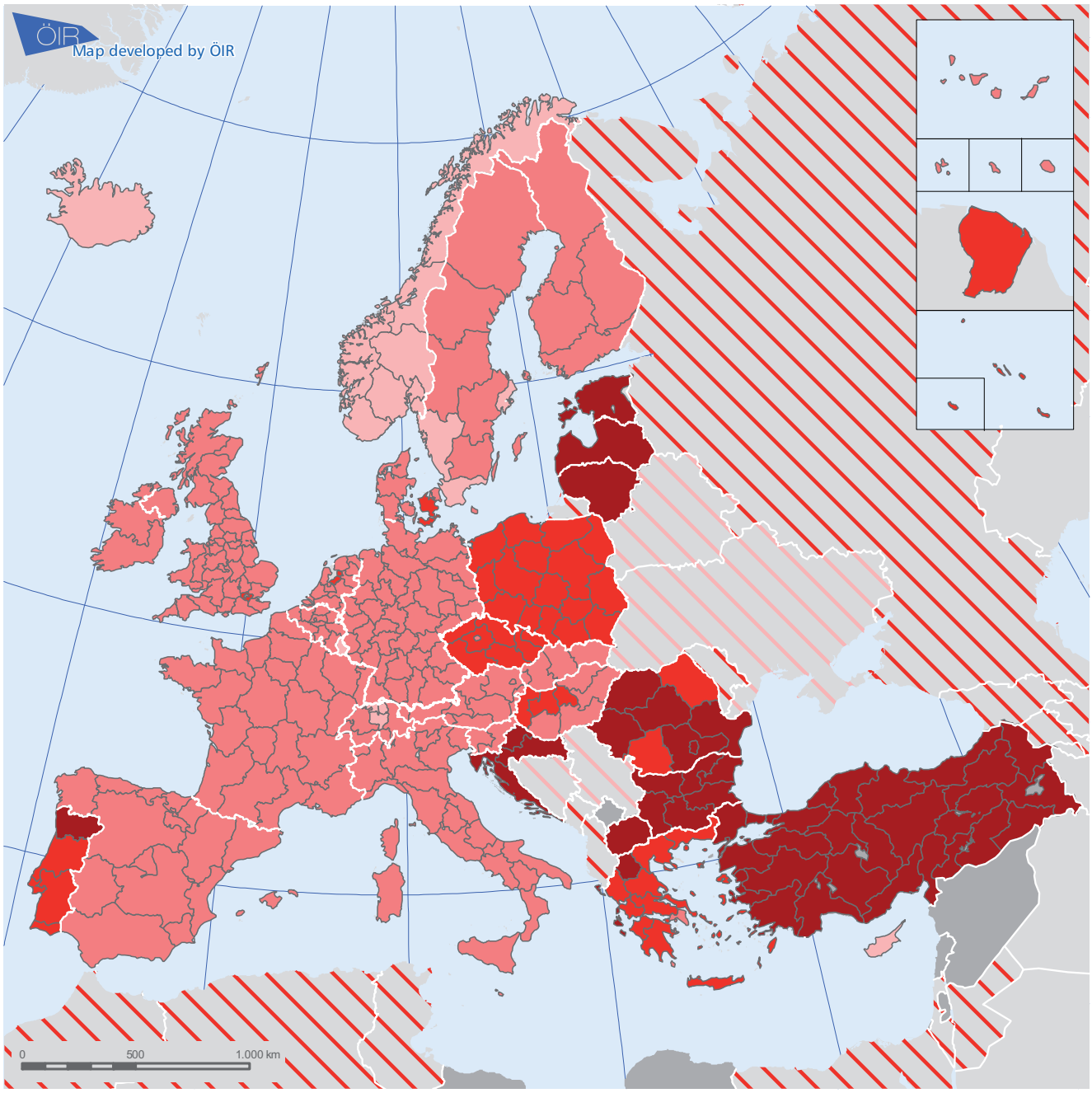
A regional workforce with a high share of poorly educated workers hampers competition even more on the globalised market. Correspondingly, regions with a high *share of persons with at most lower secondary education* are believed to have a higher **sensitivity** to labour market transformations than regions with generally higher education attainment levels.

Table 23 Indicators used for 'Labour market transformations' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	unemployment rate, 15y and over	1.50% (Liechtenstein, LI)	7.29%	32.20% (R. Makedonija, MK)	4.07
Sensitivity	share of people with maximum education ISCED Level 2	11% (Praha, CZ)	39%	87% (Sanliurfa, TR)	18
	share of employees in selected sectors at risk of offshoring [a)]	2.65% (Mecklenburg-Vorpommern, DE)	15.64%	28.82% (C. F. de Navarra, ES)	4.84
Adaptive capacity	share of people aged 25-64y participating in life long learning courses	0.23% (Gaziantep, TR)	9.49%	32.99% (Hovestaden, DK)	7.25
	total intramural R&D expenditure per GDP	0.08% (Severen tsentralen, BG)	1.41%	6.77% (Braunschweig, DE)	1.14

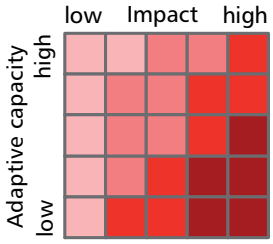
Map 42 Key vulnerability 'Income inequalities and poverty: (following page)

Income distribution - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Inequality of income distribution, Gini coefficient

Indicators describing sensitivity:
- Disposable income of households, net

Indicators describing adaptive capacity:
- Disposable income of private households as % of primary income
- GDP per capita in PPP

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Inequality of income distribution, Gini coefficient (Source: United Nations)

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

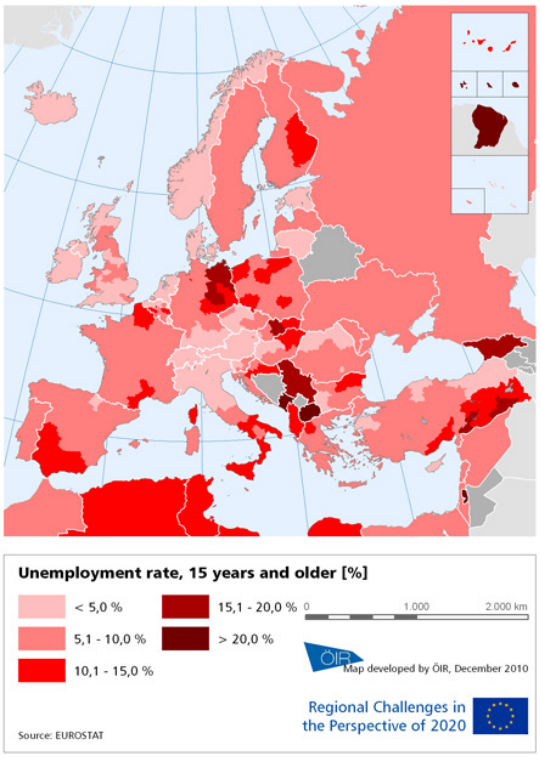
Another contributing factor, also expressing the region's sensitivity to this challenge, is the distribution of workforce over the different sectors. The more that employment is dependent on internationally volatile sectors the more likely it is, that the region cannot cope with labour market transformation. Therefore the share of employees in selected sectors at risk of off-shoring is introduced as a sensitivity indicator (based on empirical data from the European Restructuring Monitor, Eurofound 2007).

The more people who are engaged in life-long learning and the greater the expenditures in research and development, the better are the chances for the region to adapt to the challenge of labour market transformation. This information was therefore chosen as an index of regional **adaptive capacity**. Behind this lies the assumption that continuing training and investments, in order to increase the stock of knowledge, increase a region's ability to compete with others.

Neighbouring countries and cross-border effects

The cross-border effects and the situation of the neighbouring countries in labour market issues is twofold. On one hand, the New Member States (for example the Czech Republic, Slowakia, Romania) with their well trained workforce and still relatively low labour costs serve as the new labour markets for Western European corporations. In some countries of the European neighbourhood, comparable developments can be observed with industrial activities taking place in the non-member CEE countries and agricultural investments (following world trade liberalisations) in states like Morocco and Tunisia. On the other hand, the dependency of these countries on relatively few foreign investors in relatively few sectors makes these countries very vulnerable towards future shifts. The economic crisis has shown that Eastern European countries were amongst the first and hardest hit, however they were also amongst the first to come out of the crisis. Still, investments into the future in the form of research and knowledge will be crucial in the long run. As a supplementary information, Map 43 shows that the highest (pre-crisis) unemployment rates within the EU can be found in the French overseas regions, Eastern Germany and some regions along the EU's eastern border and on the southern periphery.

Map 43 Europe and its neighbourhood: unemployment rates



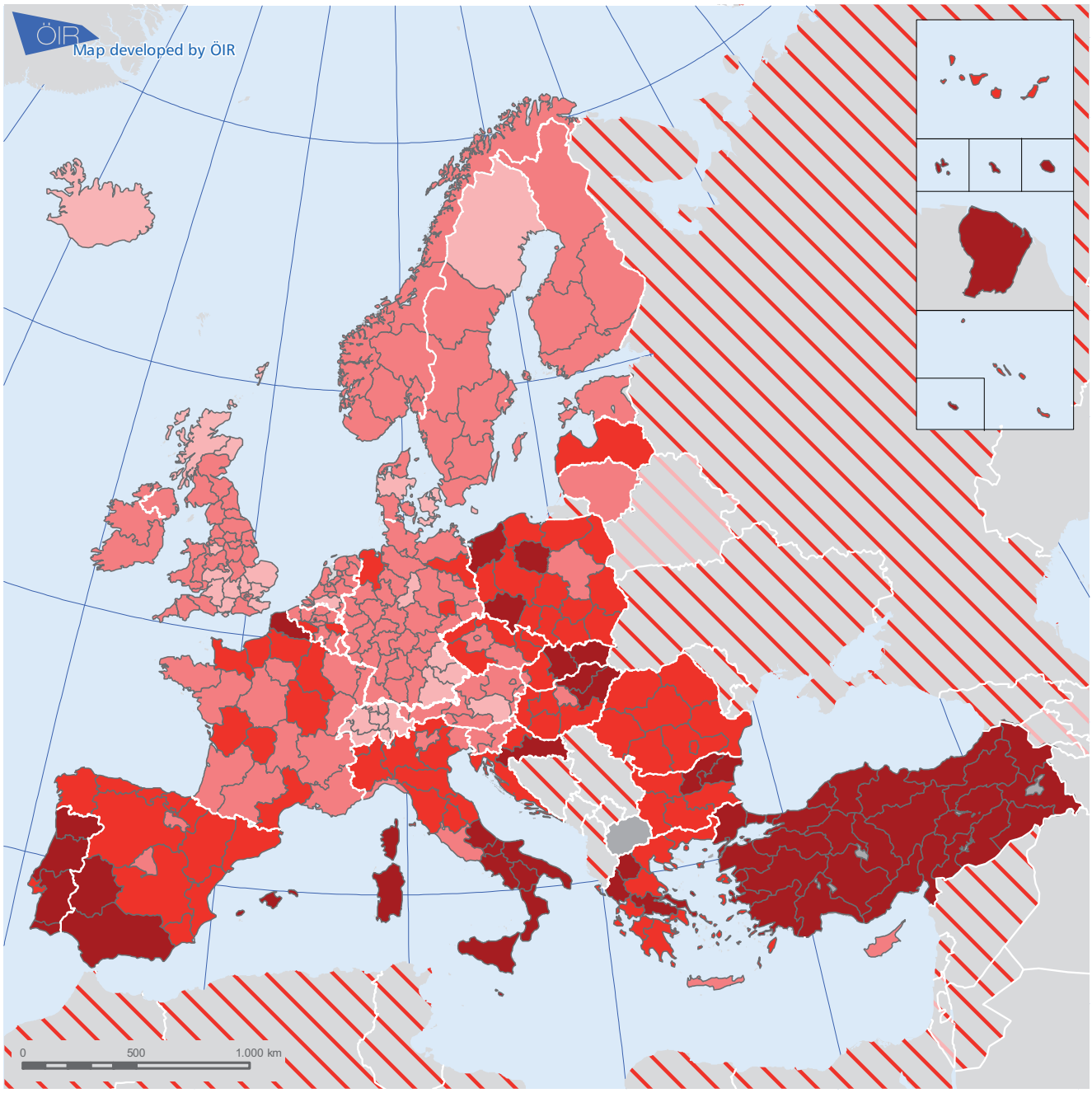
The vulnerability map

Structurally weak regions that largely depend on one or only a few sectors and/or employers have been the regions most seriously challenged by the ongoing global labour market transformation during the last decades. For instance, labour-intensive industrial regions that did not invest into research or diversification of their economy, face steady decline. Rural regions that did not assemble economic alternatives to agriculture in time are another example, especially when located in the periphery.

Accordingly, Map 44 highlights these highly vulnerable regions that are quite dispersed throughout Europe. While in the CEE countries the impact of this challenge (low unemployment rates, high education levels) is generally favourable, their adaptive capacities (life-long learning, R&D expenditures) are limited. Therefore their vulnerability – except for most of their capital regions – tends to be high as was already stressed in the cross-border section.

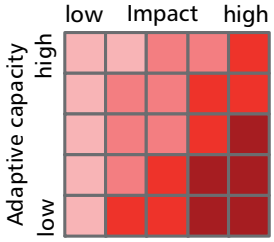
Map 44 Key vulnerability 'Labour market transformations' (following page)

Labour market transformations - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Unemployment rate, 15 years and over

Indicators describing sensitivity:
- Share of people with maximum education ISCED Level II
- Share of employees in selected sectors at risk of offshoring (Eurostat based on Eurofound)

Indicators describing adaptive capacity:
- Share of Persons (25-64 years) participating in life long learning courses on total population (25-64 years)
- Total intramural R&D expenditure as a share of GDP

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Unemployment rate 15 years of age and older

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

On the contrary, many Mediterranean regions on the other hand are better off with their adaptive capacity, but they face high impacts. In Northern Italy and Portugal for instance, the types of manufacturing activities found there have frequently been moved to lower wage countries. In Southern Spain, the general unemployment rate is amongst the highest. Most Greek regions score under-average. In turkey, it is mainly the very high level of early school leavers that is the reason for a high vulnerability. All these regions face rising demands on jobholders to adapt to new economic fields.

In Western and Northern Europe, only a few regions are overly vulnerable. These are often traditional manufacturing regions, for instance in France and eastern Germany. In many regions of the UK, Scandinavia, Southern Germany, Austria and Switzerland the low impacts are a result of the strong economic orientation towards knowledge.

The eastern neighbour states are characterised by relatively low unemployment rates (below 10%), whereas unemployment rates in the Maghreb area and especially on the Western Balkans are much higher. The regions with the highest unemployment rates are the French overseas regions, Macedonia (FYROM), Montenegro and the Palestinian Territories. Other regions with high unemployment rates are Serbia, Georgia and Southeast Turkey.

Figure 20 Recycling of domestic appliances & skill training scheme for long-term unemployed. Liverpool, UK

Source: DG Regio

This pronounced dispersion has manifold reasons and cannot only be explained by globalisation developments. However, its mainly countries dependent on the primary sector that face the highest unemployment rates.

Youth unemployment

This key issue deals with the phenomenon of increasing youth unemployment. The ageing population is extending their working life due to increased life expectancy and declining social welfare. This situation, together with labour turnover costs, hinders the youth from entering the labour market. Young people who are excluded from the labour market hold the risk of losing qualifications attained by not participating in further training and furthermore lacking social security rights, since they have not yet contributed to the social system. Rising levels of frustration and social polarisation are the consequence. Increasing youth unemployment is thus linked to the challenges of globalisation and demography.

The indicator system for regional vulnerability

Firstly, the calculation of the vulnerability index is based on the idea that the *youth unemployment rate* (of people aged 15-24 yrs.) determines the **exposure** of a region towards youth unemployment.

Table 24 Indicators used for 'Youth unemployment' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	unemployment rate of people aged 15-24y	4.60% (Zentralschweiz, CH)	16.33%	55.70% (Guadeloupe, FR)	7.89
Sensitivity	percentage of the population aged 18-24y with at most lower secondary education and not in further education or training	3.90% (HR)	17.49%	48.20% (TR)	11.41
Adaptive capacity	Students in tertiary education, as percentage of the population aged 20 to 24 years old	4.05% (Severozapaden, BG)	53.20%	205.17%[a] (Bucuresti – Ilvov, RO)	25.24
	Students at upper secondary and post-secondary non-tertiary education, as percentage of the population aged 15 to 24	17.13% (Iles Balears, ES)	38.10%	79.49% (Prov. Limburg, BE)	9.90

[a] Note: values higher than 100% point at many incoming commuting students from other NUTS 2 regions (important university sites)

Secondly, the portion of a *population aged 18-24 yrs. with at most lower secondary education and no further education or training* ('early school leavers') expresses the **sensitivity** to increasing youth unemployment. To be more specific, if a region's rate of youth unemployment is high but the young workforce is comparatively well-trained, it is less sensitive and the unemployment rate is less likely to be lasting and structural. If there are many early school leavers and generally a low education level, the region will be even more heavily affected by increasing youth unemployment.

The potential **adaptive capacity** of a region has the opposite rationale. A population with a high percentage of youth in education and training will in the mid-term enable a region to mitigate the youth unemployment challenge. Consequently, the indicators *students in tertiary education* and *students at upper secondary and post-secondary non-tertiary education* (both as a percentage of the corresponding age groups) were used for the calculation of vulnerability indices.

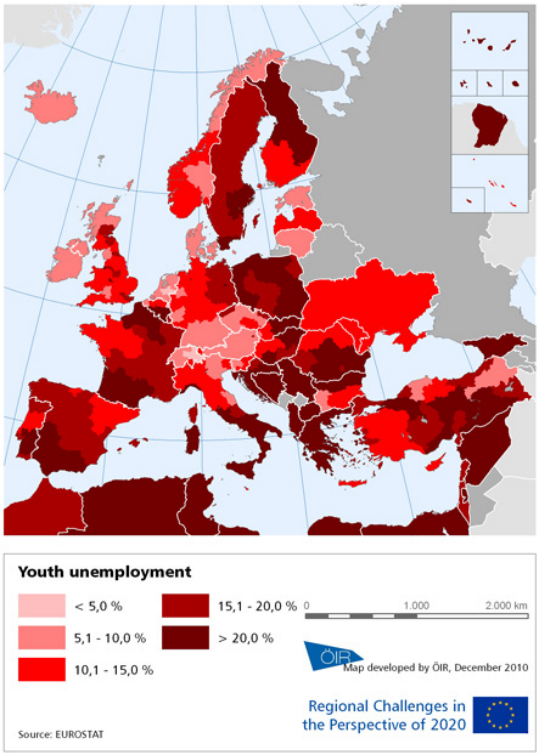
Neighbouring countries and cross-border effects

In many countries of the European neighbourhood youth unemployment is a very serious issue. The highest rates of youth unemployment (Map 45) can be found on the Balkan Peninsula (west as well as east), especially in Kosovo, Serbia and Bosnia and Herzegovina, as well as in North Africa and the Middle East (Tunisia, Egypt, Jordan, and the Palestinian Territories). The main reason for this is a demographic development with very high reproduction rates that leads to a decoupling of young people trying to enter the labour market and the real economic and labour market growth.

Not least, the desperate situation of the young generation has been a major driving force of the ongoing revolution activities in the Arab world. But also in the Western Balkans, high birth surpluses in the recent past and a depressed economic environment in the present lead and still lead to many young people seeking their luck abroad.

A high unemployment rate amongst 15-24 year olds is and will continue to be one of the biggest problems in these countries. In the rest of the neighbourhood the rate is comparable to the European average of 15-20%; however, this is not a complete relief.

Map 45 Europe and its neighbourhood: youth unemployment rates



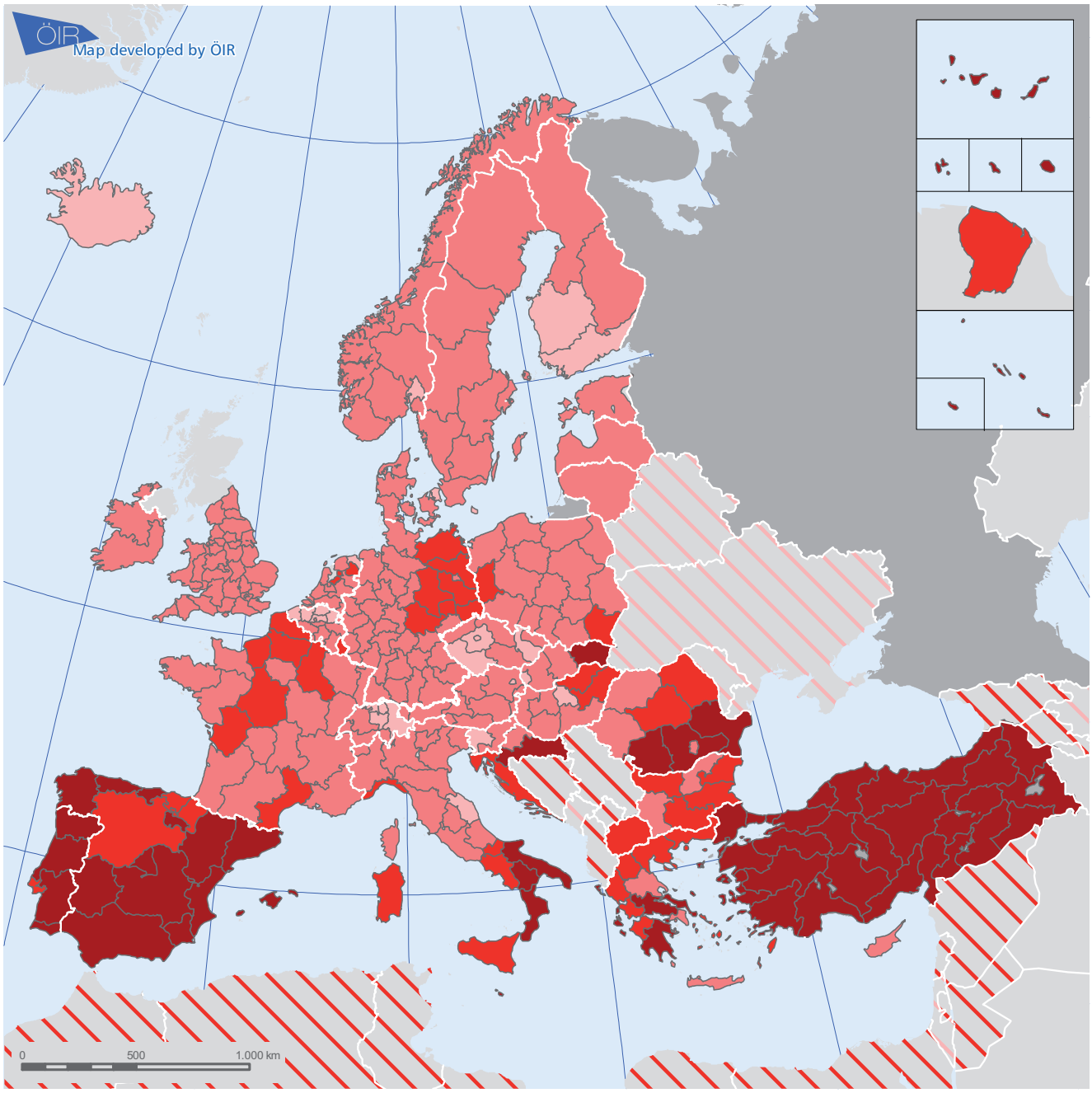
Since young people are amongst the most flexible, the poor opportunities in their local labour markets raise the potential for illegal migration and dubious business activities in border regions, which could directly affect the EU.

The vulnerability map

But also in the EU there are numerous regions in which youth unemployment is on the rise. Map 46 illustrates the vulnerability of regions to this challenge. In this case it is not so much a question of the demographic development which leads to this situation, but rather structural economic problems, the absence of higher education and difficulties to begin a career because of secluded labour markets. Most of the Mediterranean basin, most of the New Member States except for the Baltic States (pre-crisis!), Eastern Germany, a number of French regions and the Candidate Countries all show vulnerable and most vulnerable scores. There is a striking consistency between high impact regions (as a combination of youth unemployment rate and early school leavers, not pictured) and low adaptive capacity (young people in education and training).

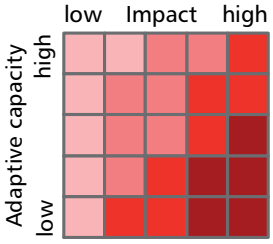
Map 46 Key vulnerability 'Youth unemployment'' (following page)

Youth unemployment - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Unemployment rate 15-24 years

Indicators describing sensitivity:
- Percentage of the population aged 18-24 with at most lower secondary education and not in further education or training

Indicators describing adapitve capacity:
- Students in tertiary education, as percentage of the population aged 20 to 24
- Students at upper secondary and post-secondary non-tertiary education, as percentage of the population aged 15 to 24

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
- Youth unemployment rate

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

I.e. almost all regions with a youth unemployment problem also have relatively few students in the education process, which is likely to exacerbate the situation during the next decade. Lazio (containing Rome) and the Belgian regions Bruxelles-Capitale, Hainaut and Liège have high impact but an excellent adaptive capacity. For the Iberian Peninsula, Southern Italy, Turkey, the French overseas territories as well as parts of Romania, the challenge of youth unemployment was extremely serious even before the crisis, with youth unemployment rates of up to 50%. In the meantime, the EU reports youth unemployment rates of more than 20%, with Spain rising from around 18% before the crisis to almost 40%. But also the most prosperous of countries, like Sweden and France, were reported at around 25% in 2010. However, taking into account the structural deficits from before the crisis, especially in adaptive capacities, the south of Europe is far more vulnerable towards youth unemployment than the north.

As was already in the neighbouring countries section, most neighbouring countries are very vulnerable to youth unemployment issues with only Ukraine, Syria and Moldova being close to the European score.

Access to SGEIs

This vulnerability analysis intends to cover at least some aspects of quality of life by including the statistically available accessibility to the services of general economic interest. This involves access to the following services: health care, child-care and elderly care. Providing affordable and high-quality SGEIs for all groups of society and regions is claimed to be crucial for social and territorial cohesion.

The indicator system for regional vulnerability

Various indicators affect the **exposure** of a region: the *road density*, the *number of hospital beds and doctors*, the *expenditures for elderly care* and the *children in pre-primary education* are all important parts of the regional infrastructure. For all those factors a low value means less access to utilities and services and thus a high exposure to the challenge.

The main element defining a region's **sensitivity** to this key issue is the population development, strongly connected to the challenge of demographic change (see chapter on population decline). Shrinking regions will not offer the same range and quality of SGEIs as growing regions, since the offer of a wide range of services will not pay off economically. However, it is assumed that growing regions need an accordingly growing supply of SGEIs in order to sustain their accessibility. If the supply of those services remains the same, while at the same time the population grows, less people will be able to use those services.

To increase a region's ability to cope with this challenge, a high purchasing power and major investments in the social sector are necessary. Hence, expenditures on health care and the GDP per capita are seen as decisive indicators for the **adaptive capacity** of a region.

Neighbouring countries and cross-border effects

The provision of social infrastructure is highly dependent on national political paradigms rather than on the geographical situation of one country. For instance, the CIS countries and most parts of the Western Balkans have a decent provision of hospital beds that is comparable to better equipped EU countries, even if they are relatively sparsely populated such as Russia.

Table 25 Indicators used for 'Access to SGEIs' vulnerability in NUTS 2 regions

	Indicator	minimum	mean	maximum	SD.
Exposure	hospital beds per 100.000 capita	165.60 (Flevoland, NL)	555.34	1,216.80 (Mecklenburg-Vorpommern, DE)	207.37
	physicians or doctors per 100.000 capita	69.80 (Voreio Agaio, GR)	303.41	996.80 (Kriti, GR)	109.25
	expenditures for elderly care as a share of GDP	0.003% (LU)	0.49%	2.39% (SE)	0.52
	road density (km per km²)	0.01 (Aletejo, PT)	1.49	18.13 (Inner London, UK)	1.88
	Share of children in pre-primary education	0.04% (Border, Midland and Western, IE)	12.97%	21.16% (Cataluña, ES)	3.93
Sensitivity	population development 2001-2007	-11.57% (Severozapaden, BG)	2.30%	26.34% (Guyane, FR)	4.32
Adaptive capacity	health care expenditures per capita	251.80 (BG)	2,378.78	4,779.34 (LU)	1,256.24
	GDP per capita	2000.00 (Van, TR)	23,805.14	96,000.00 (Inner London, UK)	14,279.77

Table 26 Neighbouring countries: indicators for access to SGEIs

	Hospital beds per 100.000 capita	Physicians per 100.000 capita	Total health expenditure as % of GDP	road density (km per capita)	rail density (km per capita)
EU, EFTA and candidate countries	555.34	303.41	8.96	11.92	4.47
Turkey	300	133.70	5	0.29	0.35
Albania	275.64	115.36	6.90	6.03	1.85
Armenia	372.04	346.33	3.80	0.61	1.20
Azerbaijan	753.65	366.57	3.60	0.50	1.32
Bosnia and Herzegovina	341.26	167.87	10.30	8.42	2.98
Belarus	1,107.06	510.91	6.50	14.63	4.91
Georgia	309.08	467.23	8.70	0.70	1.31
Moldova	608.80	309.73	10.70	9.98	3.42
Montenegro	965.85	431.04	5.20	2.00	0
Serbia	965.85	431.04	5.20	0.77	1.09
Russian Federation	965.85	431.04	5.20	0.97	1.84
Ukraine	864.09	314.85	6.80	5.35	2.77
Algeria				0.85	0.68
Egypt				0.23	0.52
Israel		339.32	8	0.69	0.48
Jordan	245	180		0.63	0.72
Lebanon	354.00	345.00		0.32	0
Libyan Arab Jamahiriya	190.00	370.00		3.74	0
Morocco	62.00	113.00		0.45	0.56
Syrian Arab Republic	150.00	151.00		0.44	0.30
Tunisia	119.00	209.00		0.82	0.65

Source: Eurostat, World Bank

In contrast, African and Near East neighbourhood countries have rates far below the EU average. Health care is generally on a higher level in the EU countries in relation to the EU neighbourhood, whereas the available Eastern countries are again much closer to the EU average.

Table 26 presents some available indicators on the supply with basic services and infrastructure. As can be seen, most countries are far below European standards in infrastructure endowment. However, this situation will not have immediate effects on the EU. At the most, access to services is one piece in the puzzle, concerning the reasons why people choose to emigrate.

The vulnerability map

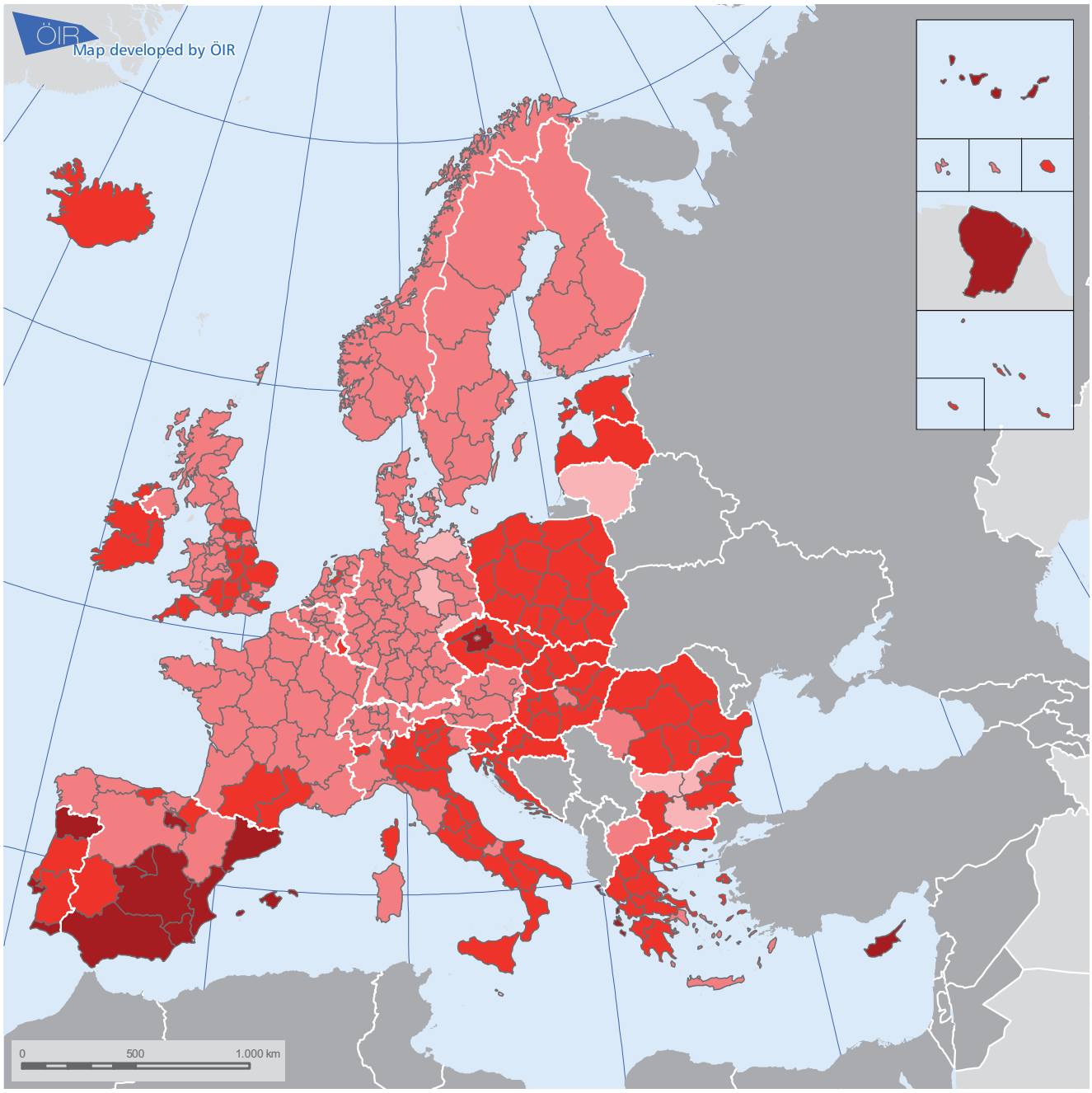
Map 47 illustrates the vulnerability of regions to this challenge. As in other vulnerability analyses containing indicators of relative economic prosperity, there is a noticeable east-west divide: most of the eastern New Member states regions appear as vulnerable. However, many of these regions – mostly rural ones – only have a below average impact, mainly because they are losing population in any case. However, combined with their low investment potentials they still show increased vulnerability. Countries to the east of Europe (from the Baltic States, throughout the Eastern European countries, Romania, Bulgaria, and Macedonia, not enough data for Turkey) reveal a deficit in their ability to adapt to this future challenge.

Of the economically more advanced regions, the southern regions of Portugal, Spain, Southern France, Italy, Cyprus and Greece are among the more vulnerable regions. Except for Greece, these are massively gaining population through immigration, but are apparently not compressing their social infrastructures. Somewhat surprising is that the UK, Ireland and Iceland are amongst the vulnerable and most vulnerable areas in this respect. The UK scores very low in all social infrastructures except for elderly care. Ireland scores only slightly better in the overall exposure index, however it has by far the lowest pre-primary educational offer of all Member States. Together with its steep rise in population before the crisis, this generates a highly above average impact. In Iceland, the fragmentary data situation on social infrastructure does not allow for a detailed analysis.

As the data situation was very poor for Europe's neighbourhood, these countries could not be included in the map. Please refer to the section on neighbouring countries and Table 26 for further information.

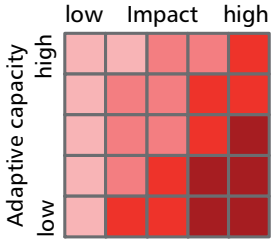
Map 47 Key vulnerability 'Access to SGEIs' (following page)

Access to SGEIs - Vulnerability



Vulnerability of Regions
linking the impact with the adaptive capacity

- most vulnerable regions
- vulnerable regions
- prepared regions
- low impact regions
- not enough data



Indicators describing exposure:
- Hospital beds / 100.000 capita
- Physicans or doctors / 100.000 capita
- Expenditures for elderly care in % of GDP
- Road density
- Children in pre-primary education

Indicators describing sensitivity:
- Population development 2001-2007

Indicators describing adaptive capacity:
- Health care expenditures per capita
- GDP per capita

Neighbouring Countries (simplyfied methodology)

- more vulnerable
- less vulnerable
- not enough data

Indicators describing Neighbours:
-

Data source Eurostat except where indicated. Detailed indicator description in the annex. Indicators have been standardised via z-transformation and polarised according to the influence on vulnerability.

Regional Challenges in the Perspective of 2020

An integrated picture of the social polarisation challenge

As for the previous challenges, the regional vulnerability indices were compared with a cluster analysis. In social polarisation, thirteen clusters were formed. What is astonishing is that, despite the fact that most of the issues of social polarisation are handled and determined at the national level; the split up of clusters does not entirely follow national borders, but rather identifies some regional and cross-border specifics. Apart from already existing differences in the southern Member States, there are also differences in a number of other Member States. To facilitate the analysis, the types of regions have been condensed into four groups of similar characteristics.

The first group consists of regional types of relatively equally distributed incomes. The '**equal incomes – rich highly educated regions**' include eighteen NUTS 2 regions: Iceland, Southern Norway, Switzerland and Cyprus. The type is characterised by a generally high performance with respect to social polarisation. Low youth unemployment rates go together with high education in the field of the labour market transformation and high income levels (except for perhaps Cyprus). The only stain on this good regional performance stems from an increased sensitivity vis-à-vis the access to SGEIs, which implies that, without immigration, these regions will not be able to maintain this standard in the long-run. The '**equal incomes – middle class with low youth unemployment regions**' cover large parts of the Netherlands, Denmark and Austria as well as parts of Southern Germany and Northern Norway. Their income levels are high, although on average not as high as in the first type, and youth unemployment is significantly below the European average and also below the rich, highly educated regions. An above average performance in all other key challenges completes this well prepared type of regions. The '**equal incomes – wealthy middle class regions**' consist of no less than sixty-three NUTS 2 regions, which is the largest cluster in the sample. The regions included cover France, Western Germany, the Spanish regions bordering on France, Greece, the UK and one structurally weaker region of Austria (Burgenland). The cluster is characterized by an overall average performance for all key challenges at a fair income distribution. They have income levels a little below the former two types of this group and a slightly higher youth unemployment rate. The fourth type of equal income regions is the '**highly educated middle class**'. This cluster comprises thirty-three NUTS 2 regions that encompass Sweden, Finland, Belgium and a number of urban regions, more precisely Vienna, Prague, Budapest, Rome, Genoa, Bucharest and London. This type of equal income distribution is characterised by a high share of young people in higher education (and also lifelong learning) which does not come as a surprise, because many are important university cities, and which is a favourable position for adapting to youth unemployment. The final group of regions has a favourable distribution of income; however, the people have an '**equally low income and high unemployment rates**'. This cluster includes Eastern Germany, Macedonia and the Spanish enclaves in Africa. The new "German Länder" determine the character of this cluster, which mirrors the domestic social polarisation in Germany. Incomes are comparatively low and the unemployment rate is significantly above the European average. However, the regions are no more vulnerable than other Eastern European regions, a fact which is particularly demonstrated by a relatively low sensitivity in Accesses to SGEIs.

Figure 21 Renovating former military bases in Ylamylly to provide community services and new employment opportunities, FI

Source: DG Regio

The second group of regions is constructed of regional types that generally have lower incomes compared to the European average. The '**low income – income detracted**' consist of thirty-eight regions and covers the Baltic countries,

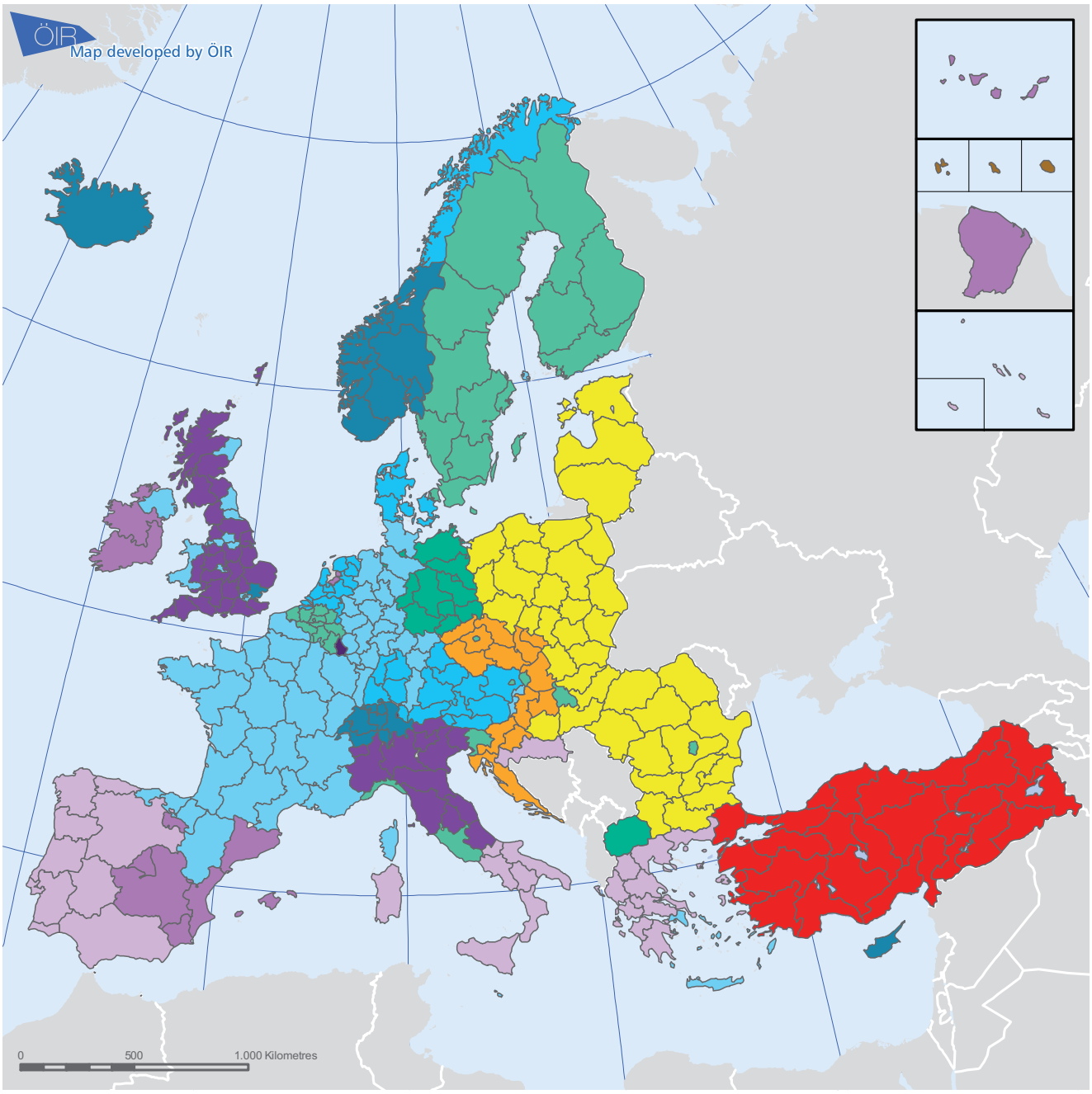
Poland, Bulgaria, Romania, Eastern Hungary and Eastern Slovakia. This cluster provides a heterogeneous picture vis-à-vis social polarisation: while in income distribution the sensitivity (income of households) is significantly higher than the European average, the average adaptive capacity is slightly below average, which indicates that redistributive effects are important for sustaining social cohesion in these countries. Especially in the case of Hungary and Slovakia, the more powerful economy in the countries' western regions is partly transferred to the weaker regions. More generally, cohesion policy measures also contribute to the high ratio between primary income and disposable income. By and large, this cluster is confronted with various vulnerabilities towards social polarisation. The '**low income – income improved**' regions form the counterpoint to the previous regions. This cluster comprises thirteen regions located in the Czech Republic, Slovakia, Hungary, Slovenia and Croatia. The location of these regions along the former Western European borders also leads to specifics. They show a comparably low exposure to inequality distribution, yet they still have to contribute to other, weaker regions' incomes. However, being relatively prosperous in an economic sense when compared to their Eastern neighbours should not be cause for concern. The third and final type of regions in this paragraph is the '**low income – French overseas departments**'. This cluster consists only of three regions, which are the French overseas island *departments*, which are facing a high risk of social unrest due to labour market shortages combined with very limited perspectives for the youth. Only the income distribution is positive in the French context, as they receive high transfer payments.

The third group of regional types shares a high vulnerability towards the access to SGEIs. The '**vulnerable access to SGEIs – average income, high youth unemployment regions** are located in Portugal, the western and southern parts of Spain, the South of Italy and Greece. The cluster is characterised by rather high exposures over all social key challenges. Especially in youth unemployment they are performing significantly below the European average. Additionally, the vulnerability towards labour market transformations is very high. The '**vulnerable access to SGEIs – average income, high GDP regions**' are located in Ireland, the more urbanised regions of Spain (e.g. Madrid, Barcelona, Valencia, and Murcia), France and Dutch Flevoland. Apart from having an increased sensitivity in access to SGEIs because of their very dynamic population development, these regions share an above average, high economic prosperity (measured in GDP), yet only average household incomes. This indicates that surpluses achieved by the economy flow to a relatively high degree into capital and profits rather than into the labour market. The '**vulnerable access to SGEIs – the wealthy households**' are a different issue. These regions consist of large parts of the UK and Northern Italy. This type is characterized by an average vulnerability compared to the other EU regions; however, apart from an under average performance in access to SGEIs, they exhibit another weakness: a higher exposure towards income distribution (relatively high Gini coefficient). On the other hand, their unemployment rates are definitely lower than the EU average. Even more mysterious seem the '**vulnerable access to SGEIs – rich microstates**' Luxembourg and Liechtenstein. As in the case of the French overseas provinces, this cluster is more or less a residual effect due to the rather unique condition of the two regions in Europe. They are among the "richest" regions in Europe but are characterised by a rather heterogeneous picture with respect to social polarisation, which is also caused by the low number of elements in this cluster and to some extent by the limited availability of data. Their income level and also unemployment performance is far above the European average. However, in access to SGEIs they are still performing below the EU average, which may also be explained by their sheer size which necessitates different rules for the provision of social infrastructure.

Finally, Turkey as a socially very different accession country forms its own group: '**social accession and early school leavers regions**'. Methodologically, it has to be mentioned that in access to SGEIs the data coverage is limited, which makes an interpretation in this field impossible. However, in the challenges for which there is available data Turkey shows very high vulnerability, with only the overall unemployment rate being in line with European averages. Turkey is facing structural weaknesses in its economy, which is causing problems in the labour markets and putting the coming generation of the workforce at risk. In income inequalities and youth unemployment, Turkey scores significantly below the European average and might be facing a very high vulnerability with respect to social polarisation in the forthcoming decade.

Map 48 Cluster analysis indicating the vulnerability for the globalisation challenge (following page)

Social Polarisation - Integrated vulnerability



Type of Regions

Equal income regions

- Rich highly educated regions
- Middle class with low youth unemployment
- Wealthy middle class
- Highly educated middle class
- Equally low income - High unemployment rates

Low income

- Income detracted
- Income improved
- French overseas departments and regions

Vulnerable access to SGEIs

- Average income, high youth unemployment
- Average income, high GDP
- The wealthy households
- Rich microstates (LUX & LIE)

Social accession regions

- Social accession and early school leavers

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source: Eurostat except were indicated

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Regional Challenges in the Perspective of 2020

Mid-term scenarios

The current economic crisis leaves marks on the European economy affecting **income distribution** and the labour market with a time delay. Wages and subsequently the income of households dropped considerately. Within the scenario of *sustainable recovery* it is assumed that this dip in the curve is only temporary and the growth rates and the wages will recover – the economy faster than the incomes. Based on this assumption, all income brackets are affected equally hence income disparities will not alter but return to status quo. On the other side of the spectrum, the scenario of the *lost decade* expects the downfall of the economy to be long lasting. The ongoing recession leads to wage cuts in order for the enterprises to stay competitive. These financial losses for the individual households result in abating purchasing power and reinforces the economic decline. At the same time, the economies have fewer funds for transfer payments at their disposal. As a consequence of this missing corrective action, the disparity of incomes grows steadily.

The scenario of *sluggish recovery* expects the economy to recover but not to return to its previous strength. It is assumed that wages will drop and the income gap widen, but not as dramatically as in the lost decade scenario. Reasons for that can be found within the insider-outsider theory. Incumbent wage earners (insiders) are – due to labour turn over costs – in a privileged position than those which are not yet part of the team (outsiders). In times of economic stagnation employees will hold on to their jobs and try to keep the wages at the same levels, arguing with the costs, that hiring, firing and training of outsiders would cost. This market power of the jobholders will make it especially hard for young people, seeking a job. In this scenario the unemployment rate among the young will rise significantly.

Concerning **labour market transformations,** once the economic crises is overcome and the economy picks up the previous growth trends the *sustainable recovery* scenario expects a rising expenditure level on research and development. These R&D measures trigger a restructuring and re-organisation within the economic sectors especially promoting innovative and green industries. Based on this assumption the demand of highly qualified personnel will increase whereas unemployment will rise among the workers in low-skill jobs. The upward trend of labour costs involves the risk of abetting offshoring, which in turn may favour emigration of the low skilled labour force to neighbouring countries. The transformation of the labour market towards creative and innovative industry (e.g. renewable energy) offers a chance for peripheral regions. On the one hand, because green industries strengthens rural areas since they are closer to the renewable resources. On the other hand, because the increasingly interdependent and globalised world enables the third sector, especially the creative industry to offer services far away from economic centres. It has to be noted however, that growth will mainly take place in the innovative and structurally sound regions, where further economic concentration will occur.

The scenario of a *sluggish recovery* holds the chance of investing into education and training, increasing the general attainment level and thus enable capacity building. Still, the potential of restructuring the economic sectors and thus boost economy is far smaller than in the scenario of sustainable recovery. All in all the scenario of sluggish recovery acts path dependently. Furthermore the available funds for qualification measures will not be enough to reach all members of society. While the third of the population with the highest income will not be affected greatly by rising unemployment, the opposite can be said about the third with the lowest income. As a consequence the wage gap will widen, primarily affecting the youth, elderly and women.

Considering the scenario of *lost decade*, the unemployment rate will rise in all walks of life and across all economic sectors. Consequently the income levels are falling, the markets shrink and consumption decreases. On one hand, these developments are accompanied by rising awareness of the scarcity of resources, which in turn increases the willingness to invest in process and product innovation. On the other hand investments in training and education are rather scarce, hindering the opportunity for further qualification for the majority of the population. The high unemployment rate will drive the wages down and by doing so decreases the risk of offshoring. The low labour costs are internationally more competitive thus it is more economically attractive to keep production process in the EU. This development can strengthen peripheral regions because they might be more competitive than central regions, where labour costs are higher. This scenario offers the biggest chances for low skilled workers.

The scenario of *sustainable recovery* offers many opportunities for the youth. The general trend will

lead to a decline in **youth unemployment**, a higher level of qualification and a greater share of people who attained tertiary education than before the years of economic decline. The restructuring of economic sectors is largely due to the stronger increase of young, highly qualified entrepreneurs, which generates a boom in high technology, micro enterprises and the creative industry. Expanding the spectrum of economy like that implicates, that the unemployment rate among the young decreases, even below the general unemployment level. These developments will lead to further concentration on dynamic, growing regions in central Europe. Apart from that they also offer a chance to peripheral regions, because of the territorial independent foot-loose industries (cf. potential mid-term development in the section on labour market transformation).

A *sluggish recovery* from the recent crisis may lead to a higher participation rate in education and training. The insider-outsider dynamic (high labour turn over costs favour incumbent jobholders over people, seeking employment) plays a big role in this scenario, where the market power of the insiders makes it especially hard for young people, seeking work. Instead those people will consider staying in school as long as possible, avoiding the frustrating search for a job. Structural change will happen very slowly, leading to the advanced thinning out of the periphery which is left with no chances for the future.

This scenario is overshadowed by the one of the *lost decade*, which will lead to a lost generation. The youth might find jobs in low skilled professions but for the European economy they are lost, since they cannot contribute to its sustainable recovery. Most chances to find work are given in regions, where the demographic structure is a young one. If the majority of the population belongs to the young segment, the other parts will have a weak bargaining power and the turnover in the labour market will happen faster. Based on this reasoning there are two kinds of regions that will be strengthened by this scenario. Firstly the peripheral regions, because there is more need for low skilled workers and secondly, the regions with a young population structure.

With the reinstated growth of the output within the *sustainable recovery* scenario, there is also a greater financial scope for transfer payments into the social sector in general, and into the health care system specifically that might ease the **access to SGEIs**. This does not necessarily mean that these resources are used to expand the social infrastructure but may contribute to a comprehensive prevention programme, which makes the health care infrastructure less important. Certainly, the recent investments into the construction sector (road, electricity, etc.) will lead to an enhanced accessibility. This improved accessibility goes hand in hand with people's willingness to overcome ever longer distances. This might lead to one or both of the following scenarios. Either, the periphery suffers even more losses in their endowment of infrastructure. People travel longer distances, hence they are not bound to local services, which leads to a thinning out of the range of services of general economic interest. Or, the better accessibility of formerly remote areas makes them more attractive for settlement. The demand for social infrastructure which comes with the increasing (or at least stable) number of inhabitants might lead to their maintenance, if not even to an increased range of services. According to the theory of territorial cohesion, these formally shrinking regions can find a way back to a new 'attractiveness' leading to new inputs for the region's economy.

In the scenario of the *lost decade*, SGEI facilities will be closed down en masse, due to the lack of adequate funding. This will be true even for regions with a high demand of these services. Disadvantaged groups, most commonly the elderly, children and women, will be the most affected, for example by the closing of the kindergarten or the only post office within walking distance.

One can argue that while in the scenario of *sluggish recovery*, some social infrastructure providers need the shakeout within its system in order to be more efficient, this course of action is not possible within the lost decade scenario. The effects there are directly linked to the prolonging of the distance between home and required facility. In both scenarios however, the effects of the economic decline on services of general economic interest can only be noticed with a delay.

Table 27 provides a comparative overview on the scenarios for social polarisation. comparative table.

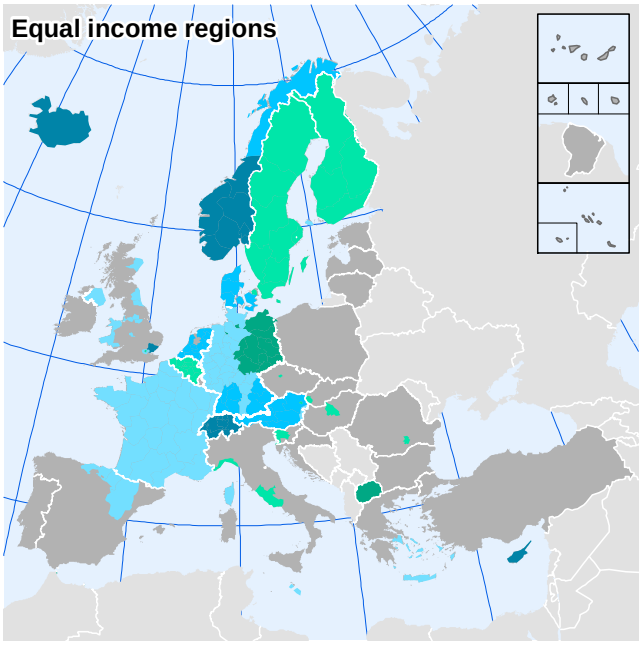
Table 27 Scenario overview for the social polarisation challenge

Scenarios	trends: ↗ situation improves; → situation stable; ↘ situation worsens	groups of regions: Equal income regions	Low income regions	Vulnerable access to SGEIs regions	Social accession and early school leavers
Income distribution					
Sustainable recovery	Temporary decline of household incomes. Will recover soon. Income inequalities will return to pre-crisis situation.	→	→	→	→
Sluggish recovery	Long lasting decline of the economy. Disparity of incomes will grow due to the economic decline that causes a lack of funds for corrective transactions.	→	→	→	↘
Lost decade	Wages drop and inequalities rise, but not as dramatically as in the lost decade scenario. Hiring and training of new staff would carry with it comparatively high costs. Job seeking would be harder than in the other scenarios.	→	↘	↘	↘
Labour market transformations					
Sustainable recovery	Re-organisation of the economic sector; promotion of innovative and green industries. Demand for highly qualified personnel will increase, whereas unemployment will rise among the workers in low-skill jobs. Off-shoring could cause migration.	↗	↗	↗	→
Sluggish recovery	Unemployment rate will rise across all economic sectors. Could increase the willingness to invest in process and product innovation. Investments in training and education are rather scarce. High unemployment rate lowers wages. This makes the regions more competitive and could be a chance for low skilled workers.	↗	→	→	↘
Lost decade	There is a chance of investment in education and training, but on a lower level than for sustainable growth. Funds for qualification measures will not be enough to reach all employees. Risk of widening the income gap by only training parts of the society.	↘	→	→	→
Youth unemployment					
Sustainable recovery	General trend will lead to decline in youth unemployment, higher level of qualification/education than before the crisis. Boom in high technology and creative sector will lower youth unemployment below general unemployment.	↗	→	↗	↗
Sluggish recovery	The youth might find jobs in low skilled professions, but for the European economy they are lost, since they cannot contribute to its sustainable recovery. Most chances to find work are given in regions where the demographic structure is a young one.	→	→	→	→
Lost decade	Higher participation rate in education and training. The insider-outsider dynamic plays a big role in this scenario, where the market power of the insiders makes it especially hard for young people to find work. Structural change will happen very slowly, leading to the advanced thinning out of the periphery which is left with no chances for the future.	↘	→	→	→
Access to SGEIs					
Sustainable recovery	Reinstated economic growth allows transfer payments into the social sector in general, and into the health care system specifically. Does not necessarily mean that these resources are used to expand the social infrastructure. Recent investments into the construction sector will lead to an enhanced accessibility which goes hand in hand with people's willingness to overcome longer distances.	↗	→	↗	→
Sluggish recovery	SGEI facilities will be closed down en masse, due to the lack of adequate funding. This will be true even for regions with a high demand for these services. Disadvantaged groups, most commonly the elderly, children and women, will be the most affected, for example by the closing of kindergartens or the only post office within walking distance.	↗	→	↗	→
Lost decade	Thinning out of infrastructure could lead to a more efficient system.	↘	↘	↘	→

Map 49 Mid-term scenarios for the social polarisation challenge (following page)

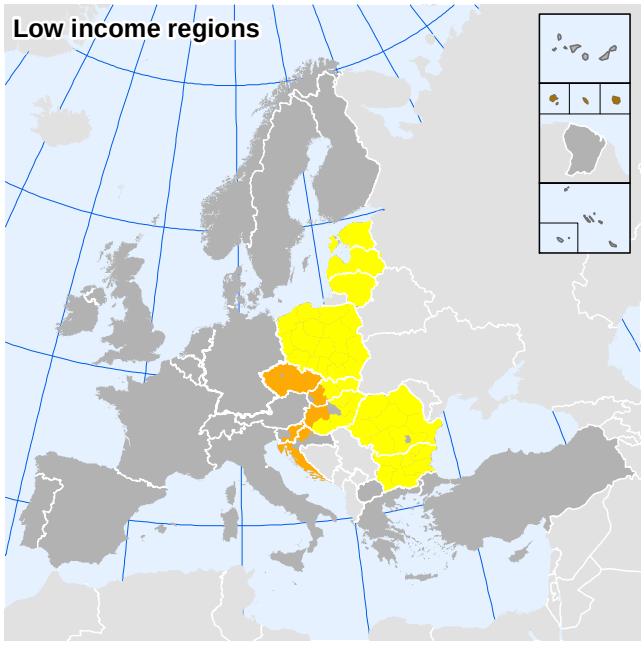
Scenarios for the social polarisation challenge

Equal income regions



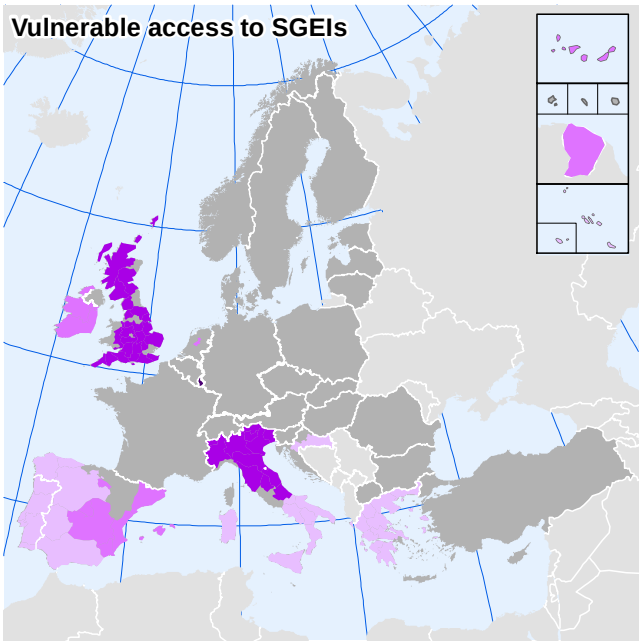
Income distribution	→ → →	Rich high educated regions
Labour market transformation	↗ ↗ ↘	Middle class, low youth unemployment
Youth unemployment	↗ → ↘	Wealthy middle class regions
Access to SGEIs	↗ ↗ ↘	Highly educated middle class regio.
		Equally low income, high unemploy.
		Other Group of Regions

Low income regions



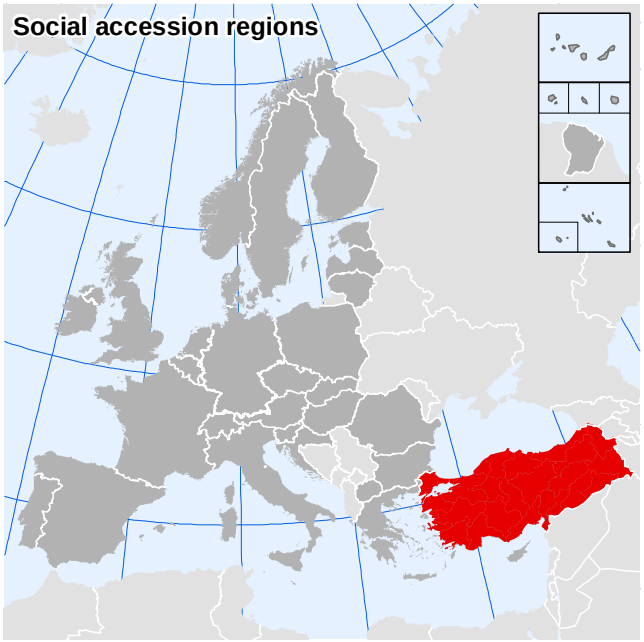
Income distribution	→ → ↘	income detracted
Labour market transformation	↗ → →	income improved
Youth unemployment	→ → →	French Overseas
Access to SGEIs	→ → ↘	Other Group of Regions

Vulnerable access to SGEIs



Income distribution	→ → ↘	average income, high youth unemploy.
Labour market transformation	↗ → →	average income, high GDP
Youth unemployment	↗ → →	Wealthy households
Access to SGEIs	↗ ↗ ↘	Rich microstates (LUX, LIE)
		Other Group of Regions

Social accession regions



Income distribution	→ ↘ ↘	
Labour market transformation	→ ↘ →	social accession and
Youth unemployment	↗ → →	early school leavers
Access to SGEIs	→ → →	Other Group of Regions

Prospects 2020

Trends	Scenarios: Sustainable recovery	Sluggish recovery	Lost decade
Challenge increases	↗	↗	↗
Challenge constant	→	→	→
Challenge reduces	↘	↘	↘
Unknown	?	?	?

Type of Region

- Type of Region
- Other Group of Regions
- Neighbouring Countries

Kilometres

0 1.000 2.000 3.000 4.000

Regional Challenges in the Perspective of 2020, Vulnerability Indices
Indicator data source
Eurostat except were indicated

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Regional Challenges in the Perspective of 2020

The challenge of social polarisation in a nutshell

- *Social polarisation vulnerabilities are by and large following the general European regional split up of Eastern and Southern regions being more vulnerable than the rest of Europe.*
- *With respect to education levels the South Eastern periphery shows the largest deficits whereas the central European area and the New Member States have rather favourable preconditions.*
- *With respect to youth unemployment the Southern countries are more vulnerable, with respect to income inequalities the Eastern periphery is more affected.*
- *The issue of labour market transformation is affecting equally the periphery and the most industrialized regions of the European centre. These regions' future success depends very much on the reaction of the regions to ongoing globalisation development, whether they find answers by diversifying their economies or intensifying the knowledge aspect in their economic structure.*
- *Economic wealth and income in Asian and African neighbouring countries are distributed much more unequally than in Europe. Still unemployment levels are not that much below the worse performing EU MS. Unemployment and especially youth unemployment are widespread in the Western Balkans and in the Arab-Mediterranean neighbourhood due to the demographic and economic development.*
- *In the mid-term social polarisation is expected to improve in the sustainable recovery scenarios due to the pick up of the economic growth path. However the threat of increasing income disparities may increase. Labour market transformation will favour new sectors and thus lead to a more balanced territorial distribution of wealth. The sluggish recovery scenario bears the challenge of slower growth rates and thus of less labour market opportunities for the young people. The economy will show more path dependencies and less opportunities with respect to decreasing disparities. The lost decade scenario will hit especially the "richer" central European regions with respect to income inequalities and decreasing levels of SGEIs. The European periphery will be less affected due to low starting conditions.*

9. Discussion of multiple challenges for EU regions

As a last step before interpreting the analysis results related to their policy implications, the analysis related to individual challenges will be pulled together in this chapter to create a typology of multiple impacts and vulnerabilities. However, the interpretation of the results requires a deep understanding of links between the challenges from which different types of regions will emerge. A systemic picture of all the important elements of the five challenges helps in this respect (Figure 22), whereas the region constitutes the systemic border.

Energy and climate change are linked through the energy supply/demand and the energy mix in the regions which influence GHG emissions and related climate agreements. Energy use is closely linked to the economic structure and dynamics of the regions by influencing the energy input into the production process, which is itself influenced by the global integration of a region, a causal chain that continues directly into the labour markets. Social polarisation is also linked to energy via the element of energy prices. An important direct link between climate change and social polarisation is established through the concept of quality of life in terms of the influence of climate change on human health, recreation opportunities and the availability and quality of specific environmental media, such as water. The challenge of demography links directly with the labour markets and the availability of workforce. Moreover, especially if we include the European neighbourhood, migratory flows can be triggered by climate change. Globalisation is brought into the picture not only via production patterns, but also through the accessibility to markets and resources. This also links the challenge to migration and social issues in terms of income levels, education and knowledge. The production patterns themselves influence climate change via their negative externalities.

In these initial thoughts, the difficulties of establishing the effects of multiple challenges on one region are already becoming apparent:

Firstly, many of the challenges may be regarded as both causes and effects of vulnerability in regions. For example, demographic change may be seen as a cause of social polarisation (with respect to misbalances of supporting vs. supported population) as well as an effect of social polarisation (with respect to income levels and distribution). For the establishment of territorial vulnerabilities under multiple challenges this means that the overall vulnerability of a region may not simply be added up from all single vulnerabilities. The result would likely be determined by enforcing and diminishing feedback loops.

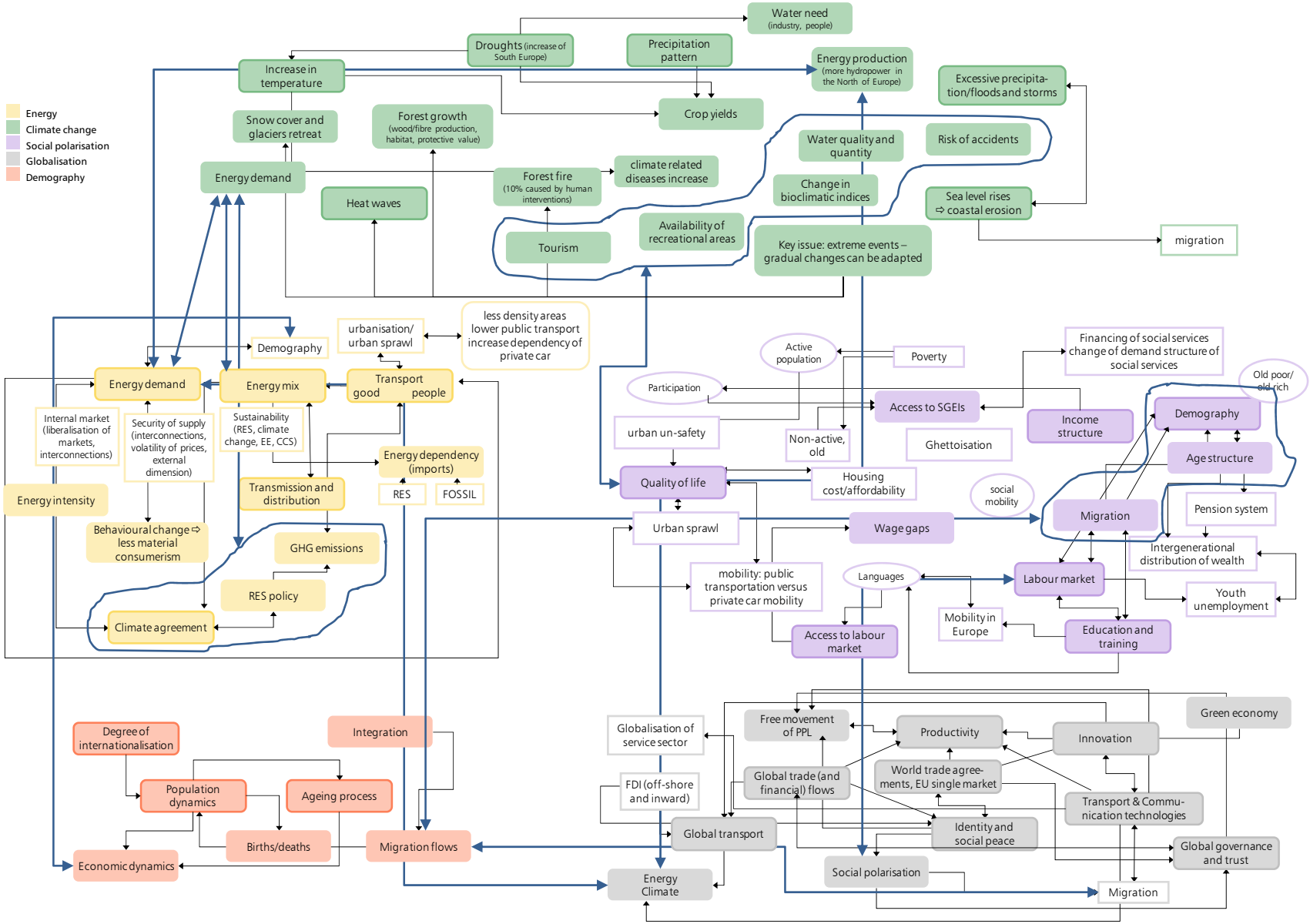
Secondly, territorial effects are not happening simultaneously. Some of the challenges affect the vulnerability of regions with considerable time lags (many measurable effects of climate change are not forecasted before 2050, for instance). However, the causes triggering these effects are set now and, moreover, we tend to weigh the impacts over time and to neglect the fact that adaption often requires time. What is to be observed in the short run is deemed more important than the long run perspectives. This leads implicitly to a higher weight being attributed to socio-economic compared than to environmental vulnerability.

The methodological approach applied in order to take these difficulties into account has therefore again been a cluster analysis computing all indices newly created for the five challenges (exposure, sensitivity, adaptive capacity). By using this approach it is possible to avoid preconceiving any specific functional links while maintaining the ability to aggregate all information available.

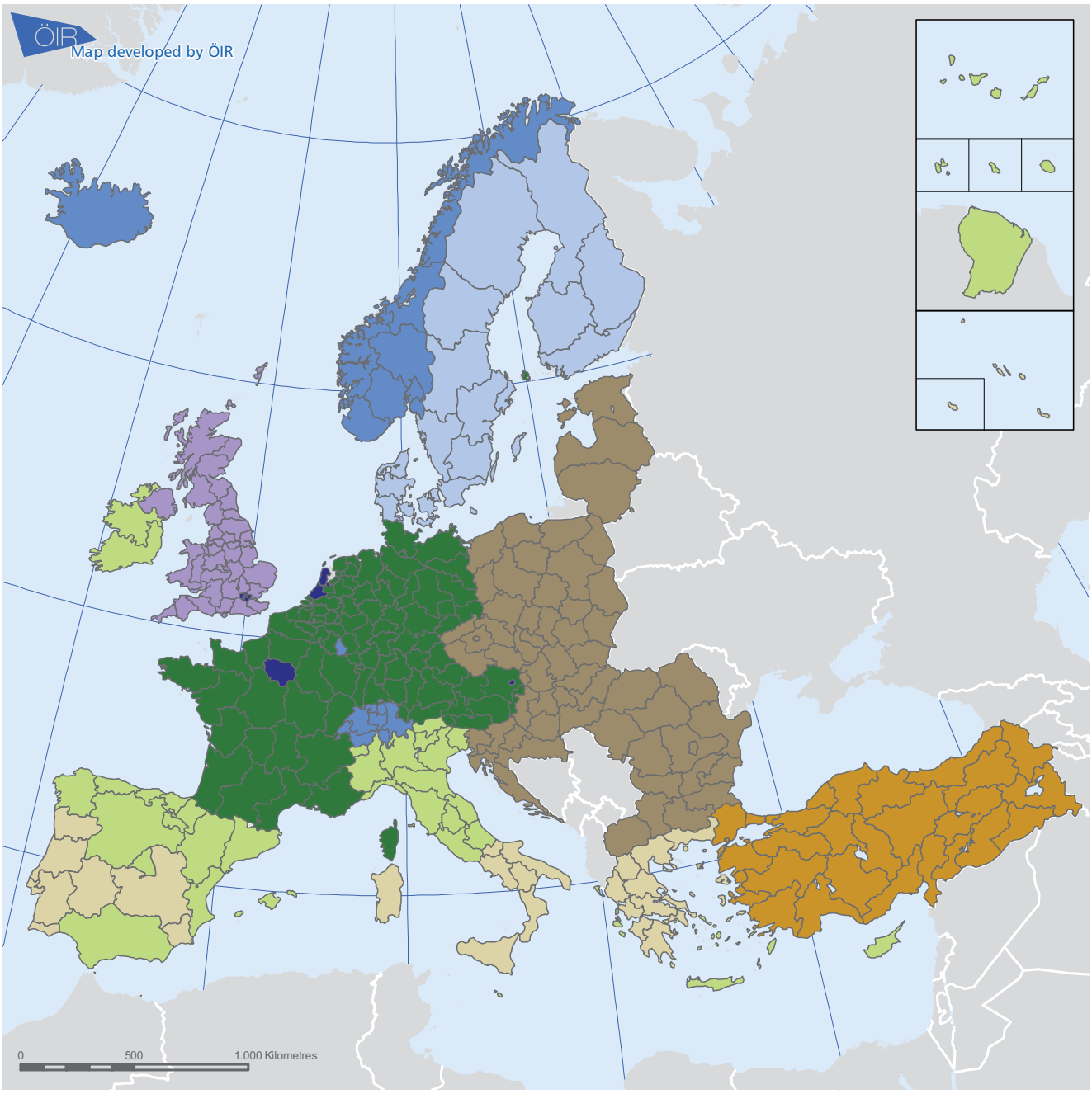
The cluster analysis has lead to an optimum set of nine clusters (see Map 1). In calculating the similarities in exposures, sensitivities and adaptive capacities it can be expected that groups of regions would emerge that often form a cluster in the topical key challenges. And indeed, examining the map we come across a number of clusters that have been recurring throughout the analysis: The CEE New Member States form more or less homogeneous clusters in most challenges. The Southern Member States show a north-south divide (with Southern Italian and Spanish regions closer to Greece and Portugal than to the rest of their countries) at least to some extent in all but the energy challenge. The UK and Turkey often form a heterogeneous cluster. The three Northern Member States showed many similarities in the single topical challenge analyses as did the wealthiest countries Norway, Iceland (pre-crisis!), Luxemburg and Switzerland. In the following sections, the nine regional types will be characterised in more detail.

Map 50 Cluster analysis indicating the vulnerability for all challenges (page after the following)

Figure 22 Systemic overview of all challenges



Multiple challenges - Integrated vulnerability



Types of Regions

Barley vulnerable Europe

- Global economic high performers
- Social and economic high performers
- Social and knowledge high performers
- UK

Moderately vulnerable Europe

- Economic high performers
- Climate change challenged regions

Highly vulnerable Europe

- Globalisation and energy security challenged regions
- Globalisation and climate change challenged
- Globalisation and socially challenged regions

Source: Regional Challenges in the Perspective of 2020, Vulnerability Indices

ÖIR Map developed by ÖIR

Regional Challenges in the Perspective of 2020

The first four clusters form the group of European regions that mostly feature very low vulnerabilities. The '**barely vulnerable – global economic high performers**' consist of only seven regions building the smallest cluster in the sample. These are the metropolitan areas of Paris, London, Vienna, Brussels, Amsterdam and Rotterdam. These are regions which are economically well off and can often be found together in other typologies (for instance various ESPON projects) as European forerunners in terms of economy and innovation. This is underlined by the good performance of the cluster in the challenge globalisation, where the regions are leaders in all key issues except for mobility (on account of their high dependence on cargo and passenger flows). This depiction is accompanied by above average performances in secure, sustainable and competitive energy and social polarization. Vulnerability towards demographic change is also low, which is largely due to the attractiveness of these metropolitan regions to immigrants (which makes them however vulnerable towards integration issues). Only in climate change, especially towards the natural hazard challenge, do these regions score below average (floods and storms).

A similar group of regions are the '**barely vulnerable – social and economic high performers**', yet this cluster also includes many rural regions. This cluster comprises seventeen regions and covers Norway, Iceland, Switzerland, Liechtenstein and Luxembourg. Again, these regions are economic high-performers and perform even higher in their national context than in the first cluster. Furthermore, except for Luxemburg they are all associated EFTA rather than full EU members. Their high GDP levels offer them – at least potentially – the capacity to adapt to most of the analysed key issues, which of course adds to their low vulnerability across all topics. Specifically, the vulnerability towards social polarization is very low, lower even than in the above mentioned EU metropolitan regions. The energy challenge is also not a significant issue except for capacity deficits in Iceland and fuel vulnerability in Luxemburg.

The '**barely vulnerable – social and knowledge high performers**' cluster covers the entire Northern Member States of Denmark, Sweden (except for the autonomous island of Åland) and Finland. Like the previously mentioned cluster, these regions show a comparably low vulnerability across most challenges. They build upon strengths in the challenges social polarisation and globalisation, particularly economic strength (illustrating the well-known Nordic model). Especially in the key social issue "income distribution", their high level of taxation and their highly redistributive tax system allows these nations to stand out above the European average. However, this could in principle trigger problems concerning competitiveness. As the results of the globalisation challenge analysis show, most of these regions perform well regardless, which is mainly based on their role in global knowledge production as shown by the indicators for transnational headquarters, R&D expenditures, broadband access, patent applications. A notably high vulnerability in these countries can only be found in accessibility (on account of their position on the periphery) and energy demand.

The fourth and final cluster that is ahead of the European average in terms of regional vulnerability is the '**barely vulnerable UK**'. It comprises the entire United Kingdom with the exception of Inner and Outer London. The UK shows an overall low vulnerability due to the fact that it is economically advanced, demographically stable in the national context, not overly exposed to climate change issues, and well positioned regarding energy supply. The only potential threat for some of the UK can be identified in its exposure to income disparities and an underperformance in the access to SGEIs.

The following two clusters generally show increased vulnerabilities; however, this must be considered in the European context and within an average range. The '**moderately vulnerable – economic high performers**' cluster is built of no less than eighty-nine regions and is thus the largest cluster in the sample. It covers most parts of France, Germany, Austria, the Netherlands and Belgium except for some urban areas. The cluster is characterized by an average vulnerability performance in almost all challenges. Only in globalisation do these regions stand out as being, in economic terms, relatively successful and very accessible due to their location in the centre of Europe. Generally speaking, these regions are not particularly vulnerable vis-à-vis any of the challenges, but they are also not explicitly well equipped against future challenges.

The '**moderately vulnerable – climate change challenged regions**' covers forty-one regions: Ireland, Cyprus, the more prosperous regions of Spain and northern Italy and the Greek islands. These regions are commonly considered the 'winners' of Cohesion Policies in Europe.

They show some increased vulnerabilities; however, compared to the southern periphery of Europe presented in the final group of clusters below, they are by and large oriented towards the EU high performers. The main vulnerability of

these regions is towards the climate change challenge, which can be explained – with the exception of the less vulnerable Ireland – by their often subtropical climate and the connected factors of water scarcity and tourism importance. These regions are, as a consequence, mainly challenged with respect to their natural resources and their management. A minor point of concern is the hindered access to SGEIs in almost all of these regions. In the otherwise average performance of this cluster the high sensitivity in access to SGEIs is the key issue. Another potential source of increased vulnerability is migration/integration, since many of these regions have experienced high third country immigration in recent times.

The '**highly vulnerable – globalisation and energy security challenged regions**' cluster includes fifty-eight regions that are all located in Central and Eastern Europe. It covers all of the 2004 and 2007 accession countries and the candidate countries Croatia and Macedonia. It does not come as a surprise that these regions are classified as being similar with respect to their overall vulnerability, as these regions have been classified similarly in many of the key issues. They all show an increased vulnerability in a majority of key issues, which is very often a result of low adaptive capacities (they would otherwise score higher in the climate change vulnerability, for instance). This is due to the fact that their economic capability is still low compared to the European average and their global position is weak. They are also characterised by a highly vulnerable energy supply, which is mainly a question of efficiency deficits. Also negative population dynamics remain a major problem in these countries' rural regions, even if the economic crisis probably decelerated the decline.

The '**highly vulnerable – globalisation and climate change challenged regions**' cluster includes twenty-seven regions in the southern-most areas and covers Portugal, parts of Spain, Southern Italy and most of Greece. These are *cohesion* regions still considered as weak economic performers. They are specifically vulnerable to climate change as their economies depend largely on tourism and agriculture and their natural resources are strongly affected by an already hot and arid climate. Their economic structures also cause strong vulnerabilities in the processes of globalisation and they are adversely affected by their peripheral position. Moreover this may trigger future challenges in demography and social polarisation (shrinking regions and social disparities).

The '**highly vulnerable – globalisation and socially challenged regions**' cluster covers all of Turkey. Turkey is to be considered as highly vulnerable in many fields; however, it displays other characteristics than the previously mentioned southern peripheral regions. Turkey is characterised by a very high vulnerability in the key issues of the challenge social polarisation (except for access to SGEIs, where there were too many data gaps). The inequality of income distribution is high in most Turkish regions while average income levels are low. Furthermore, the education level is very low in many regions, which may threaten labour markets in a globalised world, in the mid-term, even if unemployment rates are currently moderate. From a demographic perspective, the problem of regions shrinking due to emigration is very present in all rural regions, although the Turkish population is very young. In the energy and climate change challenges there is too little available data to make definite conclusions. However, as the climate is hot and arid and interior energy resources are scarce, a high vulnerability can also be assumed in these challenges.

It appears that the hypothesis at the beginning of this section – that the clusters for multiple challenges would consist of regions that are often in the same clusters from the topical analysis – was accurate. The clusters have been more generalised along national borders, but the characteristics of the European macro-geographical region are well represented. However, the project team also developed a new method that functions as a robustness analysis. This experimental method is called the 'vulnerability DNA of regions' and is essentially a calculation of how many times a single region shares a cluster membership with another single region (a more detailed illustration can be found in the subsequent Box 2: The vulnerability DNA of regions).[6] The results showed that some patterns are indeed very robust, for instance the peculiarities of the UK and Turkish regions forming clusters of their own or the frequent similarities between the New Member States or the wealthy EFTA states.

[6] This newly developed approach is originally based on discussion results from the third project workshop on 9 September 2010.

Box 2: The vulnerability DNA of regions

Within the topical chapters, the EU regions were analysed according to their vulnerability to five challenges plus the challenge of the economic crisis (available as a self-standing document). Consequently, six cluster analyses were computed that categorise the European Union in different clusters for every challenge. The aim of the "vulnerability DNA" is to compare those clusters and find regions that are always (or very frequently) placed in the same cluster. Its output will be a matrix with all regions on both axis showing how often region X shares the same cluster with region Y. The "vulnerability DNA" cannot generate quantitative results that would state whether region X would perform better or worse than region Y.

Within In the first step of the "DNA analysis", every cluster set was analysed according to regions that share the same group. Therefore the 317 NUTS 2 regional units were listed on the abscissa as well as on the ordinate. Each region was then compared to every other region and if both regions were within the same cluster they were classified as "1", otherwise as "0". This was done for each challenge, which resulted in six cross tabulations showing similar regions. The six tables were than combined into one table by a simple matrix addition. The result is a matrix with values ranging from "0" to "6",thereby showing how often region X is classified in the same cluster as region Y.

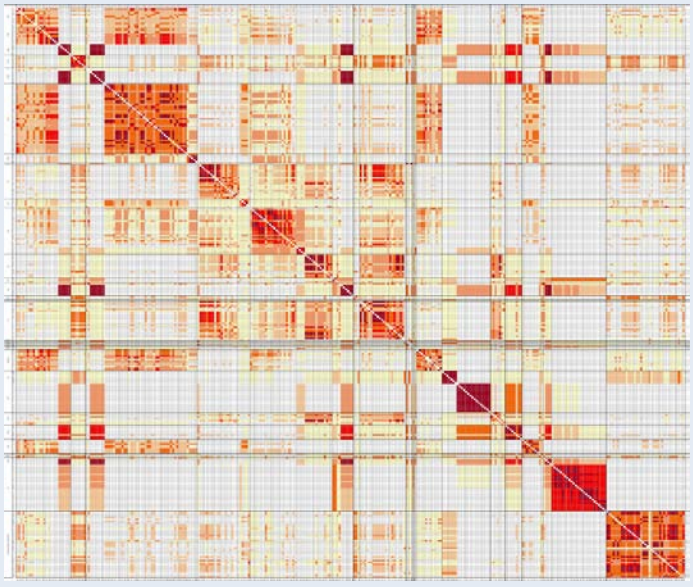
This matrix is the "Vulnerability DNA" shown in the illustration. The cells are coloured on a yellow-red scale, starting from light yellow for only one match between two regions up to dark red for regions that are in the same cluster for every key vulnerability issue. Combinations of two regions that are never in the same cluster stayed white. Since the matrix compares every region on the abscissa with every region on the ordinate and all 317 NUTS 2 regions are listed on both axes, the result is a symmetric picture that mirrors along the diagonal.

The matrix shows that regions within one country are quite dark most of the time, meaning that regions within one country are in the same cluster more often than average. Since several of the indicators used were available on the national level, this could be expected. It might also show that national policies have a high influence. This is, however, not the case for Spain and Italy, where the northern parts of both countries are very often in the same cluster and the southern parts are very often together in a different cluster (Greek and Portuguese regions can also be found within this cluster). Other interesting correlations are:

- ALL regions of Hungary, the Czech Republic, Bulgaria and Slovakia are ALWAYS in the same cluster
- Austrian, Belgian, Dutch, German and Swedish regions very often form the same cluster
- French regions very often form a distinct cluster or join the northern Italian/northern Spanish cluster
- The Turkish regions form their own cluster most of the time, often joined by the Croatian regions
- The UK forms its own cluster most of the time; the only countries joining this cluster more often than average are the Republic of Ireland and Switzerland
- The city of London is in the same cluster with the rest of the UK only one time, but is together with Liechtenstein four times
- Norway and Iceland form a cluster most of the time, though very often joined by Switzerland, Liechtenstein and Luxembourg
- The three Baltic states are always within one cluster (Estonia five out of six)

These first conclusions already illustrate groups of regions with different types of vulnerabilities. To translate this into a map of vulnerability clusters, the exposures, sensitivities and adaptive capacities of all six key issues were used for one "overall" cluster analysis.

Figure 23 "Vulnerability DNA"



10. Policy implications

What has become clear in the analysis so far is that the multiple future challenges that many of the European regions face cannot be addressed by single policies. Rather, a sound mix adjusted to the addressed regions will be necessary. The Europe 2020 strategy indicates a similar approach; however, the Europe 2020 strategy as such does not introduce concrete policy measures for Member States and regions but rather remains a cross-cutting strategy that shall be introduced in all EU policies, instruments and legal acts and national policies. Work is underway concerning how to integrate Europe 2020 into the EU multi-annual financial framework (review of the Financial Regulation). It is envisaged to use existing as well as new policy instruments:

- Possibilities to improve the effectiveness and efficiency of the existing EU policies through stronger prioritisation and better alignment of EU expenditures with the goals of Europe 2020 should be fully exploited. In this respect, the Barroso paper speaks of a *fragmentation of EU funding instruments*.
- New financial instruments should be developed, e.g. in cooperation with the European Investment Bank, the European Investment Fund and the private sector to add leverage to public funds.

Cohesion should ensure that all energy and capacity is mobilised and focused on the pursuit of the strategy's priorities. The structural funds are judged to be key delivery mechanisms at the heart of the Europe 2020 strategy (which does not come as a surprise as today they are the most important Community policy instrument in terms of budget). Cohesion policy should have a clearer role to play in supporting Member States' actions to address structural weaknesses and competitiveness challenges. The 5th Cohesion Report (COM 2010) presented proposals in this respect, particularly with a view to strengthening institutional capacity and efficiency of public administrations. The future of cohesion policy has been stipulated as follows:

- Enhancing the European added value of Cohesion Policy through reinforcing strategic programming (e.g. a common strategic framework for all territorially relevant EU – co-financed funds, development and investment partnership contract);
- increasing thematic concentration (core priorities concentrating on a few public goods – towards a territorialized social agenda);
- introducing stronger incentives and conditionality, improving evaluation, performance and results, supporting use of new financial instruments (financial engineering instruments);
- strengthening governance by reinforcing partnerships (within Member States, across borders but also improving the involvement of local and regional stakeholders, social partners and civil society);
- introducing a new dimension of territorial cohesion (territorial cooperation, urban agenda including urban-rural linkages, addressing areas with specific geographical or demographic features).

The Europe 2020 Strategy was developed under the influence of the economic and financial crisis—especially the state of public finances and sovereign debts—and the role that the European administration plays in the aftermath of the downturn. Therefore, the implementation of the Strategy should be based on a stronger policy framework at the EU level than previous growth strategy attempts.

The most relevant policies that address the future challenges

The following sections will provide an overview of the EU policy fields relevant for each of the five challenges in this study.

Globalisation

For addressing globalisation, development potentials in all parts of the European Union must be drawn on. Therefore territorial awareness and fine-tuning of policies as well as the basic ideas of territorial cohesion and place-based policy making are important. Furthermore, the issues raised by globalisation cannot be answered by one single policy field, which implies both horizontal and vertical integration of policies. Given the main characteristics of globalisation, the following policies seem to be at the heart of the development of a smart policy mix:

- **Territorial and regional policy** aimed at strengthening development potentials and balanced development is needed to keep all regions 'on board'. These policies tackle the

full utilisation of regional specificities and development of local and regional capacities to respond to globalisation challenges and potentials.

- **Transport policies** (from EU to regional levels) are needed on two very different scales. On the one hand, there is need to develop global transport hubs and support good access to these hubs all over the EU (development of the single European transport network), including a territorially balanced hub development. On the other hand, transport policy must ensure local accessibility which is the key for the global integration of rural and peripheral areas. The main problems to be solved in the mid-term in this respect are financing gaps in some convergence countries and administrations hit strongly by the crisis and how to focus on importing missing transport links to connect to the single market.
- **Information and communication technology (ICT) policies** can ensure the link into the global net and the information society. In addition to ensuring a competitive position of Europe, it can also contribute to lessening territorial effects of accessibility inequalities. Therefore, ICT policies are a means to 'compensate' for other disadvantages and are closely linked to the key issues of accessibility and knowledge.
- **Research and development (R&D) policies** aimed at international competitiveness. These policies need to involve private companies in order (1) to increase available R&D financing and (2) to apply new knowledge economically. No global player can persist without state-of-the-art applied knowledge.
- **Education policies** for enhancing the human development potential which in turn is a fundamental prerequisite for realising R&D objectives. These policies are therefore fundamental for the knowledge sub-challenge, especially in terms of long-term development perspectives.

Past experience has shown that the utilisation of development potentials and the overcoming of challenges are also highly linked to issues of **governance** and **leadership**. Therefore, in addition to the sectoral development of policies, the dynamics of local and regional development based on intangible assets and human interplay also need to be considered. While the above formulations for relevant policies are relatively abstract, they can be easily translated into more specific objectives and recommendations once national and regional characteristics are considered.

A quick screening of national strategies addressing globalisation has shown that long-term oriented strategies can be found in the Nordic and north-eastern countries of the EU, France and Germany. The strategies of north-eastern countries have a larger time horizon than those of other European and the Nordic countries. Latvia, Lithuania and Poland target the year 2030, allowing for greater and more substantial changes.

Demographic change

The advancing statistical ageing of Europe's population is a result of low birth rates coupled with a rising (healthy) life expectancy. This manifests itself in changing intergenerational relations (for instance influencing pension or elderly care systems). Economically, in many countries the young people entering the labour market are no longer able to fully replace the older people leaving the workforce. Some countries, such as most recently Denmark, react to this by ceasing early retirement schemes.

Policies that directly influence demographic change are the exclusive competence of the Member States. The main instrument is the **family policy** whose challenges today are the facilitation of child care offers and family support to improve the reconciliation of work and family life. There is a clear positive correlation between the quality of childcare and birth rates in Europe, with the Nordic countries and France scoring high in both. Financial support for families is not easily comparable throughout Europe, as they are a complex mixture of transfers and benefits, tax regulations, allowances and grants.

Nonetheless, there is also a strong common European interest. Concerning the population development and fertility rates in many European countries, the European Commission stated in their Green Paper "Confronting demographic change: a new solidarity between the generations" (Com 2005): "*Europeans would like to see more family policy. But they are discouraged from doing so by all kinds of problems that limit their freedom of choice, including difficulties in finding housing*". The following are a number of common policies:

- The **European Employment Strategy** promotes "active ageing", i.e. the gradual raising of the average retirement age and an improvement in the quality of jobs.

Box 3: Demographic challenges between place and territory

Demographic developments and challenges mirror strong interdependencies between places. For example, in most cases migration is based on the individual's decision to improve their living conditions. As such, territory is more or less split into migration-producing places and migration-gaining places, both with related, distinct place-based policies. Following a philosophy of ever-growing efficiency and productivity, the migration flows, both within the Union and also from outside agglomerate in the most attractive places. As stated in the Barca report, 'place-based policies are, in fact, intended to enhance individuals' substantive freedom of deciding whether to stay (and to make the most of staying) or to move (and to make the most of moving)'.

Place-based, distinct policies are required in different regional types and sometimes appear contradictory in the overall perspective. A clear understanding of the interrelations and interdependencies between the different types of regions is necessary. The places of emigration need targeted policies related to the regional re-structuring and development, whereas the immigration regions require more regulatory policies to deal with the additional demands on infrastructures and integration.

- As an important financial instrument in this respect, the **Cohesion Policy** structural funds have multiple roles in adapting to the ageing society. First, via life-long learning and other education initiatives, they can facilitate a longer working life by improving the state-of-the-art qualification of older workers. Second, this is facilitated via the provision of infrastructure, provision of SGEIs, childcare and mobility also for elderly people in peripheral areas.
- Finally, the **Agricultural and Rural Development Policy** is the EU's main instrument for addressing aspects of demographic change such as depopulation in rural areas with a sector focus. Cohesion Policy is another important instrument to address these challenges across rural sectors and by supporting linkages between cities and rural areas.

Finally, Europe will have to find innovative ways to address the demographic challenge. Social innovation is about developing new forms of organisation and interactions between the public sector, third sector, social enterprises, the social economy, economic operators and civil society. Social innovations address a social demand (e.g. care for the elderly), contribute to addressing a societal challenge (e.g. an ageing society) and, through its process dimension (e.g. the active engagement of the elderly, new services), it contributes to reshaping society in the direction of participation, empowerment and learning. The territorial aspects will play a crucial role in this respect, as was already stressed in the much appreciated Barca report (see Box 3: Demographic challenges between place and territory).

Climate change adaption

Following previous national developments, the main strategic source of EU **climate policy**, a 'White paper on adaptation – Adapting to climate change: Towards a European framework of action" (COM/2009/147) was published in April 2009 by the EU Commission and defines a framework for reducing the EU's vulnerability to the impact of climate change by accumulating and sharing knowledge. Therefore a European Climate Change Clearing House is being prepared by the EC and will contain future updates of national adaptation strategies. Other tools supporting climate policy are the national emissions ceiling for certain atmospheric pollutants (NEC) (Directive 2001/81/EC), integrated pollution prevention and control (IPPC) (Directive 2008/1/EC), the strategic environmental assessment (SEA) and environmental impact assessment (EIA), which has the potential to include climate change objectives related to adaptation.

Policy coherence between climate and EU **transport and energy policy** should be ensured.[7]

Figure 24 Providing irrigation water for agriculture and hydro-electrical power for industrial development, Alqueva dam, PT

Source: DG Regio

[7] see, for example, the 'Energy Performance of Buildings Directive' [EPBD] [Directive 2010/31/EU], 'Indication by Labelling and Standard Product Information of the Consumption Of Energy And Other Resources By Energy-Related Products' [Directive 2010/30/EU], 'Commission Staff Working Document Annex to the Impact Assessment Document Accompanying the Package of Implementation Measures for the EU's Objectives on Climate Change and Renewable Energy for 2020', Brussels, 27.2.2008 SEC[2008] 85 VOL. II, Plan Bleu [2008]: Climate Change and Energy in the Mediterranean, www.planbleu.org/themes/energieUk.html.

Water, nature and biodiversity policies play crucial roles in the progress made in terms of understanding and implementing adaptation measures. In the Report to the Commission regarding water scarcity and droughts in the EU (COM/2007/0414 final) the progress made in the implementation of the policy options is assessed and the following options named: water pricing, allocating water and water-related funding more efficiently (improving land-use planning, financing water efficiency), drought management, assessment of water supply infrastructure, water efficient technologies and practices, development of a water-saving culture in Europe and improvement of knowledge and data collection.

Efficient water pricing that takes into account the external costs is one main aspect for the development of a water-saving culture but also for new and sustainable investments in water supply. The Water Framework Directive (2000/60/EC) asked the Member states to establish monitoring programs for the assessment of water status, to publish draft river basin management plans, and to adopt the river basin management plan, which should result in the achievement of good status for ground and surface water by December 2015. The Flood Directive (2007/60/EC) requires Member States to make preliminary flood assessments and produce flood hazard and risk maps as well as resulting flood risk management plans, which should be delivered in 2015. In the Bathing Water Directive (2006/7/EC) the legal framework for clean water is set, which will delay the growth of algae due to warmer water temperatures.

Other important policies that should be aimed at are the European economic and employment policy, which influences mitigation and adaptive initiatives. In addition, coherence should be aimed for between the Agricultural and Rural Development Policy and the Soil Policy, Common Fishery Policy, as well as the Marine and Coastal Policies. Finally, from a regulatory point of view, the promotion of climate proofing of plans and projects would be an important step.

Climate change mitigation and secure and competitive energy

In December 2008 the leaders of the EU27 Member States adopted the comprehensive **energy and climate package** that aims to combat climate change and increase the EU's energy security while strengthening its competitiveness. They committed the European Union to transforming itself into a highly energy efficient, low carbon economy. Key aspects of this climate and energy package include:

- a 20% reduction in EU greenhouse gas emissions, as compared with 1990 levels, or 30% if international agreement is achieved;
- an increase in the use of renewable energy to 20% of all energy consumed
- a binding minimum target for each member state to achieve at least 10% of their transport fuel consumption from biofuels; and
- a 20% increase in energy efficiency.

Collectively those targets are known as the 20-20-20 targets.

Instruments to achieve these targets include the **EU Emission Trading Scheme**, voluntary initiatives such as the Environmental Management Auditing System (EMAS), the Covenant of Mayors launched by the European Commission to encourage European cities to take actions and develop projects, policies and measures to reduce energy intensity and greenhouse gas emissions, and the deployment of new energy technologies to improve energy efficiency (in particular for housing) and further introduce renewable energies. The measures will also reduce dependence on imports of gas and oil and help shelter the economy from volatile energy prices and uncertain supplies.

The third energy package adopted by the Commission in September 2007 aims at ensuring that all European citizens can take advantage of the numerous benefits provided by a truly competitive energy market: consumer choice, fairer prices, cleaner energy and security of supply In order to reach those goals, the Commission proposes:

- to separate production and supply from transmission networks
- to facilitate cross-border trade in energy
- more effective national regulators
- to promote cross-border collaboration and investment
- greater market transparency on network operation and supply
- increased solidarity among the EU countries

The EU is responsible for designing climate change and energy policies at the EU level; however, the EU has no authority to execute measures. Policies need to be implemented by supranational institutions of the EU and national or sub-national institutions in Member States. Energy policy is mainly national policy. However, to achieve secure and reliable energy supply in the European Union, action is needed from the regional level upwards. Regions are key players within regional programs of the Cohesion Funds

and the realization of concrete measures.

The EU **Structural & Cohesion Funds** represent an important instrument to enhance the social and economic cohesion and restructuring within the European Union. These funds are to be used for sustainable energy investments in order to achieve a greening of the economy. Sustainable energy projects are eligible for co-financing from the Structural Funds; however, the extent of the support depends on the Member States and regions. Sustainable use of energy is, however, not a specific priority in the structural funds 2007-2013, but rather a cross-sectoral strategic perspective. If supported by national frameworks, it can help to achieve the cohesion policy goals. In the present programming period, the focus of suitable and efficient energy measures has been significantly on the local level.

Social polarisation

Generally, the challenge of social polarisation at the EU policy level is tackled by positively supporting Member States. The regulatory power of the Union is limited and despite the fact that freedom of **labour movement** is one of the leading principle of the EU, the harmonisation of the underlying social regulations (labour rights, safety, social security and unemployment insurance as well as pension rights, the acceptance of qualifications all over the EU) is still a pending issue. Thus, in principle the interventions of the EU in the field of social disparities are limited to transfers:

The EU tries to offset social differences within the regions of its Member States by funding projects carried out by the Member States. The main fund for this financial support is the **European Social Fund** (ESF). As one of the EU Structural Funds, it tries to reduce the disparity in wealth and living standards in the EU regions. Its Operational Programmes are then implemented through a wide range of organisations, both in the public and private sector. These organisations include national, regional and local authorities, educational and training institutions, non-governmental organisations (NGOs) and the voluntary sector, as well as social partners, for example trade unions and works councils, industry and professional associations, and individual companies. The ESF is designed to promote employment and helps Member States to make Europe's workforce and companies better equipped to face the new global challenges.

Figure 25 Stenfors Rural and Environmental Centre: gift shop selling local produce, SE

Source: DG Regio

It is a central element of the EU 2020 Strategy for Growth and Jobs targeted at improving the living conditions of EU citizens by giving them better skills and better job prospects. As in the demographic change challenge, social innovations would be a welcome addition to future ESF objectives.

Side by side with the ESF, there are other initiatives tackling the challenges of unemployment and income distribution. The **European Globalisation Adjustment Fund (EGF)** exists to support workers who lose their jobs as a result of changing global trade patterns so that they can find another job as quickly as possible. The EGF can fund active labour market measures focused entirely on helping the workers made redundant as a result of globalisation, for example through job-search assistance, occupational guidance, tailor-made training and re-training, including IT skills and certification of acquired experience, outplacement assistance and entrepreneurship promotion. It can also fund aid for self-employment or special time-limited measures, such as job-search allowances, mobility allowances or allowances to individuals participating in lifelong learning and training activities.

Implications for interregional co-operation

Interregional cooperation may take the form of cooperation within Member States, cooperation within the EU across borders (European Territorial Cooperation objective), cooperation across borders with neighbouring countries (EU neighbourhood policy) or international (global) cooperation. All these forms should be strengthened as challenges and vulnerabilities do not stop at borders. Climate change and its implications with respect to natural disasters and extreme weather events are a good example. Measures strengthening adaptive capacities may be applied more effectively in a larger regional context across borders – as foreseen in the Water Framework Directive. The importance of governance structures and the inclusion of a wide diversity of actors are illustrated by the Lithuanian long-term strategy (see Box 4: The example of the Lithuanian long-term strategy).

What can be extracted from the findings of this study is the necessity to proactively engage in the prevention of vulnerabilities in the countries and regions of origin. The migratory flows as well as the increase of mitigation capacities against climate change serve as examples. Cohesion policy is prompted to look at these challenges and act accordingly, for instance by fostering regional economic development in Central Turkey as a source of large migratory flows, or by drawing on the innovative potential of young, well-trained people in Eastern Europe in order to prevent brain drain from these regions. The need to foster interregional cooperation to balance vulnerabilities can also be achieved by establishing territorial partnerships comparable to “regional buddy systems”.

Another crucial point is the proactive engagement of the EU in countries not directly neighbouring the Union. Often vulnerability (e.g. in demography and climate change, but also energy) is triggered by developments in Asia, Africa or South America. The engagement of the EU as a partner providing not only development aid, but offering packages for self-development within these regions will effectively help diminish the potential impacts on EU regions.

Box 4: The example of the Lithuanian long-term strategy

In April 2010, the Lithuanian Cabinet endorsed the creation of a State Progress Council. The State Progress Council has been conceived as an instrument for the development of a long-term strategy: Lithuania 2030. Chaired by Prime Minister Kubilius, the Council is composed of representatives of the government, public institutions, business, arts, academia, cabinet members as well as ambassadors and advisers to the president. Lithuania’s strategy 2030 shall set strategic objectives and guidelines for future growth as well as indicators measuring the progress made. Lithuania also invites the broad public to contribute to the development of the strategic priorities by setting up an idea generation platform. The aims as presented by the Prime Minister are currently the following:

- the creation of a Northern service hub
- the continuation of the global achievements in ICT
- the development of knowledge, education and R&D infrastructure
- the creation of a modern financial and legal framework in the pursuit of an innovative economy

Furthermore, Lithuania commissioned a study called “FDI promotion strategy” from Ernst & Young to suggest a cluster, infrastructure, revised investment and an internal/external marketing plan.

The aspect of water shortage and water supply may be seen as an example, but also the opening of markets to products from these countries in order to provide economic prosperity and endogenous growth there.

An aspect which may only be established through territorial cooperation is the establishment of a decreasing dependence on fossil fuels and the founding of a European sustainable energy base. Biofuels and renewable energy sources will only replace European energy dependency (constituting a major source of vulnerability) if regional cooperation is strengthened, as many of these energy sources are decentralized (e.g. wind, bio-mass, solar) and will call for new urban-rural partnerships. Moreover, this energy production will have to go hand in hand with consumption efficiency and smart grid solutions, which will only be implemented across borders as well.

Implications for long term regional strategies

The need for long term strategies is already clearly indicated in the recommendations for the future Cohesion policy, but is also highlighted within this study. The time periods for specific potential impacts and different time horizons for specific vulnerabilities cause imbalances in the prioritisation of policies as the obvious short-term effects may be more highly weighted than the long-term effects (thus leading to a stronger emphasis on socio-economic development support instead of concerns regarding natural resources or climate). What might be learned from this study in this respect is the need for balanced long-term strategies (which might easily have a longer time horizon than the average elective periods in Member States).

A quick scan of national strategy papers has shown that most long-term oriented strategies can be found in the north or north-eastern countries of the EU, France and Germany. The strategies of north-eastern countries also have a longer time horizon than those of other European and Nordic countries. Latvia, Lithuania and Poland target the year 2030, allowing for greater and more substantial changes. When examining these national strategies, it becomes also apparent that in Finland, Scotland, Latvia, and Poland, sustainable economic growth is the main point of interest. In addition to the general strategies, a few countries have also developed more explicit globalisation strategies, such as Denmark or Sweden. The example of the Danish globalisation strategy (Box 5: The example of the National Globalisation Strategy of Denmark) shows possible additional adaptation to national needs and stresses the role of the above mentioned R&D and education policies. This example shows that, with regard to the integrative and forward looking character of policies, not only the actual sector policies and their instruments are of importance but also the development of integrated development strategies.

All these examples show that, on the national scale, initial good attempts are to be identified for establishing long-term strategies. This study may help regions to more precisely identify their strategic emphasis and strategies to foster their adaptive capacities and handle their regional vulnerabilities in the long run.

Box 5: The example of the National Globalisation Strategy of Denmark

The Danish Globalisation Adaptation Strategy, entitled “Progress, Innovation and Cohesion”, shall set the framework for Denmark so that it can maintain its position as one of the wealthiest countries in the world. The strategy introduces no less than 350 specific initiatives entailing reforms and the reconstruction of frameworks. The focus of the strategy is on the following fourteen fields.

- All young people should complete a general or vocational upper secondary education programme
- A coherent education system and professional guidance
- At least fifty per cent of young people should complete a higher education programme
- Education and training programmes with a global perspective
- World Global top level short-cycle and medium-cycle higher education programmes
- World Global top level universities
- More competition and better quality in public sector research
- Good framework conditions for companies’ research, development and innovation
- Stronger competition and greater openness and transparency to strengthen innovation
- Strong interaction with other countries and cultures
- More high-growth start-ups
- Everyone should engage in lifelong learning
- Partnerships to promote the implementation of the Globalisation Strategy

The choice of the priorities shows the great importance put on education, training, research, growth and innovation.

Denmark’s global orientation and the role it seeks to play in the world is stressed by the fact that in 2005 the Danish Government had already created a Globalisation Council. The Danish Globalisation Council is composed of representatives of trade unions, businesses, education and research organisations and the Danish Government. Top priorities of the Council are again education, research, the spread of knowledge, innovation and internationalisation. The Globalisation Adaptation Strategy clearly has a long-term focus.

Conclusions for Cohesion Policy 2020

When looking at the results of the vulnerability analysis of Regions 2020, some striking common issues become apparent and may be seen as guiding principles for an EU Cohesion Policy in the future.

First of all, the findings seem to underline most of the lessons for the future Cohesion policy drawn from the 5th Cohesion Report. It must be emphasized that it is necessary to pay attention to a territorially specified policy mix according to the detected vulnerabilities. It is important not to concentrate all funding on the lagging regions only. For instance, classic convergence regions have difficulties to capitalise innovation funds, because institutional and economic structures for innovation are often missing. In more successful regions funding impulses might produce more effects, because they can make use of synergies and present structures.

The vulnerability analysis of EU regions has clearly shown that regional situations are to be regarded with respect to multiple challenges and that the development of adaptive capacities is important even if the current regional conditions seem to be relatively favourable (see, for instance, the Central European regions facing the challenge of an ageing population and the associated social challenges). This is consistent with the need of Cohesion Policy to target beyond short term and directly increasing GDP measures. Especially quality of life, health and long-term environmental changes will have to be captured in order to evaluate the capacity of cohesion policy to find answers that address the challenges.

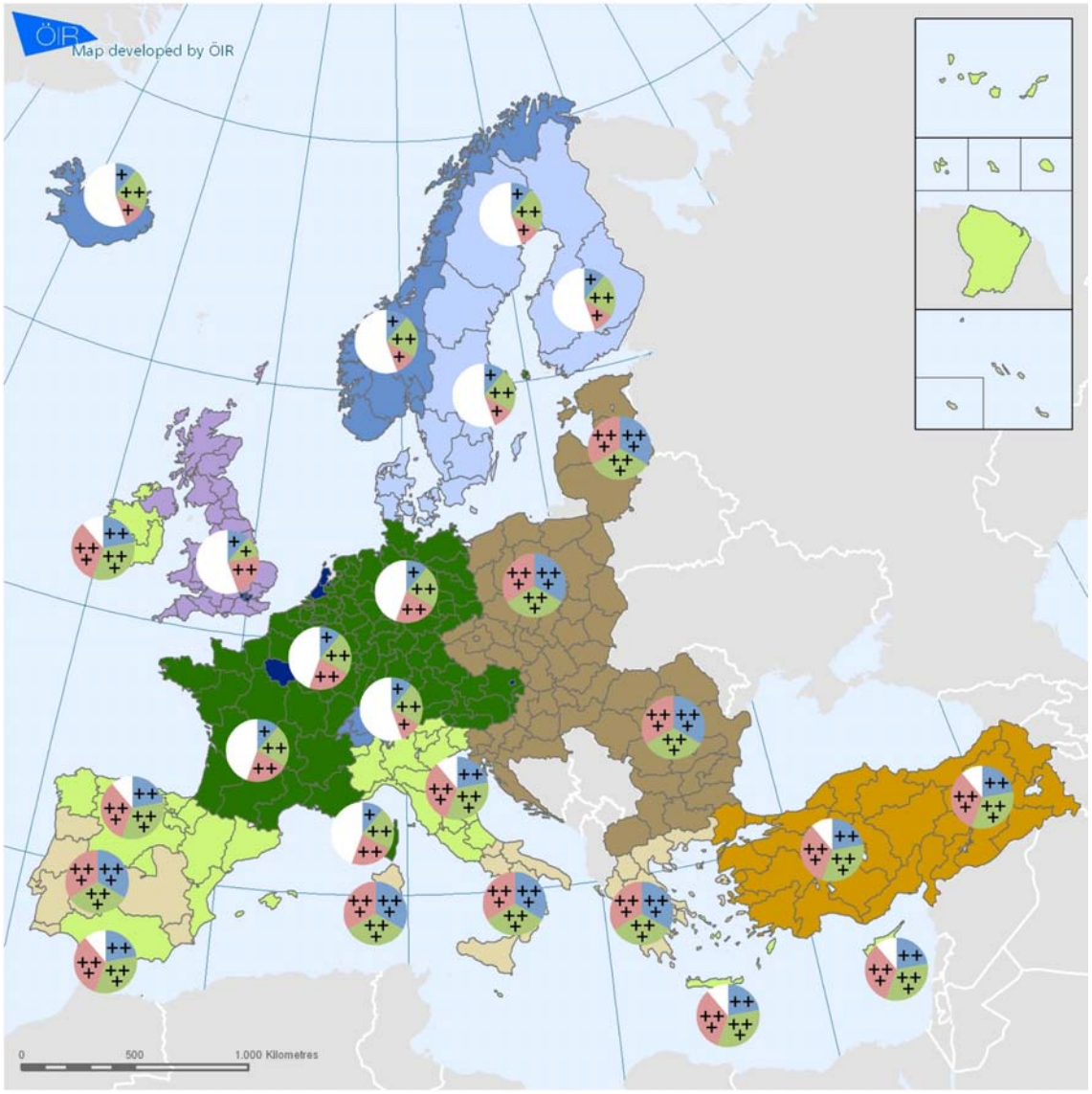
Other aspects are still the balanced development of regions (i.e. balanced distribution of economic sectors contributing to the regional economic income) and their embeddedness in strong socio-economic unions and cooperation, which seems to decrease vulnerability and strengthen the adaptive capacities of regions. This is in line with the general idea of resilience of systems, with a higher variety and diversity within systems proving stronger against external shocks. This principle should lead to Cohesion Policy taking notice of overemphasis of growth poles and over-specialisation of regions. Solidarity is an important element as well advocating strong territorial cooperation and exchange, especially cultural ones.

Table 28 European macro regions, their challenges and emphasis on growth strategies

Challenges / Aggregated regions	Globalisation	Demographic change	Climate change	Secure, sustainable and comp. energy	Social polarisation	Smart growth	Sustainable growth	Inclusive growth	growth strategies / Present cohesion policy objective
Barely vulnerable – global economic high performers	+	+	++	+	+	+	++	++	Competitiveness and Employment Regions
Barely vulnerable – social and economic high performers	+	+	+	+	+	+	++	+	Competitiveness and Employment Regions (mostly third countries)
Barely vulnerable – social and knowledge high performers	++	+	+	+	+	+	++	+	Mostly Competitiveness and Employment Regions
Barely vulnerable UK	+	+	+	+	++	+	+	++	Mostly Competitiveness and Employment Regions
Moderately vulnerable – economic high performers	+	++	++	++	++	+	++	++	Mostly Competitiveness and Employment Regions
Moderately vulnerable – climate change challenged regions	++	++	+++	++	++	++	+++	+++	Mostly Competitiveness and Employment Regions
Highly vulnerable – globalisation and energy security challenged regions	+++	++	++	+++	++	+++	+++	+++	Mostly Convergence Regions
Highly vulnerable – globalisation and climate change challenged	+++	++	+++	++	++	+++	+++	+++	Mixed Convergence and Competitiveness and Employment Regions
Highly vulnerable – globalisation and socially challenged regions	+++	++	+++	+++	+++	++	+++	+++	Candidate country

+	Barely challenged/basic emphasis on growth strategy	++	Moderately challenge/average emphasis on growth strategy	+++	Highly challenged/high emphasis on growth strategy

Map 51 EU 2020 growth strategy strands with relation to regional challenges in Europe



Smart growth Sustainable growth Inclusive growth

The size of the wedges symbolizes the relative emphasis on the specific aspect of the EU 2020 strategy.

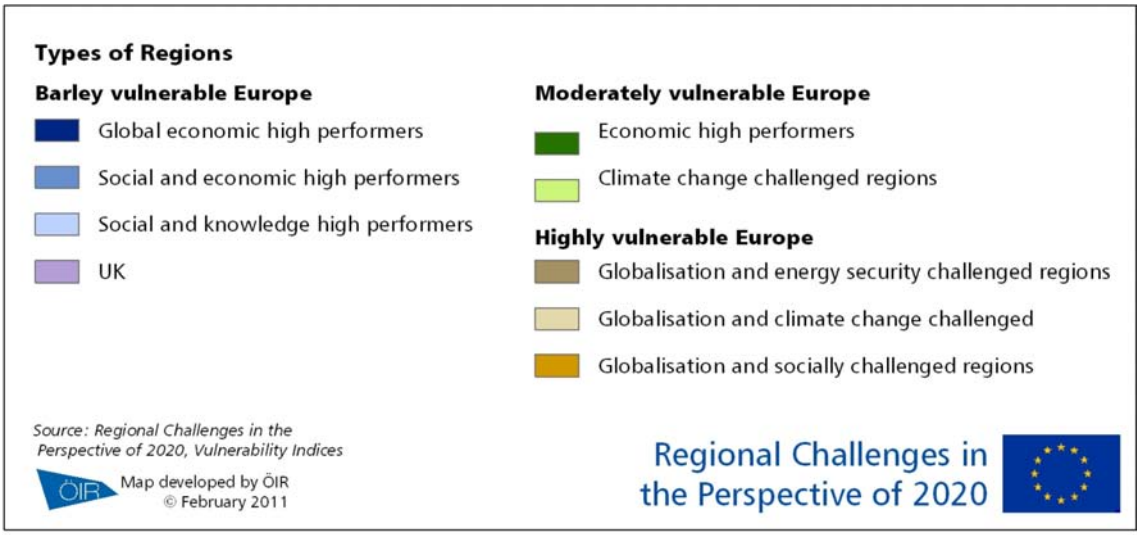


Table 28 attempts to summarize the findings of this report. The table shows the aggregated regions that resulted from the cluster analysis of multiple challenges. The five subsequent columns show the challenges most crucial for the macro regions, while the three ‘growth strategy’ columns give an impression which of the three Europe 2020 growth strategy strands should be most strongly emphasised. Compared to the Cohesion Policy criteria based on economic wealth, it becomes clear that there is a tendency among economically lagging regions to also need more support in order to reach the 2020 targets. This is, at least to some extent, a result of low adaptive capacities towards challenge impacts that are often measured by economic power and wealth. The table may be seen as a compass to territorially guide Cohesion Policy by showing which regions should be emphasised by Cohesion Policy. To a large extent this corresponds to existing objective areas, which are indicated in the final column. Cohesion Policy is in need for an update beyond the programming period. Regions need to better address the challenges by concentrating on them and setting the right priorities for the investments and find the right policy mix. There are some regions which will have to address more challenges and need broader approaches than others It is important that futures investments have the critical mass to change challenges into opportunities In this sense the regional performance vis-à-vis the five challenges may be used for finding the right investment priorities in the partnership contract and the subsequent operational programme. Achieving the right policy mix that is attached to these criteria and their implementation will have an influence on whether the Cohesion Policy will be more or less successful in contributing to the answers to the challenges Europe will face in the next decade.

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Glossary

CEE	Central and Eastern Europe
ESPON	European Observation Network for Territorial Development and Cohesion
FDI	Foreign direct investments
G-20	Group of Twenty
GHG	Greenhouse gas emissions
ICT	Information and communication technologies
IMF	International Monetary Fund
NUTS	"Nomenclature des unités territoriales statistiques" (system of hierarchically organised territorial units for statistical purposes)
SD	Standard deviation
SGEI	services of general economic interest’
TFR	Total Fertility Rate
TNC	Transnational corporation
UAA	utilized agricultural area
WMO	World Meteorological Organization
WHO	World Health Organization
WTO	World Trade Organization

Country abbreviations

AL	Albania
AM	Armenia
AT	Österreich
AZ	Azerbaijan
BA	Bosnia and Herzegowina
BE	Belgique-belgië
BG	Bulgaria
BY	Belarus
CH	Schweiz/Suisse/Svizzera
CY	Kypros/Kibris
CZ	Ceska Republika
DE	Deutschland
DK	Danmark
DZ	Algeria
EE	Eesti
EG	Egypt
ES	España
FI	Suomi/Finland
FR	France
GE	Georgia
GR	Ellada
HR	Hrvatska
HU	Magyarorszag
IE	Ireland
IL	Israel
IS	Island
IT	Italia
JO	Jordan
LB	Lebanon
LI	Liechtenstein
LT	Lietuva
LU	Luxembourg (Grand-Duche)
LV	Latvija
LY	The Great Socialist People's Libyan Arab Jamahiriya
MA	Morocco
MD	Moldova
ME	Montenegro
MK	Poranesnata Jugoslovenska Republika Makedonija
MT	Malta
NL	Nederland
NO	Norge
PL	Polska
PS	Occupied Palestinian Territory
PT	Portugal
RO	Romania
RS	Serbia
RU	Russian Federation
SE	Sverige
SI	Slovenija
SK	Slovenska Republika
SY	Syriaa Arab Republic
TN	Tunisia
TR	Turkiye
UA	Ukraine
UK	United Kingdom
XK	Kosovo (under United Nations security council regulation 1244)