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# The pan-European environment: glimpses into an uncertain future

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European Environment Agency

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# Contents

# Preface

The foremost task of the European Environment Agency (EEA) is to provide information to policy makers and the public on how Europe's natural environment is changing, on the socio-economic activities that drive these changes and on the policies that have most success in mitigating negative impacts.

Our role in this respect is primarily to support the policy objectives of the European Union and its closest neighbours. Increasingly, however, we are being asked to put such information in a broader context — for example supra-regional policy processes, such as the pan-European *Environment for Europe* ministerial process, and global assessments, including the United Nations *Global Environmental Outlook* and the *Millennium Ecosystem Assessment*. Across these various processes and assessments we see an increasing need not only to better understand what is happening but also to reflect on the future prospects for environmental changes.

The rapidly changing nature of and increasing inter-linkages between many socio-economic phenomena — population growth and migration, globalisation and trade, personal consumption patterns and use of natural resources — are reflected in many of today's environment policy priorities: minimising and adapting to climate change; loss of biodiversity and ecosystem services; the degradation of such natural resources as land, freshwater and oceans; and the impacts of a wide range of pollutants on our environment and our health.

The challenges that environmental policy makers are facing in this century are already very different from those of the last. Given the rapid change in socio-economic trends, both designing and implementing actions are becoming much more complex, and the way in which such policies deliver effective outcomes seems to be becoming increasingly uncertain. Alongside this, the time-lags between policy demands and institutional responses are often lengthening, with the institutional structures charged with designing and implementing agreed actions needing to change in order to keep up with this process.

This report aims to contribute to the discussion about plausible future developments relevant to the wider European region and to stimulate medium to long-term thinking in policy-making circles. It does so by sketching some of the key environmental concerns for the pan-European region based on the EEA's *Europe's environment — The fourth assessmen*t, and by highlighting some of the many uncertainties the future holds.

The magnitude and complexity of the environmental challenges we face should not paralyse us into inaction. The scale of the problems facing post-war Europe spurred the Treaty of Rome and unimagined cooperation across the continent. Similarly, the environmental challenges ahead can help us develop new, more sustainable patterns of living, producing and consuming. To do so, however, we need to raise awareness of what lies ahead, and develop a better understanding of it through the use of innovative approaches that can inform medium- to long-term policy thinking.

Prof. Jacqueline McGlade
EEA Executive Director

# Acknowledgements

This report has been authored by **Thomas Henrichs** (National Environmental Research Institute, Denmark), **Anita Pirc Velkavrh** (EEA), **Elena Veligosh** (UNEP/GRID Arendal), and **Tony Zamparutti** (Milieu Ltd).

Other contributors to the report include: **Ann Dom** (EEA) drafted a background paper that provided a starting point for this report; **Hugo Ahlenius** (UNEP/GRID Arendal) prepared and designed many of the maps; **Adriana Gheorghe** and **David Stanners** (EEA) coordinated *Europe's environment — The fourth assessment* which provides an overview of the pan-European region's environmental challenges; **Valery Votrin** and **Melita Rogelj** drafted a review of the scenario studies in EECCA and SEE (which provided the basis for Annex 1 of this report) with the support of number of regional experts: **Mia Bertetto**, **Fethi Silajdžić** (Bosnia and Herzegovina), **Katya Trichkova** (Bulgaria), **Yűksel Alper Ecevit** (Turkey), **Oriana Hanxhari** (Albania), Sanja Kostovska (Former Yugoslav Republic of Macedonia), **Madalina Caprusu** (Romania) and **Dejan Sandić** (Serbia); **Peter Saunders** and **Bart Ullstein** provided language editing.

The 'Pan-European workshop' hosted by EEA in March 2006 paved the way for this analysis by exploring the driving forces and uncertainties of the issues at very early stage of analyses: Participants included: **Birgit Georgi** (Umweltbundesamt, Germany), **Bettina Menne** (World Health Organisation), **Cagatay Dikmen** (Avrupa Cevre Ajansi Ulusal Odak Noktasi/EEA National Focal Point for Turkey), **Janusz Radziejowski** (Former vice-Minister of Environment, Poland), **Krzysztof Zmijewski** (Warsaw University of Technology, Poland), **Libor Lochman** (Community of European Railway and Infrastructure Companies, Belgium), **Martin Kroon** (Ministry of Environment, The Netherlands), **Sergey Bobylev** (Moscow State University, Russian Federation), **Tea Aulavuo** (United Nations Economic Commission for Europe).

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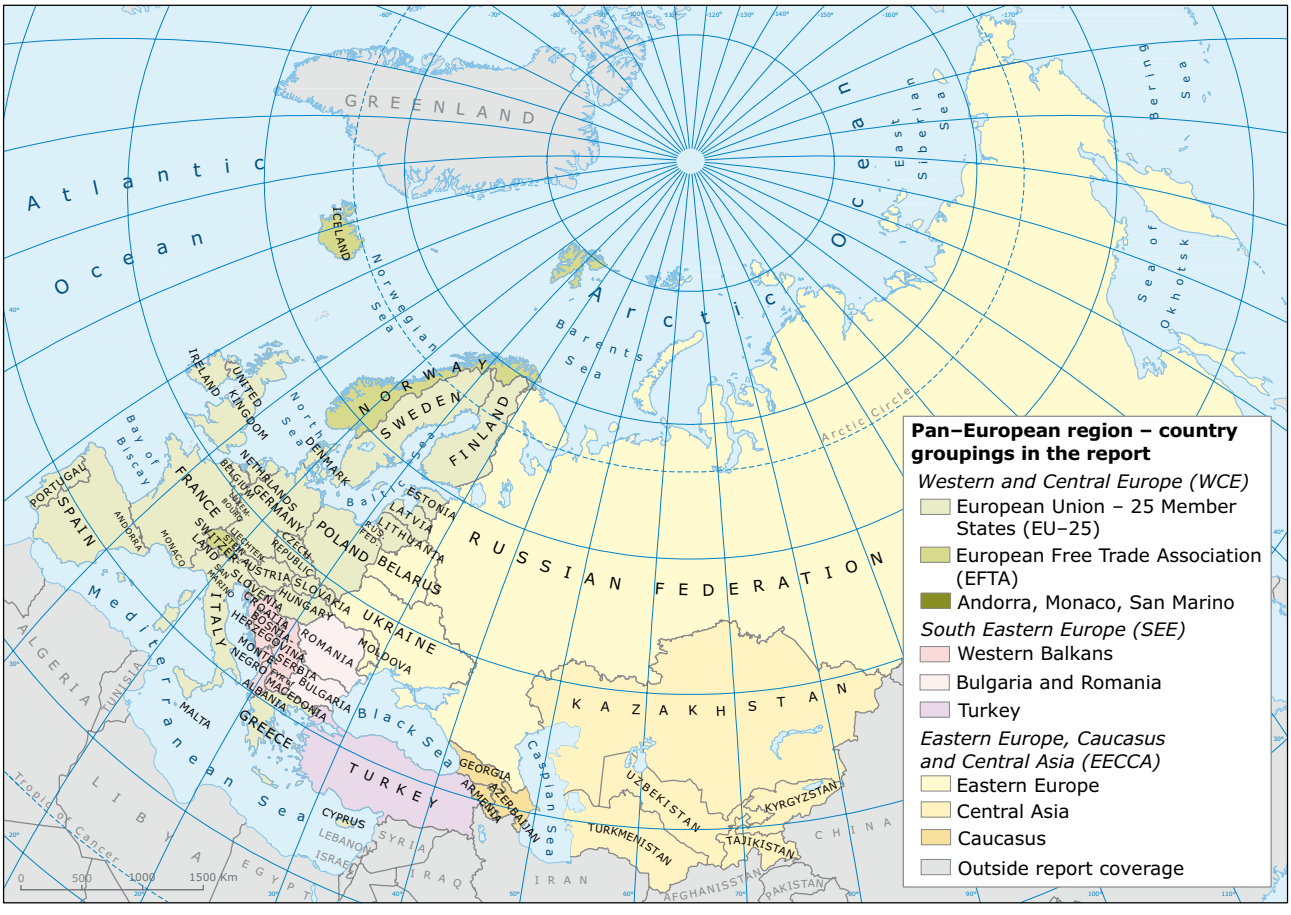
# 1 Introduction

The main challenge that those responsible for designing environmental policies face today is ensuring that they uphold longer-term sustainability goals. The aims of sustainable development require us to take decisions today that allow us to 'meet the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987). However, such decisions will necessarily have to be taken against the backdrop of an uncertain future — uncertainty about how current and future environmental challenges may unfold, about what setting future geo-political and economic developments may provide, about what future technological breakthroughs may bring, and about what future cultural preferences and societal needs may be. These and similar uncertainties open up a myriad of plausible future pathways and possible response options from which to choose, and thus complicate robust planning and the taking of sound decisions.

However, such uncertainty about future developments is not new. Who could have guessed, fifty years ago when much of the world was locked

**Figure 1.1 The pan-European region in 2007** (1)




**Source:** EEA, 2007a.

(1) Regional groupings used in this report are defined in Annex 1 (see Table A 1.1).

into the 'cold war', that the Treaties of Rome signed by six Western European countries would evolve into a political union of 27 Member States across Europe today? And who would have imagined twenty years ago that the Berlin Wall would fall so swiftly in 1989; or expect — for that matter — any of the subsequent rapid political, social and economic changes that occurred throughout the former Soviet Union and its satellite nations? And some forty years ago, who would have expected environmental concerns, such as climate change and biodiversity loss, to feature so prominently on the international policy agenda? ([2]) And yet, these developments have drastically altered the face of the pan-European region (see Figure 1.1) and the way its environmental policies have evolved.

And, arguably, the rate of change continues to be staggering, as new alliances are forged, markets open further and a new spectrum of environmental, social and economic opportunities and challenges emerge. While there are still huge disparities — for example, in income (see Table 1.1) — the countries and economies of the pan-European region seem to be growing ever closer. The issue of globalisation, in particular, appears to be fuelling these trends, leading to high levels of connectivity and interdependence between nations in cultural, social, technological, economic, environmental and political terms. These and other developments, which seem to be accelerating and increasing in complexity, underline the need to prepare for the future. And, as noted above, the uncertainty of how future developments may play out clouds the design of robust and sustainable approaches for dealing with current and future environmental challenges.

This report aims to contribute to the discussion about plausible future developments and stimulate medium to long-term thinking in the context of environmental policy-making. It sketches some key environmental concerns for the pan-European region based on EEA's recent *Europe's environment — The fourth assessment* (EEA, 2007a). Where available, forward-looking indicators are used to illustrate possible future developments — although such indicators are often somewhat limited in scope and few are available. However, one should bear in mind that future developments cannot be predicted. Thus, as well as introducing projected trends and their implications, some of the major uncertainties that surround future developments are highlighted. For this, the report builds on a wide range of existing forward-looking studies that have become available for the pan-European region during the last few years. To our knowledge, this is the first such review that systematically includes assessments not only for Western and Central Europe, but also for South Eastern Europe and Eastern Europe, Caucasus, Central Asia. It shows that across the region a variety of scenarios exist that explore a range of uncertainties and provide some glimpses into the future.

Many different approaches exist to help assess uncertain future developments in a structured manner (see Chapter 2). In order to inform the debate on environmental prospects within the pan-European region, it is crucial to see current and projected environmental developments in the context of their underlying socio-economic trends: here the key findings of recently published pan-European environmental assessments provide an overview (see Chapter 3). Faced with the challenge of planning for an uncertain future, our societal responses also need to reflect key uncertainties and the implications of plausible alternative scenarios (see Chapter 4). And a broader understanding strengthens our ability to respond to future environmental threats and opportunities in a more robust manner (see Chapters 5 and 6).

**Table 1.1 The pan-European region — key indicators in 2005**

| Sub-region | Land area (1 000 km²) | Population (million) | Density (population per km²) | GDP per capita (PPP USD) | Human Development Index |
|---|---|---|---|---|---|
| Western and Central Europe (WCE) | 4 440 | 472 | 106 | min: 4 761<br>max: 49 980 | min: 0.85<br>max: 0.97 |
| South Eastern Europe (SEE) | 1 396 | 124 | 89 | min: 1 369<br>max: 5 138 | min: 0.76<br>max: 0.85 |
| Eastern Europe, Caucasus and Central Asia (EECCA) | 22 132 | 278 | 13 | min: 237<br>max: 2 447 | min: 0.65<br>max: 0.80 |

**Note:** A Human Development Index rating of 0.8 and above is generally considered a measure of high development.

**Source:** Human Development Index from UNDP, 2006 (http://hdr.undp.org/hdr2006); all others from EEA, 2007a.

([2]) Note that the first environment ministry in Europe was only established in 1970 in the federal state of Bavaria (Germany).

# 2 Understanding future environmental challenges and uncertainty

## 2.1 Dealing with uncertainty and complexity

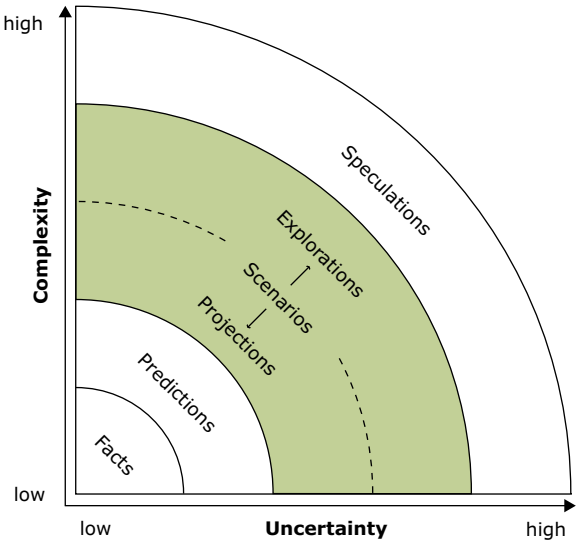
While we cannot and should not aim to predict the future, forward-looking approaches such as developing scenarios and analysing projections do help us to assess and understand changes that might be expected to shape the environment in the coming decades in a structured manner. Guiding policy-making to sustainable approaches and where necessary precautionary action is one of the key aims of forward-looking assessments of environmental futures.

Different approaches to such forward-looking assessments exist. Short time-horizons tend to present only low levels of uncertainty, endowing projections of future implications with some confidence. Conversely, where high levels of uncertainty exist, especially in assessments of the longer-term future, precise projections can become meaningless and sometimes even create a misleading sense of certainty about future trends. Here, exploratory scenario-based approaches can help to explore key uncertainties and their implications across a wider range of contrasting futures; see Figure 2.1.

Scenarios can be defined as *plausible descriptions of how the future may unfold based on 'if-then' propositions* (EEA, 2005b). A typical environmental scenario includes the representation of a defined situation and a storyline that describes the key driving forces and changes that lead to an image of the future. Simply put, scenarios present an outlook on future developments, which can be presented either qualitatively — in words or pictures, quantitatively — as numerical estimates, or by combining both. They are usually best used by making comparisons across a set of different scenarios.

Forward-looking assessments and scenarios can serve a range of purposes. Within the realms of science and research, for example, they further

**Figure 2.1 Dealing with uncertainty and complexity of the underlying system dynamics in forward-looking assessments**




**Source:** Zurek and Henrichs, 2007.

the understanding and dynamics of a system by exploring interactions and linkages between key variables or driving forces. In the wider context of education and information, they provide a useful tool for ordering, conveying and/or illustrating different perceptions of a variety of future environments and their implications. Especially scenarios can help structure choices by revealing their possible long-term consequences. Thus they can serve to support strategic planning and decision-making by providing a platform for thinking through the implications of various options in the face of future uncertainties. And, importantly, scenario planning approaches allow for more profound and integrated stakeholder participation in the strategic development process — allowing, as they do, the voicing of conflicting opinions and world views (Zurek and Henrichs, 2007).

## 2.2 Forward-looking studies in the pan-European region

A wide range of forward-looking assessments relevant to the pan-European scale have been published — both at a supra-national level and for individual countries within the region. Indeed, a recent EEA literature review of more than 300 studies across environmental topics and many economic sectors identified nearly 70 future-oriented studies within the EECCA region, and more than 80 within SEE. In addition, more than 80 global-scale studies relevant to analyses in the pan-European region are available. Similar reviews previously identified studies in Western and Central Europe (see Annex 1, EEA 2005b, EEA 2000 and EEA's environmental scenarios information portal) ([3]).

The majority of these studies within both EECCA and SEE, however, focus on non-environmental issues. In EECCA countries, economy and energy studies dominate. Fewer studies can be found on transport (despite its recognition as a key issue in the EECCA Environment Strategy adopted in Kiev in 2003), demography (with the exception of some country-level projections), land use, agriculture, consumption, forestry, health, technology, or wastewater. And of the existing studies, only a very limited number deal with possible future environmental implications. A noteworthy exception here are water scenarios for Central Asia, as this is an important environmental and security issue (UNECE/UNESCAP, 2004). Another is the *Carpathians Environment Outlook* (UNEP, 2007b) that focuses on the three pillars of sustainable development — environment, society and economy.

In SEE common topics in forward-looking assessments include the discussion of demographic, economic, energy, and political futures. But studies that address environment implications are scarce — examples here include the Plan Bleu's Mediterranean outlook for 2025 (Benoit and Comeau, 2005).

At the global scale, a variety of forward-looking assessments have laid out possible developments that are also relevant to the region. Indeed, several of these have received considerable attention within the research community and have played an important role in informing decision-making. Examples include the emission scenarios developed by the Intergovernmental Panel on Climate Change (IPCC, 2000), ecosystem assessment scenarios published by the *Millennium Ecosystem Assessment* (MA, 2005a, 2005b), and the scenarios used by the United Nation Environment Programme's *Global Environment Outlook* (UNEP, 2002, 2007a); see also Section 4.7.

A range of different approaches to developing future studies have been used in the studies reviewed; from model-based projections, through comparing reference scenarios with alternative scenarios, to fully explorative scenario studies. Many studies built on the participation of different stakeholders in the scenario-building process — although it is not always clear how the inputs from stakeholders have shaped the outcomes of forward-looking assessments.

The review of forward-looking assessments within the region also highlights a number of gaps, including weak coverage of environmental concerns, recurring problems of methodological soundness, reliability, information gaps, and a lack of direct relevance to priority policy issues. These gaps are also a key reason why only a limited number of the studies reviewed are highlighted in the environmental outlook provided in Chapters 3 and 4 of this report. Instead, the analyses presented here rely mainly on information published by the EEA and information from other international organisations that provide forward-looking assessments that cover the pan-European region — using, where applicable, country-level scenarios for illustration.

([3]) See http://scenarios.ew.eea.europa.eu/ and www.eea.europa.eu/themes/scenarios.

# 3 A brief environmental outlook for the pan-European region

This chapter provides a brief overview of environmental outlooks related to priority policy areas identified in the Sixth Environment Action Programme of the European Community and the Environment Strategy for Countries of Eastern Europe, Caucasus and Central Asia. For this overview, a deliberate focus is placed on the issues and outlooks presented in EEA's *Europe's environment — The fourth assessment* (EEA, 2007a) and the *European environment outlook* (EEA, 2005b). These assessments provide starting points, as they discuss a wide range of environmental challenges faced by the pan-European region, and highlight some priority areas such as environment-related health concerns including issues related to, amongst others, air quality and inland waters; climate change; biodiversity loss; and resource use and waste generation.

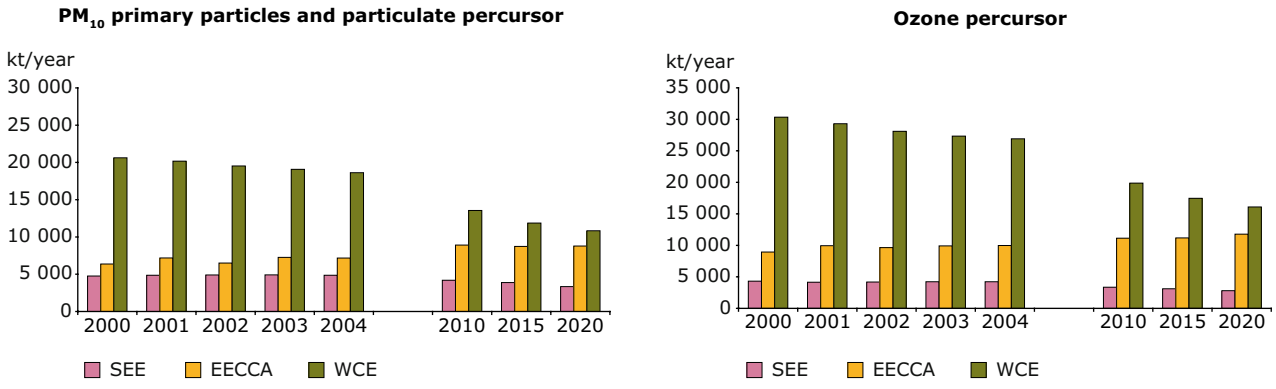
The overview presented here is complemented by a selection of forward-looking environmental indicators, presented here and in Annexes 2 and 3, many of which build on information obtained from other international organisation. It should be noted, however, that most indicator-based reporting and environmental information systems do not commonly include forward-looking data. Additional information about environmental outlooks and related indicators for the pan-European region can also be found on the EEA's website (see www.eea europa.eu/themes/scenarios).

## 3.1 Environment-related health concerns

*Air pollution*

Air pollution, mainly by fine particles and ground-level ozone, continues to pose a significant threat to health ([4]). Despite considerable reductions in emissions, particularly in WCE and SEE, atmospheric pollution in much of the pan-European region still poses a significant threat to human health and the environment as a whole. While further emission reductions are expected up to 2020, these are unlikely to be enough to ensure the elimination of significant threats to human health and the environment (see Figures 3.1 and 3.2).

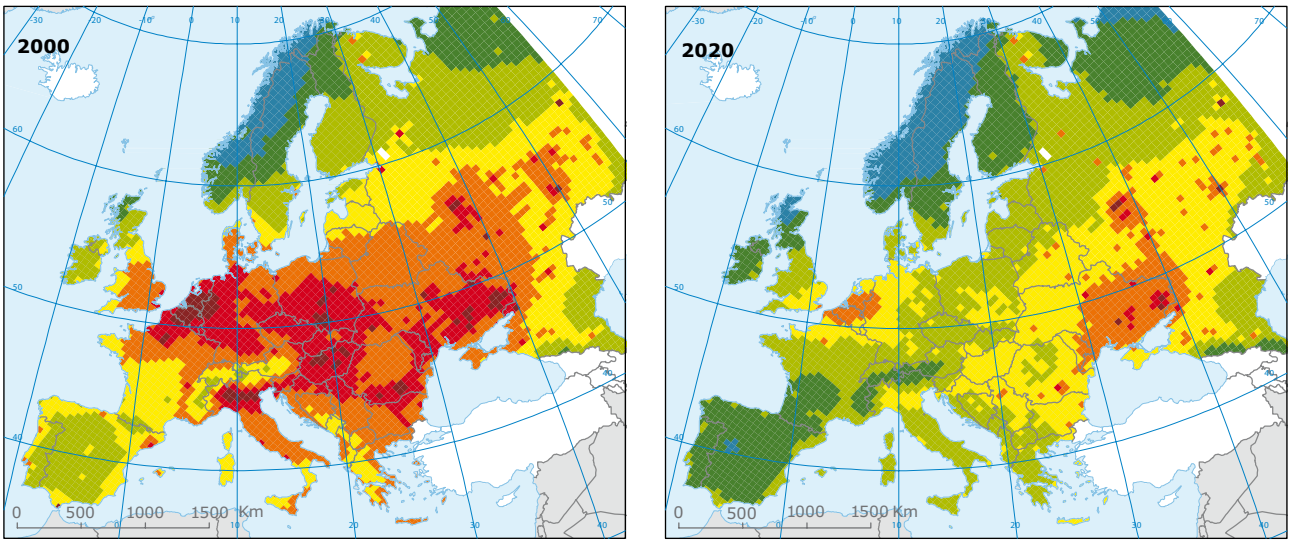
**Figure 3.1 Emissions of primary particulates and ozone precursors, 2000 to 2020**




**Source:** EEA, 2007a — Figure 2.2.1 (based on official country report to UNECE/EMEP and projections from IIASA, 2004).

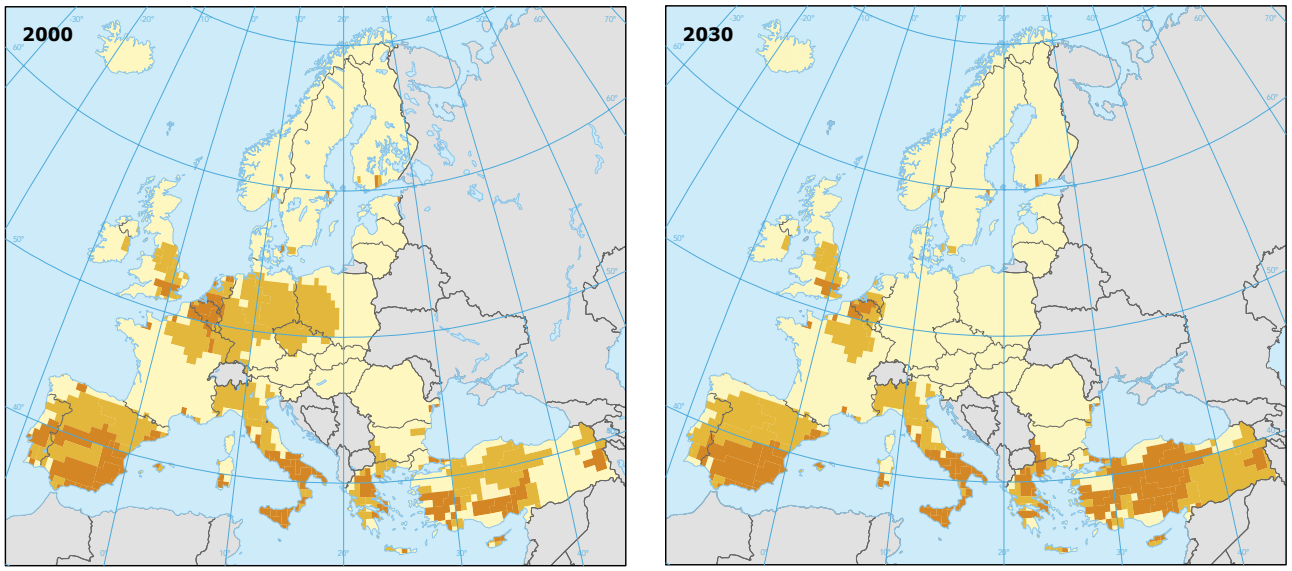
([4]) In WCE, for example, air pollution shortens average life expectancy by almost one year and affects the healthy development of children.

**Figure 3.2 Loss of statistical life expectancy attributed to anthropogenic contributions to $PM_{2.5}$, 2000 and 2020**




**Source:** Amann *et al.*, 2005a (left); Amann *et al.*, 2005b (right) (also published in EEA, 2007a — Map 2.2.2).

**Figure 3.3 Water stress in Europe, 2000 and 2030**




**Source:** EEA, 2005b — Map 4.5.

*Inland waters*

The pan-European region faces two distinct but interrelated freshwater challenges: increasing water shortages, and ensuring access to safe drinking water and adequate sanitation by all citizens. One third of the region's population lives in countries

where water resources are already under substantial pressure and high levels of water stress are expected to continue or even increase due to increasing demand and/or reduced water availability in much of Europe — in particular many Mediterranean river basins are expected to continue to face water stress (see Figure 3.3) (EEA, 2005b). This has potential long-term consequences for both environmental and human health. In addition, poor water quality is well known to raise health concerns: while water quality appears to have improved in rivers across the region, more than 100 million people still do not have access to safe drinking water and adequate sanitation (EEA, 2007a).

Selected indicators:

- Emissions of acidifying pollutants ($SO_2$, $NO_x$, $NH_3$) (Annex 2)
- Emissions of ozone precursors ($NO_x$, NMVOC) (Annex 2)
- Emissions of particulate matter ($PM_{2.5}$, $PM_{10}$) (Annex 2)

## 3.2 Climate change

The International Panel on Climate Change (IPCC) suggests that the continuance of current trends and policies is likely to result in increased global emissions of carbon dioxide ($CO_2$), the largest contributor to total greenhouse gas (GHG) emissions, up to 2020, with resulting overall temperature increases of 1.8 to 4.0 °C during the 21st century — some studies suggest an even wider possible range of 1.1 to 6.4 °C (IPCC, 2007a) ([5]).

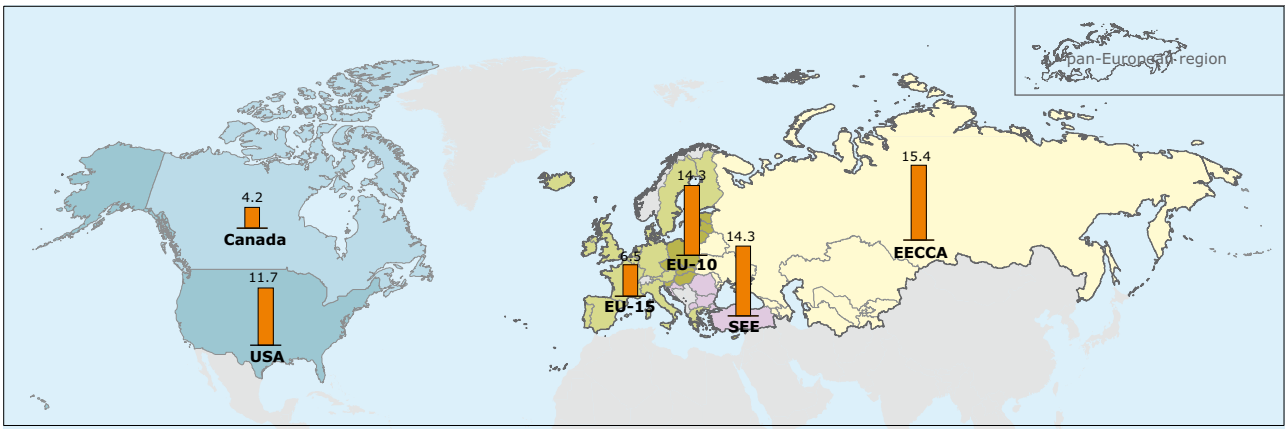
Meanwhile the EU has proposed a global target of 50 % reduction in $CO_2$ emissions by 2050, with the aim of limiting temperature increases to a maximum of 2 °C above pre-industrial levels. However, emissions of GHGs are currently still rising in most European countries — with per capita emissions expected to increase more in relative terms in the EU-10, EECCA and SEE than in the EU-15 up to 2020 (Figure 3.4).

Even with the strong mitigation programmes needed to meet the EU target, and allowing for regional variations in temperature and precipitation, some unavoidable climate change impacts are likely to affect most sectors of the economy and natural resources; see, for example, Figures 3.5 and 3.6. It is therefore urgent to adapt to these impacts by developing and implementing policies and measures in all sectors of society.

Selected indicators:

- Greenhouse gas emissions (Annexes 2 and 3)
- Energy-related $CO_2$ emissions (Annex 2)
- Projection of temperature changes (Annex 2)
- Projection of precipitation changes (Annex 2)

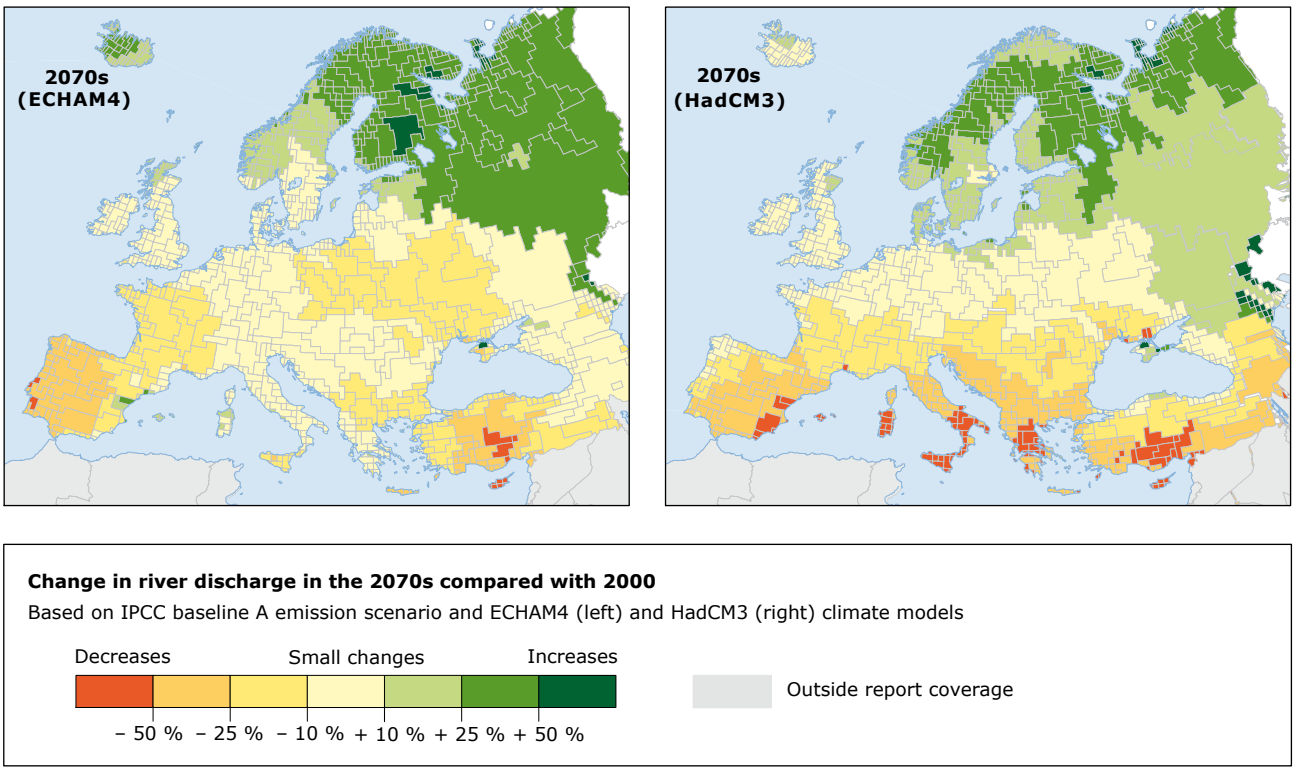
**Figure 3.4 Projected percentage change in greenhouse gas emissions as $CO_2$-equivalents per capita, 2000–2020**




**Source:** EEA, 2007a — Annex 3 (based on national communications on climate change to UNFCCC, 1997–2007).

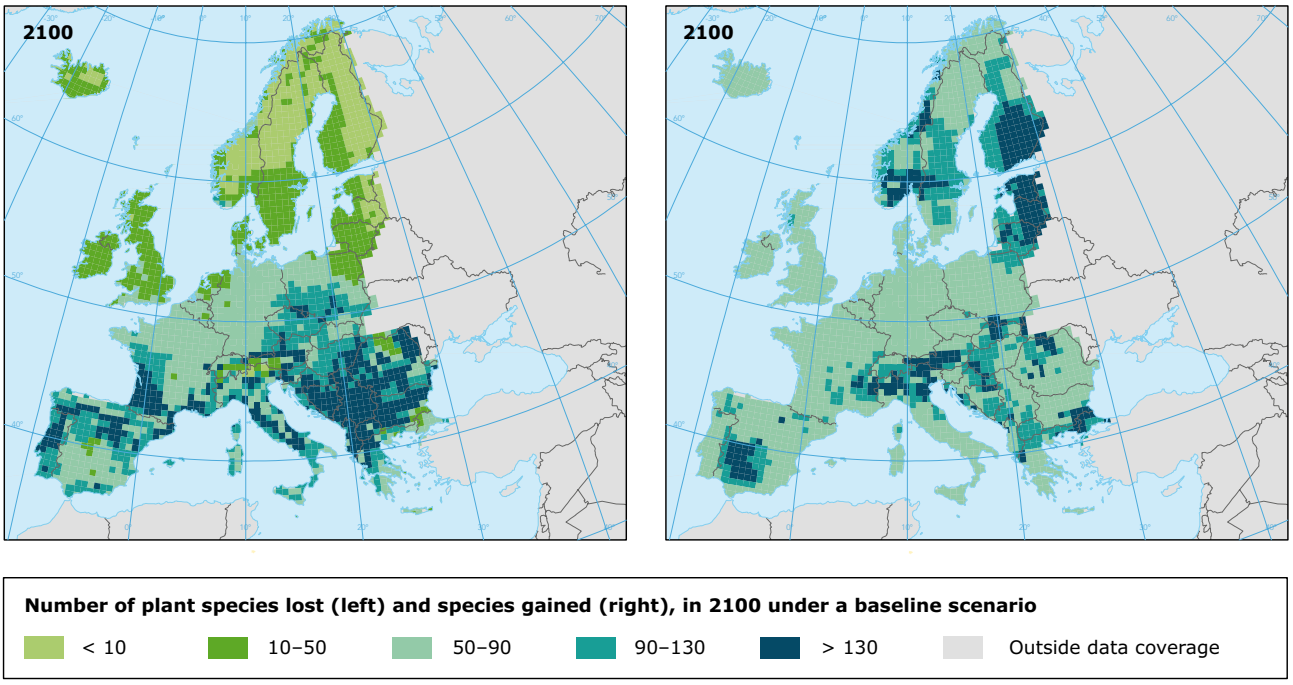
([5]) Regional projections of temperature and precipitation changes do, however, vary.

## Figure 3.5 Projected changes in annual river-flow, 2070s




**Source:** Lehner *et al.*, 2005 (also published in EEA, 2007a — Map 3.3).

## Figure 3.6 Impact of climate change on number of plant species, 2100



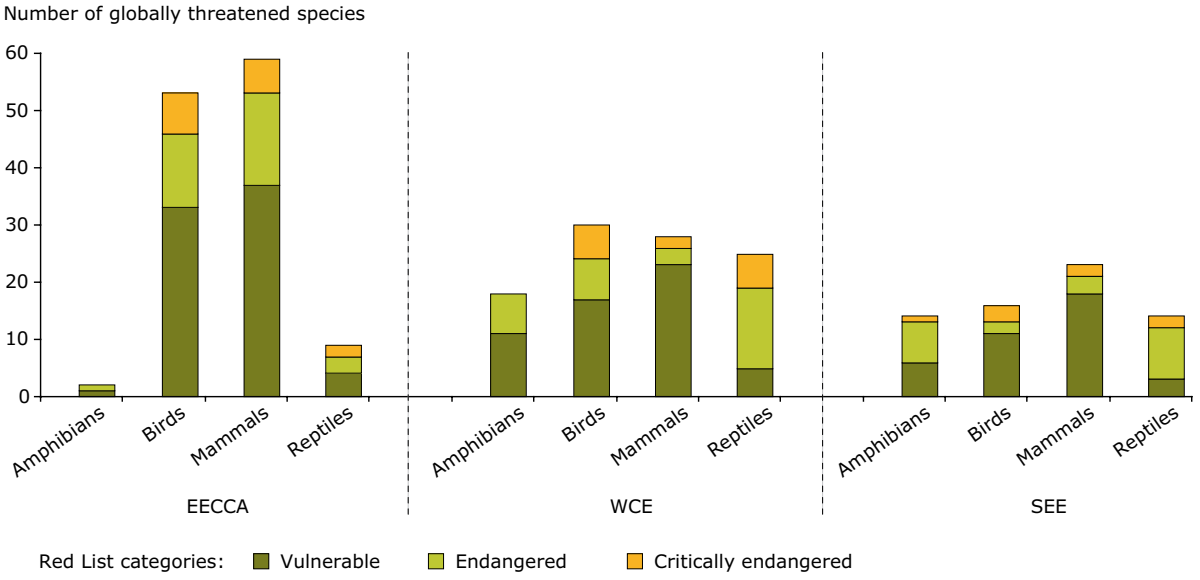

**Source:** EEA, 2005b — Map 4.1.

## 3.3 Biodiversity loss

Biodiversity decline and loss of ecosystem services continue to be of major concern across the pan-European region. Biodiversity is particularly under threat on farmland, and in mountain regions, forests and coastal zones, with losses occurring as a result of habitat loss brought about by changes in land use and urban sprawl; pollution causing acidification and eutrophication; the introduction of invasive species; resource overexploitation; and climate change, leading, for example, to desertification.

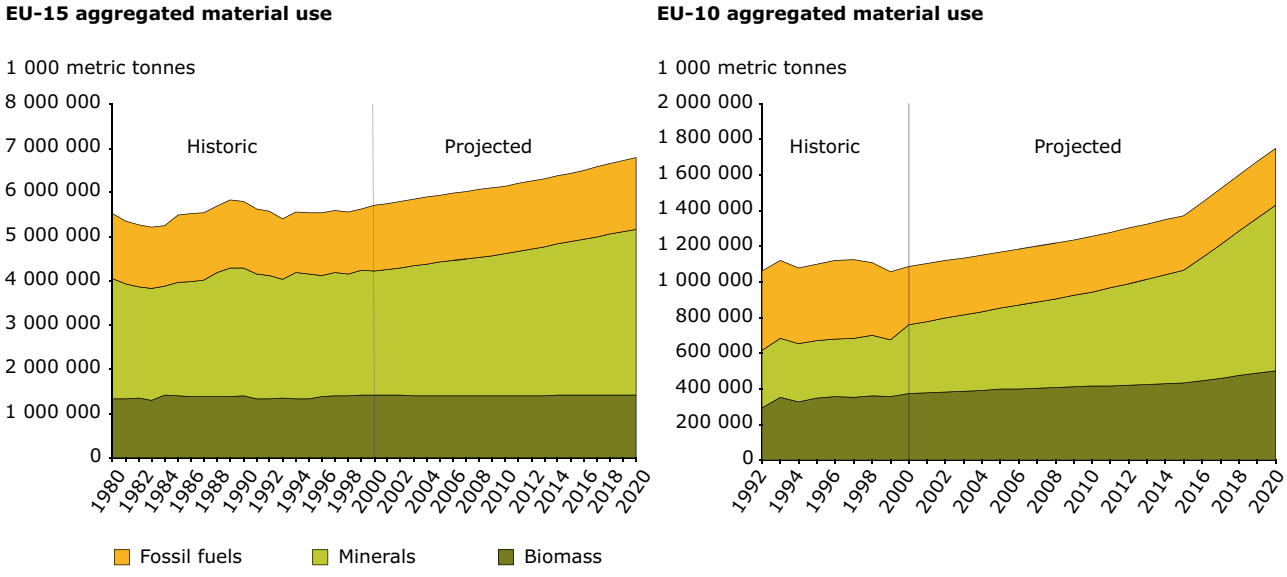
The global target of halting biodiversity loss by 2010 is unlikely to be achieved without considerable additional effort — more than 700 of the 16 000 or so plant and animal species that, according to the

**Figure 3.7 Globally threatened terrestrial vertebrates in the pan-European region, 2006**




**Source:** IUCN, 2006a (also published in EEA, 2007a — Figure 4.1).

**Figure 3.8 Aggregated material use, historic and projected to 2020**




**Source:** Skovgaard *et al.*, 2005 (also published in EEA, 2007a — Figure 6.8).

IUCN Red List of Threatened Species, are threatened at a global level occur in Europe (EEA, 2007a) (see Figure 3.7). However, it should be noted that the quality and amount of information on the conservation status of species in EECCA countries is limited.

Selected indicators:

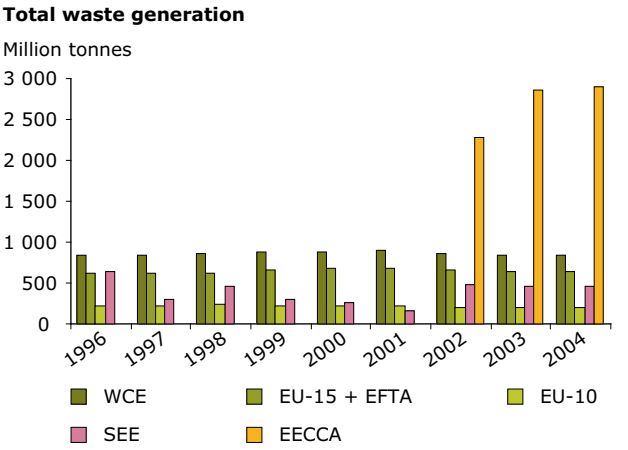
- Mean species abundance (Annex 2)
- Fertiliser consumption (Annexes 2 and 3)

## 3.4 Resource use and waste generation

Although pan-European per capita resource use levels have remained relatively stable over recent years, they appear once again to be on the rise (see Figure 3.8) and are projected to increase in the coming decade. Driven by socio-economic changes, consumption patterns are altering rapidly, with food and beverages, private transport, and housing having the highest life-cycle environmental impacts. Indeed, food and drink consumption in the EU-15 is projected to grow by 17 % by 2020 (EEA, 2005b). Tourism and air travel are also emerging as key areas of future impacts. Overall, concern is rising over unsustainable patterns of production and consumption, driven by society's desire for ever higher standards of well-being, leading to increasing resource needs which can deplete and even contaminate natural resources both within and beyond Europe's borders.

Meanwhile, the pan-European region is generating ever more waste: overall waste generation is highest in EECCA due to the production of large amounts of waste from raw material extraction and processing (see Figure 3.9). Recent projections expect municipal waste generation to continue to increase over the next 10 to 20 years: For Western Europe (i.e. EU-15) a growth of more than 25 % is projected, while the expected increase for Central Europe (i.e. EU-10) is a more moderate at 10 %. For EECCA countries, however, substantial increases, more than doubling municipal waste volumes, are assumed (see Annex 2).

**Figure 3.9 Total waste generation in the pan-European region, 1996–2004**




**Source:** EEA, 2007a — Figure 6.18.

Selected indicators:

- Municipal waste generation (Annex 2)
- Car ownership (Annexes 2 and 3)

# 4 Wider trends that shape pan-European environmental futures

The short overview of selected priority environmental issues presented in the previous chapter illustrates how these challenges may take decades to solve and therefore that related policies and response options would benefit from long-term perspectives. Moreover, unless they are well-managed, political and economic changes in the pan-European region may exacerbate some environmental problems or even create new ones in the longer term. As environmental change is firmly embedded in the wider societal context, its underlying dynamics and uncertainties can only be understood within it. Thus, addressing environmental challenges in a sustainable manner requires us to ensure that sound reflection of plausible future developments and their implications forms the foundation of policy-making.

This chapter reviews seven broader issues that underlie many of the environmental developments highlighted in the previous chapter. It presents some of the broader trends that shape these issues, and puts them into the context of the uncertainties, challenges and opportunities that surround them. The issues and trends that are likely to shape Europe's environment in the future discussed here are:

- geo-politics and international cooperation;
- globalisation and trade;
- population growth and migration;
- macro-economic development;
- consumption patterns: energy, transport, food;
- land use and use of natural resources;
- global environmental change and its feedback.

These issues influence environmental developments both directly and indirectly. Table 4.1 gives an indication of whether and how different clusters of driving forces within the broader issues listed above affect the environmental concerns presented in Chapter 3 — for a broader discussion of the interrelationship between driving forces and environmental issues (see, for example, EEA, 2005b).

## 4.1 Geo-politics and international cooperation

Geo-politics and international cooperation play an important role in shaping the state of our environment. The geopolitical situation and its stability provides the basis for trade and globalisation as well as migration and economic development — and thus indirectly affects how human activity results in environmental pressures. The international political context also provides a backdrop to international environmental agreements and partnerships between countries and organisations as well as environmental governance.

For centuries, the pan-European region has been highly dynamic: it is an area of constant cultural, political, social and economic change that over the past 20 years has witnessed a near-unprecedented transitional process. Not only have these recent changes influenced economic development — particularly in the countries of Central and Eastern Europe, the Caucasus and Central Asia — they have also led to a redrawing of the political landscape with the number of independent countries in the pan-European region increasing from 33 in 1990 to 53 in 2007, the most recent additions being the Republic of Serbia and the Republic of Montenegro (see Figure 4.1).

At the same time, international cooperation across the region has grown to unprecedented levels. The European Union has expanded from 12 Member States in 1990 to 27 in 2007, and now effectively stretches from the North Sea to the Black Sea — unthinkable 20 years ago. This process seems set to continue with European Union accession negotiations currently underway with Croatia and Turkey. The Former Yugoslav Republic of Macedonia, too, is an EU candidate country, although negotiations are still pending, and also

**Table 4.1 The strongest links (between key driving forces and environmental issues analysed in this report)**

| | Environment-related health concerns (i.e. air/water pollution) | Greenhouse gas emissions and climate change | Nature and biodiversity loss | Resource use and waste generation |
|---|---|---|---|---|
| **Geo-politics and international cooperation** | | | | |
| Geo-politics | •• | ••• | •• | ••• |
| Environmental governance | ••• | ••• | ••• | ••• |
| **Globalisation and trade** | | | | |
| Trade flows | •• | ••• | •• | ••• |
| Market liberalisation | • | ••• | •• | ••• |
| **Population growth and migration** | | | | |
| Population | ••• | ••• | ••• | ••• |
| Migration | •• | • | •• | ••• |
| **Macro-economic development** | | | | |
| Gross domestic product (GDP) | •• | ••• | •• | ••• |
| Income distribution | •• | •• | •• | ••• |
| **Consumption patterns: energy, transport and food** | | | | |
| Households (number, average size) | ••• | ••• | •• | ••• |
| Consumer preferences | •• | ••• | •• | •• |
| Energy use | ••• | ••• | •• | ••• |
| Water use | ••• | • | •• | ••• |
| Transport | ••• | ••• | •• | ••• |
| Tourism | •• | ••• | ••• | •• |
| **Land use and use of natural resources** | | | | |
| Urbanisation | ••• | •• | ••• | •• |
| Transport infrastructure | •• | •• | ••• | •• |
| Crop and livestock production systems | ••• | ••• | ••• | ••• |
| Timber production/forestation | • | •• | ••• | ••• |
| **Global environmental change** | | | | |
| GHG emissions and climate change | •• | – | ••• | •• |
| Nature and biodiversity loss | •• | • | – | •• |
| Water stress, flooding, droughts | •• | • | ••• | •• |

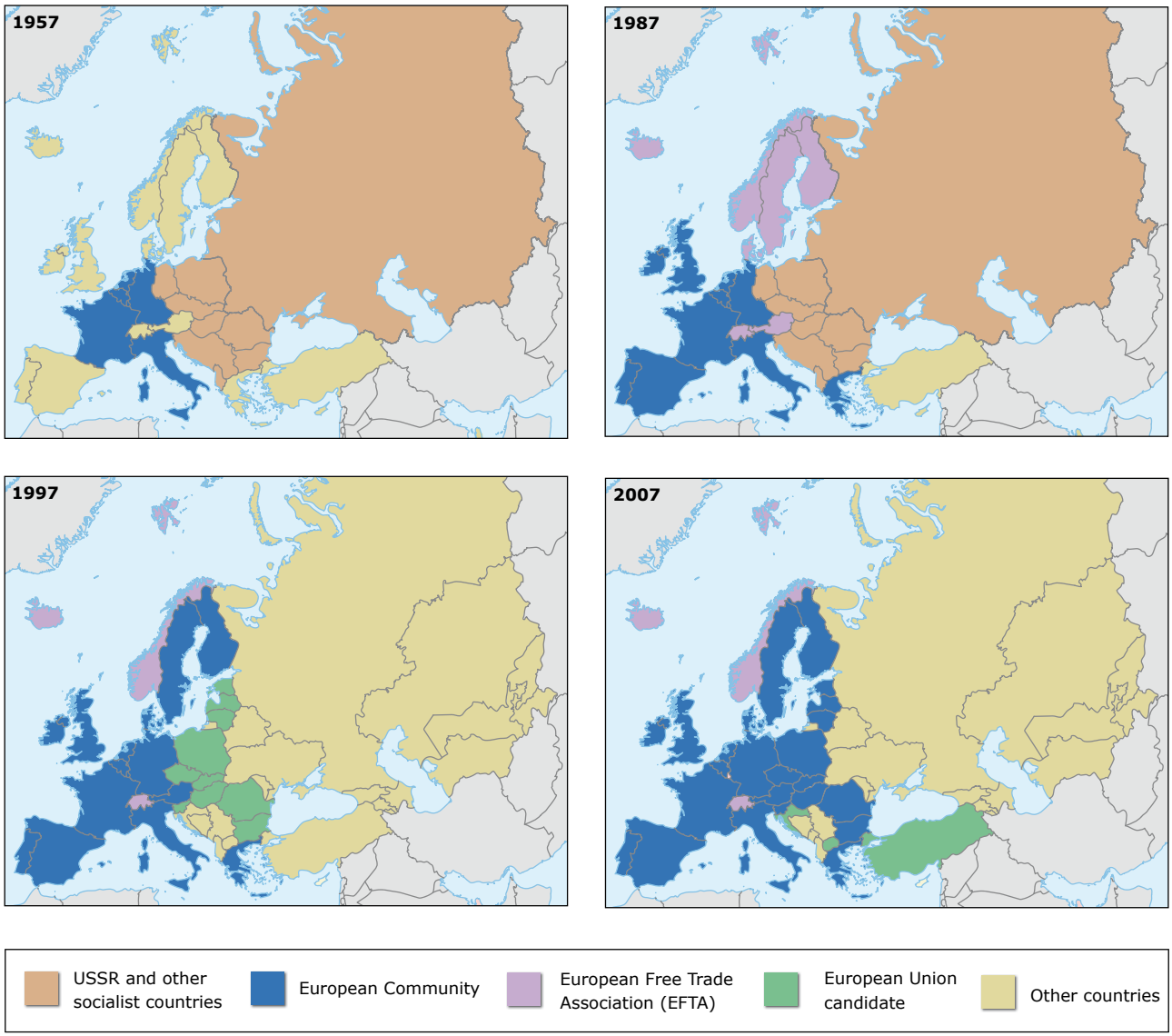
••• Strong links (direct effects)
•• Medium links (mostly indirect effects)
• Weak or no links

**Source:** Based on EEA, 2005b.

all other Western Balkan countries are regarded as potential candidates.

In several EECCA countries the aftermath of the changes of the early 1990s continues to impact the political context — some recent examples include the political changes in Georgia (2003), in Ukraine (2004) and in Kyrgyzstan (2005). Nevertheless, cooperation both across the EECCA region and with the European Union is increasing, with the EU neighbourhood policy (ENP) being reaffirmed by the Council meeting in 2006. As political instability and weak governance in the European neighbourhood could impact the EU, the ENP is seen as a core priority of EU external policy. Its goals and partnership have been revisited, strengthened

**Figure 4.1 Political maps of the pan-European region, 1957 to 2007**




**Source:** UNEP/GRID Arendal.

and enhanced with further EU assistance, providing flexibility for all parties involved, but it remains distinct from the EU enlargement process ([6]).

Meanwhile, EECCA countries are also re-asserting their roles on the global scene and are exploring new forms of regional cooperation, such as the GUAM group (Georgia, Ukraine, and the Republics of Azerbaijan and of Moldova) and the Shanghai Cooperation Organisation (People's Republic of China, Russian Federation, Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan). In addition, the Collective Security Treaty Organization links Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, and Uzbekistan in a common defence structure.

Not only in the pan-European region but also at the global level, international cooperation has increased significantly over the past 20 years — especially in the context of jointly addressing environmental challenges. Today, environmental

([6]) General Affairs and External Relations Council (GAERC), 18/19 June 2007: Strengthening the European Neighbourhood Policy Presidency progress report.

governance benefits from a web of agreements and institutions at global (WSSD, international climate agreements), regional (UN-ECE Environment for Europe), sub-regional (EU, SEE and EECCA strategies, and bi- and multilateral cooperation) and local levels — although still more international effort is needed to combat global environmental challenges, such as climate change, effectively. More and more, governance structures are also being set up for specific ecosystems, such as the Arctic, the Caspian, Black Sea and Danube conventions, the Mediterranean and Adriatic-Ionic Initiatives, the Carpathian and Alpine conventions, and the Nordic Dimension Environmental Partnership.

The geopolitical landscape, to a large extent, determines the effectiveness of international environmental cooperation — and is bound to continue to do so into the future. In particular, the level or absence of global conflict or cooperation in coming decades will deeply influence the patterns of globalisation in general as well as the effectiveness of environmental governance and international alliances to combat environmental threats. However, geopolitical futures are likely to remain uncertain both at the global level and for Europe.

Several scenario-based forward-looking studies explore the theme of global cooperation and reflect on its impacts on the environment. Such studies include business-oriented exercises such as Shell's Global Scenarios to 2025 (Shell, 2005, see Section 4.2) and the scenarios presented by the World Business Council on Sustainable Development (e.g. WBCSD, 2004) or by international environmental assessments such as the *Millennium Ecosystem Assessment* (MA, 2005a, 2005b, see Section 4.7) and UNEP's *Global Environment Outlook* (UNEP, 2007a, see Section 4.7). Recent forward-looking studies also address the uncertainties around the future of the European Union, despite its economic growth and expansion (see, for example, Box 4.1). For SEE countries, where a key uncertainty relates to the region's integration with and accession to the European Union, the Economist Intelligence Unit has developed three scenarios for the accession of Western Balkan countries: 'benign accession', 'malign accession' and 'no accession' (EIU, 2005). And a major uncertainty elaborated upon in scenarios describing possible futures for the EECCA region relates to the future development of the Russian Federation and its role in the regional setting (see, for example, Box 4.2).

As noted above, geopolitical developments and international alliances provide part of the context for international environmental governance. A world characterised by conflict, for example, would almost certainly have difficulties reaching or implementing environmental agreements, including global measures to address climate change and other transboundary environmental problems. Conversely, if the geopolitical context remains stable and global cooperation in general increases, international efforts to promote sustainable development might be strengthened.

Geopolitical developments also affect the environment indirectly, with political alliances, for example, influencing the security of energy supply, trade flows, transport, and the use of natural resources. And the outcome of geopolitical developments would inevitably influence the evolution of institutions dealing with environmental issues — existing global, regional and national structures might be strengthened, adapt gradually, be rethought entirely, or even disappear.

Regional political dynamics, too, are bound to influence the pan-European region's capacity to respond to environmental challenges. The recent Environmental Action Plan (EAP) Task Force report on EECCA (OECD, 2007a) and the UNDP report on SEE (UNDP, 2007a) both emphasise the need for

**Box 4.1 Five scenarios for the EU to 2025**

*Status quo* — A scenario assuming little progress for further membership or the EU's political role.

*Europe unbound* — A scenario which sees more powers returning to the national level (though with Turkey and the Western Balkans joining the EU by 2020).

*Europe unravelled* — A scenario characterised by increasing conflicts among Member States and a collapse of the Euro.

*Back to the core* — A scenario based on a split between a core of 'inner' EU Member States and a less integrated 'outer ring' (though, in this scenario, enlargement continues).

*Europe revived* — A scenario that explores further economic integration and continuing enlargement.

**Source:** Economist Intelligence Unit, 2005.

strong cooperation, in particular with EECCA and SEE countries, to deal with both global and regional environmental issues. Such cooperation will also be beneficial to strengthen the management of regional seas and ecosystems, such as the Black Sea and the Carpathian mountains.

Thus a key challenge for future environmental governance will be its ability to adapt effectively to global and regional geopolitical dynamics. Conversely, international environmental initiatives can help building further cooperation — as, for example, initiatives to reduce transboundary air pollution in Europe in the 1980s established cooperation across the then divided continent (EEA, 2001b).

## 4.2 Globalisation and trade

Globalisation and trade are key determinants of how goods and services are transported from one part of the world to another, and thus shape how economic activity affects environmental pressures across regions. Strong linkages exist between trade and the geopolitical context on the one side (see Section 4.1) and economic development on the other (see Section 4.4).

World trade expanded in the second half of the 20th century, growing by a factor of six to eight for raw materials, and by as much as a factor of 40 for finished and semi-finished goods (WTO, 2006). The pan-European region has also experienced significant growth in imports and exports since the 1990s. In the EU-25 as a whole, the contribution of imports and exports to GDP grew from 27 % in 1990 to more than 33 % in 2005, with exports being one of the main drivers of economic growth. The same trend holds true for SEE countries, in the three largest of which (Bulgaria, Romania and Turkey) the export component of GDP almost doubled between 1990 and 2005, increasing from 16 % to 31 %. In EECCA countries the contribution of imports — up from 20 % to 29 % — and exports — up from 20 % to 39 % — to GDP also grew (EEA 2007a).

Both the growing globalisation and interdependence of the world economy have been mirrored in the pan-European region, the countries of which have become increasingly connected both with each other and with the rest of the world. Within the region an important trade flow is that between WCE and SEE, and EECCA. WCE and SEE countries mainly export manufactured goods to EECCA, while almost 80 % of the exported value from EECCA countries to WCE and SEE in 2005 stemmed from fuels and mining products, an asymmetry that appears to be growing (see Figure 4.2).

If current trends continue, both global GDP and trade are expected to increase. The IEA's *World Energy Outlook*, for example, assumes continued trade growth and, without a change in policy, a further increase in oil and natural gas imports to WCE in the coming decades (IEA, 2006). In parallel, the flow of resources, services, capital, technology and information between countries within the

**Box 4.2 Four scenarios for Eurasia in 2020**

The US National Intelligence Council investigates possible scenarios for EECCA countries in its 'Eurasia 2020' study. Four scenarios were elaborated based on the interplay of economic development and natural resource prices; demography and health; social and ethnic identity, federalism and regionalism; and science, technology and the military:

*Economic prosperity and political stability* — A scenario in which Russia prospers as a world supplier of natural resources, and diversifies its economy into manufacturing and services. Ukraine and several other EECCA countries strengthen their ties with the EU without regional tension. Central Asia remains stable.

*Muddling through* — A scenario in which Russian growth remains tied to natural resources, and where political power remains very centralised. Central Asia faces political and economic difficulties. In the Caucasus, ethnic tensions continue.

*Decline and isolation* — In this scenario, the EECCA region becomes more isolated from the rest of the world. The Russian economy stagnates, in part because of declines in natural resource prices. Tensions within the EU block further integration and accession for western EECCA countries.

*Central Asian meltdown* — This scenario sees regimes in Central Asia collapse in the face of rising religious fundamentalism. The remaining EECCA countries align more closely with Russia, and receive strong support in the fight against the new terrorism front.

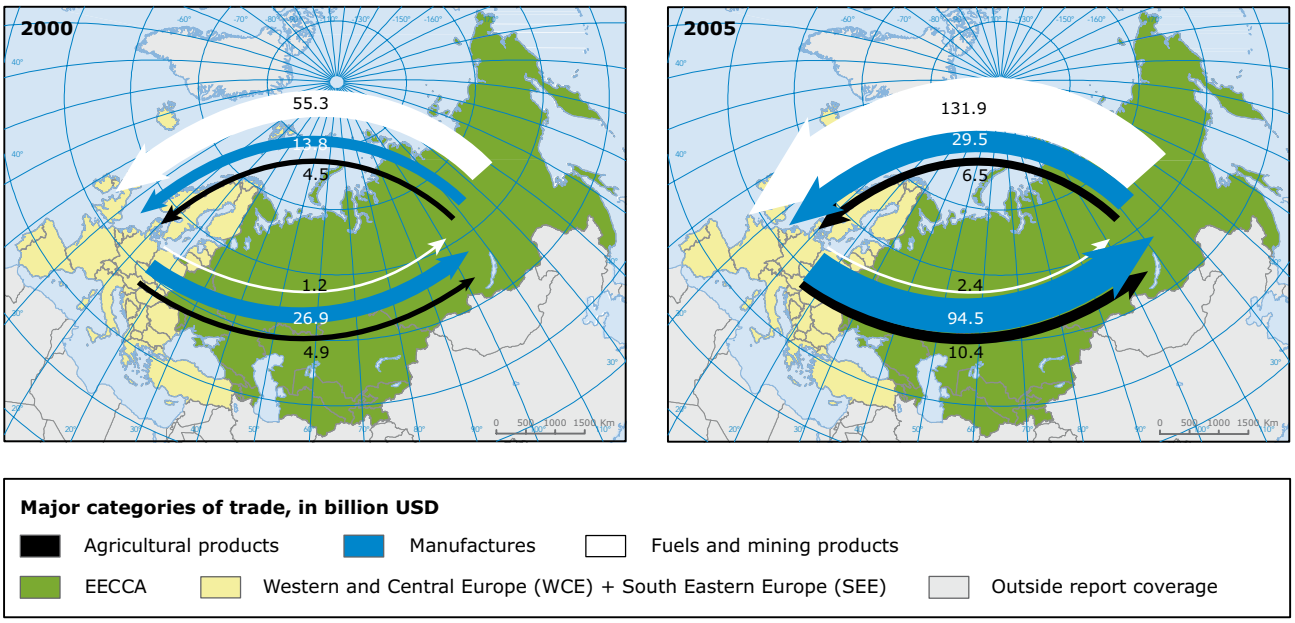
**Source:** US National Intelligence Council, 2004.

region has grown and is expected to increase further, resulting in a web of interdependence across the region.

Although globalisation and world trade have expanded substantially over recent decades, we now appear to be at a crossroads, with the success of the current 'Doha Round' of trade negotiations seemingly in doubt. While previous negotiations have faced difficulties prior to reaching final results, major trading powers are now more than ever hedging their bets by negotiating regional and bilateral trading agreements: notably, the EU and the United States are discussing a transatlantic free-trade area. An additional uncertainty relates to the economic role of emerging markets and economies, such as China, Brazil and India, in the coming decades. Here, continued growth could easily create further pressure on global commodities — especially oil, natural gas, raw materials, and fish — and, in turn, increase global vulnerability to supply shocks (see, for example, Box 4.3).

Trade and globalisation have far-ranging influences across the economy and the environment. Some observers claim that a reduction in global trade might lead to environmental improvements. Not all future studies agree, however: for example, among the scenarios developed for the *Millennium Ecosystem Assessment*, a security-focused world based on

**Figure 4.2 Trade between Western and Central Europe and South Eastern Europe (WCE + SEE), and EECCA, 2000 and 2005**




**Source:** EEA, 2007a — Map 6.1 (based on World Trade Organization, 2006).

### Box 4.3 Three global scenarios to 2025

The global scenarios to 2025 explore the three forces of market incentives, communities, and coercion or regulation by the state. Three main forces drive towards different objectives: efficiency, social cohesion and justice, and security. While societies often aspire to all three objectives, the forces display elements of mutual exclusivity — one cannot be at the same time be freer, more conformant to one's group or faith, and more coerced.

*Low Trust Globalisation* — This scenario depicts a legalistic world where the emphasis is on security and efficiency, even at the expense of social cohesion.

*Open Doors* — This scenario depicts a pragmatic world that emphasises social cohesion and efficiency, with the market providing 'built-in' solutions to the crises of security and trust.

*Flags* — This scenario depicts a dogmatic world where security and community values are emphasised at the expense of efficiency.

**Source:** Shell, 2005.

regional structures leads to the greatest pressures on habitats and biodiversity worldwide (MA, 2005b).

Either way, changes in trade flows have considerable impacts on how and where environmental pressures unfold. Through trade, environmental impacts of a particular product or resource may occur in several countries. What is true for individual goods is just as true across economies. The EU, increasingly a service-producing economy (e.g. EEA, 2005a and b), imports both raw materials and manufactured goods that create environmental impacts in other parts of the world — shifting the environmental burden both globally and across Europe.

At the same time, the future development of globalisation and trade are bound to have direct impacts in areas where trade and the environment are closely linked, such as agriculture. Global trade negotiations are likely to influence agricultural subsidies in the European Union, an area in which the EU has already made significant reforms. New trade agreements may require further changes — and this in turn influences the environmental pressures arising from agriculture, as well as land-use patterns. Fishery subsidies, a concern for over-fishing, have also been raised in international trade negotiations.

Selected indicators:

- Gross domestic product (Annexes 2 and 3)

## 4.3 Population growth and migration

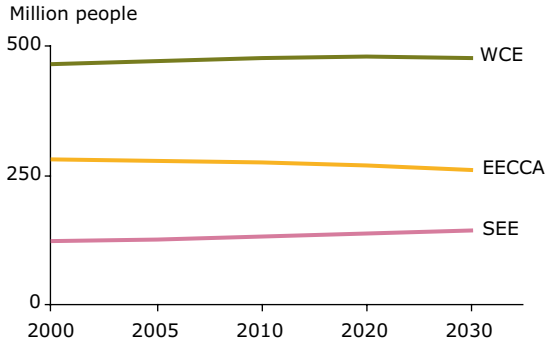
Demographic patterns are central to the discussion of how human activity affects the environment. Simply put, a larger population leads to more resource requirements, higher emissions and more pressure on the environment — unless technological progress or socio-cultural changes trigger more efficient or entirely different kinds of resource use. The relationship between demographics and the environment becomes particularly evident where environmental impacts are closely coupled to per capita resource usage (for example, food, energy, and water consumption; see Section 4.5). Key demographic drivers include developments in population size, ageing, migration and spatial distribution of the population (see EEA, 2005b).

Today, more than 870 million people live in the pan-European region, although population density and distribution vary considerably across the region. More than half of the total live in Western and Central Europe, making this sub-region one of the most densely populated regions of the world, with an average of nearly 110 people per km$^2$. This is in stark contrast to Eastern Europe and Central Asia, where the average density is well below 20 people per km$^2$ (see Table 1.1).

While global population is projected to continue to grow from 6.5 billion in 2005 to more than 9 billion in 2050 (according to the United Nations Population Division medium variant), it is expected to remain fairly steady or even decrease by 2030 in most parts of the pan-European region (Figure 4.3). Although the population in Central Asia is projected to continue growing for the foreseeable future, declines in Eastern Europe and the Caucasus are expected to more than balance the overall EECCA population trend to 2030. In contrast, in SEE as a whole, the population is projected to increase — this is due mainly to the expected population growth in Turkey. A stable or even declining population trend is already discernable in most of WCE — although Cyprus, Ireland and Malta are noteworthy exceptions (Eurostat, 2005).

In general, demographic patterns are key to how environmental challenges unfold since they govern consumption and determine the demand for and use of resources, goods and environmental services.

**Figure 4.3 Population projections, 2000 to 2030**




**Source:** United Nations Population Division, 2007.

The age structure of populations also inevitably shapes consumption patterns and demands for environmental services.

Populations are expected to age considerably across the pan-European region: under current trends, according to the United Nations, more than one-fifth of the population is projected to be 65 or older by 2050 (see Table 4.2). In EECCA, the relatively young and growing population in Central Asia currently offsets the rapidly ageing population in other countries, including the Russian Federation — but here too, one-fifth of the total population is expected to be over 65 by 2050. And in WCE, the OECD reports, there could be almost 'one older inactive person for every worker' by 2050 (OECD, 2006).

The current trend across Europe towards an ageing society may further alter susceptibility to adverse environmental changes and health risks. With the growing number of elderly people, the emergence of medical innovations, and citizens' growing expectations regarding the quality and availability of health care, the affordability and efficacy of national systems are at great risk. Recent studies expect an increase in public health care expenditures from 6.6 % of GDP in 2000 to 8.8 % in 2020 ([7]) as well individual spending on health care — a Dutch study ([8]) projects increases from a current 15 % of personal income dedicated to health care to more than a quarter in 2020 ([9]). Indeed, the ageing of the population in WCE and other developed countries is unprecedented in human history, and poses a new challenge for government budgets, health care and social structures. These challenges may limit government capacities to address other problems, including environmental ones, or it could create the opportunity to put new policies in place.

Generally speaking, population forecasts that look 20 to 30 years into the future are considered to be fairly certain. Nevertheless, the United Nations makes low, medium and high forecasts for each country, which differ primarily in regard to the fertility assumptions used: the medium variant assumes that fertility rates decline to merely replacement level at some point before 2050 in all countries that currently have a high fertility rate, and stable fertility rates in those countries that currently have lower than replacement rates. For Europe, the overall trend of a stable or slightly decreasing population remains clear and consistent across the different variants.

Meanwhile, international migration and internal population movements have been on the rise in Europe since the 1990s. One major driver is that people in unstable and poor areas have moved to seek work to better sustain themselves and their families. Over the past 20 years in Central Asia, poverty and natural disasters have led to large-scale emigration. In SEE, many, often the educated, working-age people, left the Balkan countries during the 1990s to escape the war and the economic difficulties of transition — for example more than 3 % of the population migrated from Albania and Bosnia and Herzegovina.

Also within countries, people have moved from mountain and rural areas to cities to seek better opportunities, increasing pressures on urban and coastal environments. This trend is particularly visible in SEE where it is expected to continue in

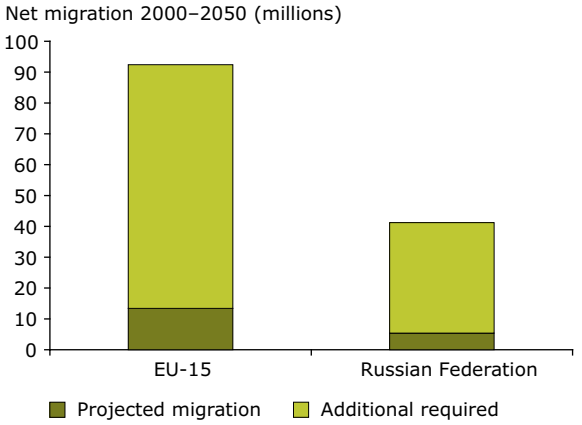
**Table 4.2 Projected population above 65 in different European sub-regions in 2005 to 2030 (according to medium variant)**

| Region | 2005 | 2010 | 2020 | 2030 |
|---|---|---|---|---|
| Pan-European region (total) | 16 % | 16 % | 19 % | 23 % |
| WCE | 17 % | 18 % | 21 % | 24 % |
| SEE | 8 % | 8 % | 10 % | 13 % |
| EECCA | 12 % | 11 % | 13 % | 16 % |

**Source:** United Nations Population Division, 2007.

([7]) Economic Policy Committee (2001), Budgetary Challenges Posed by Ageing Populations: the Impact of Public Spending on Pensions, Health and Long-Term Care for the Elderly and Possible Indicators of the Long-Term Sustainability of Public Finances, EPC/ECFIN/655/01-EN final.
([8]) Netherlands Bureau for Economic Policy, Analysis, *Uitgavenontwikkeling in de gezondheidszorg*, July 2001.
([9]) Health Care in an Ageing Society, A Challenge for all European Countries, Background Paper of the Netherlands EU Presidency, Informal Health Council, Noordwijk, 9–10 September 2004.

**Figure 4.4 Net migration required to hold working age population constant at 1995 levels in 2050**




**Note:** For the sake of comparison, there was a net migration of about 8.8 million into the EU and about 3.3 million into the Russian Federation during the 1990s.

**Source:** EEA, 2007a — Figure 1.1 (based on data from World Bank, 2006).

the future. In a similar movement in the Russian Federation, many people have moved south from the country's formerly large settlements in the Arctic region. A further trend, especially in WCE, has been the movement of retirees seeking better or cheaper lifestyles, often in coastal areas along the Mediterranean.

Unlike forecasts for population growth, future migration patterns are far from certain, even over a 20 year perspective, as they are more directly influenced by economic, political and environmental factors — see, for example, Box 4.4 or the EEA's PRELUDE scenarios that depict land-use consequences related to climate change-induced migrations (EEA, 2007b; Section 4.6). Across the pan-European region, countries are seeking to halt immigration: the Russian Federation has proposed restrictive immigration laws, while the EU has stepped up the control of illegal immigration across its borders and partial restrictions across some EU Member States. But as populations age, the need for increased immigration to European countries may develop to bolster the economically-active population (see Figure 4.4).

Migration has a series of consequences: some positive, others negative. At an economic level, immigrants can help to sustain economic growth in their new countries, and often transfer vital financial resources back to their home countries. Immigration can help to provide workers and address imbalances in ageing societies. But many emigrants are young and educated, and take their energy and skills from their home countries, though those that return may bring back new skills and ideas. Migration can also add to environmental pressures, particularly in large cities with expanding economies, such as Istanbul, London and Moscow, and in coastal areas where migrating retirees can add to growing tourism pressures on these often already stressed environments.

Selected indicators:

- Population (Annexes 2 and 3)
- Working age population per person over 65 (Annex 2)

**Box 4.4 Migration from Turkey to the EU**

A recent study used past immigration and economic modelling to estimate potential emigration from Turkey to the existing EU in the period to 2030. It compared one scenario in which Turkey joins the EU and then experiences strong economic growth, against another, in which Turkey does not join and GDP, especially in rural areas, stagnates. According to this study, emigration could be as low as one million people in total over the period in the first scenario, while in the second, i.e. without EU membership, emigration from Turkey is assumed to exceed 2.5 million.

**Source:** Erzan *et al*., 2004.

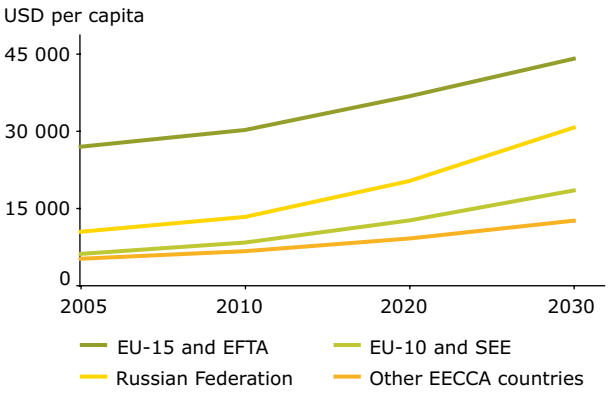
## 4.4 Macro-economic development

Economic activity is often — or at least has been in the past — directly coupled to the intensity of both resource use and environmental impacts. Transport-related greenhouse gas emissions, for example, still follow overall economic development. Indeed, achieving a decoupling of environmental pressures from economic growth remains a key policy challenge (see EEA, 2005b). Economic development often affects the environment through sectoral activity (energy, transport, etc.) and consumption patterns (see Section 4.5). Economic conditions are also particularly related to developments in geo-politics (Section 4.1) and trade (Section 4.2). And conversely, the impacts of global environmental change may also affect future economic development.

During the past five years, per capita income has grown in almost all countries in the pan-European region. Most countries in Western Europe have enjoyed continuous economic growth for several decades, while Central European, SEE and EECCA countries faced major economic disruption in the 1990s due to economic transition and political turmoil. In some EECCA countries only now are personal incomes returning to pre-1989 levels, and in some Western Balkan countries this has yet to happen.

Assuming the current trends continue, economic growth is expected to raise personal incomes across the region substantially. The EECCA economies' GDP per capita is projected to almost triple between 2005 and 2030. Growth in the EU-10 is projected to be slightly lower, adding an extra 140 % to today's income (EEA, 2007a), while Western Europe is likely to experience the slowest growth in the region, a 65 % increase between 2005 and 2030. Nevertheless, GDP per capita in Western Europe would remain more than twice that in other regions. It should be noted here that globally both China and India are expected to continue their current rapid growth, while growth rates in Canada and the US match or even lag behind those of Western Europe (see Figure 4.5 and Annex 3).

**Figure 4.5 GDP projections, 2005 to 2030**




**Source:** Based on OECD, 2007b.

**Box 4.5 Russian economic scenarios to 2020**

In 2005, Moscow's Centre for Macroeconomic Analysis and Short-Term Forecasting released a study on economic trends, presenting four scenarios for Russia's economic future:

*Super-industrial modernisation* — In this scenario, Russia guarantees energy supply stability to other G8 countries, and uses its revenues to finance long-term projects to boost its energy, research and agricultural potential and renew its capital base. Foreign direct investments also help modernise the economy. A 'rouble area' links Russia's economy to its EECCA neighbours. Annual economic growth reaches 6-7 % after 2020.

*Burst into globalisation* — This scenario has a similar opening to the world; however, new wealth remains in traditional sectors and does not lead to a broad modernisation of the economy. Moreover, income inequality continues, and the middle class and social infrastructure, such as education, are less well off. In this scenario, Russia's economic growth remains below 6 %.

*Economic isolation* — Here Russia chooses not to integrate with the world economy and instead pursues an 'import substitution' strategy, with the state retaining a strong role in the economy. Due to delays to long-term projects, natural resource and other exports start to decline after 2012. Economic growth also slows to about 4 % per year.

*Energy autism* — In this scenario, the Russian economy faces a set of crises, including growing pension costs and declining oil and gas output as well as problems with agricultural production. Direct foreign investment is very low. Economic growth slows to 3 % in 2016 and 2 % in 2020.

**Source:** Belousov, 2005.

The per capita GDP projections shown here are based on the assumption that current trends in economic growth continue. However, a number of uncertainties are not included in such projections, and might jeopardise future income growth. At the macro-level these include the future extent of conflict and cooperation (Section 4.1), possible changes in global trade (Section 4.2), the future of energy supplies and fuel prices (Section 4.5), and even the economic impact of global environmental changes (Section 4.7). While standard projections usually implicitly assume no major disruptions in the above, or any other, issues, they would undoubtedly alter the future pattern of economic growth.

In addition, each part of the pan-European region faces its own specific set of uncertainties about future developments: in particular, resource-exporting EECCA countries run the risk of becoming single-engine economies, with their growth dependent on the extraction of natural resources, a dilemma that has been highlighted, inter alia, in the scenarios for the Russian Federation's economic growth elaborated by a Moscow research centre (see, for example, Box 4.5). Those countries that do not have such wealth of natural resources will have to look for other options — the Kyrgysztan-2025 strategies and development scenarios (Omasov, 2005) discuss some examples that centre on economic reforms and investments in the service sector.

Effectively, pan-European countries have an opportunity to pursue both environmental improvement and economic growth. If the EU were to succeed in increasing its economic competitiveness *and* its sustainability, it could reduce its ecological footprint and provide an example of economic growth for other economies. In both SEE and EECCA, a key question is whether and how economies can leapfrog the environmental problems that developed countries are trying to tackle. The choices in EECCA also involve efficiency gains and a shift away from the current resource-based economy — as well as ensuring more efficient practices in resource extraction.

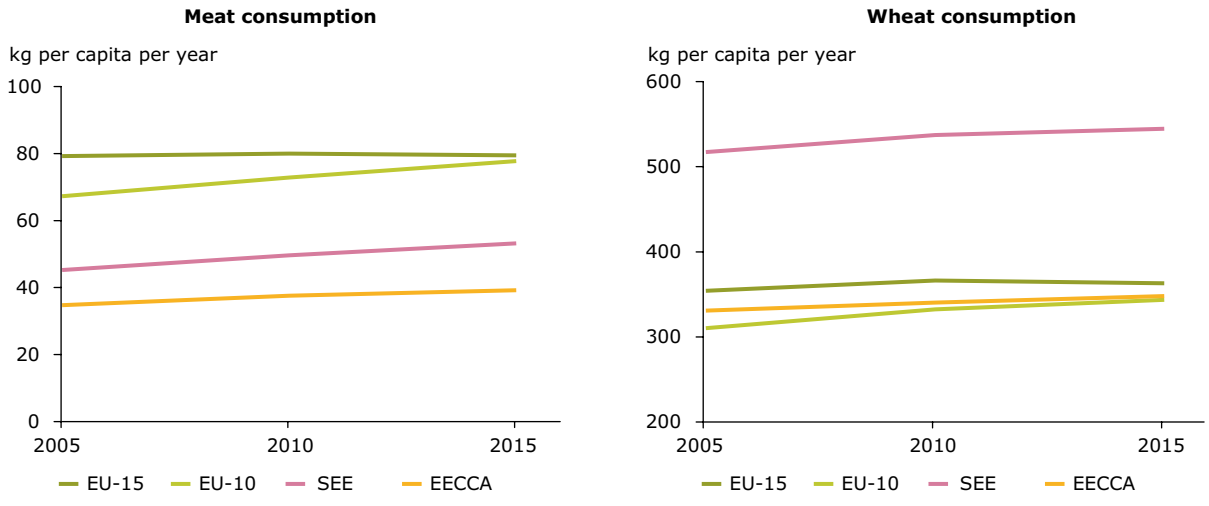
Selected indicators:

- Gross domestic product (Annexes 2 and 3)

## 4.5 Consumption patterns: food, energy, and transport

Consumption patterns, which are changing rapidly across the region, are shaped by a large number of interdependent economic, social, cultural and political driving forces. In relative terms, the food component of household expenditures is decreasing while the shares of transport, communication, housing, recreation and health are on the rise. In Western Europe, tourism and air travel are emerging as future key impact areas (EEA, 2007a). Significant drivers of these changes, especially in the EU-15, are: increasing incomes and growing wealth (see

**Figure 4.6 Food consumption projections, 2005 to 2015**



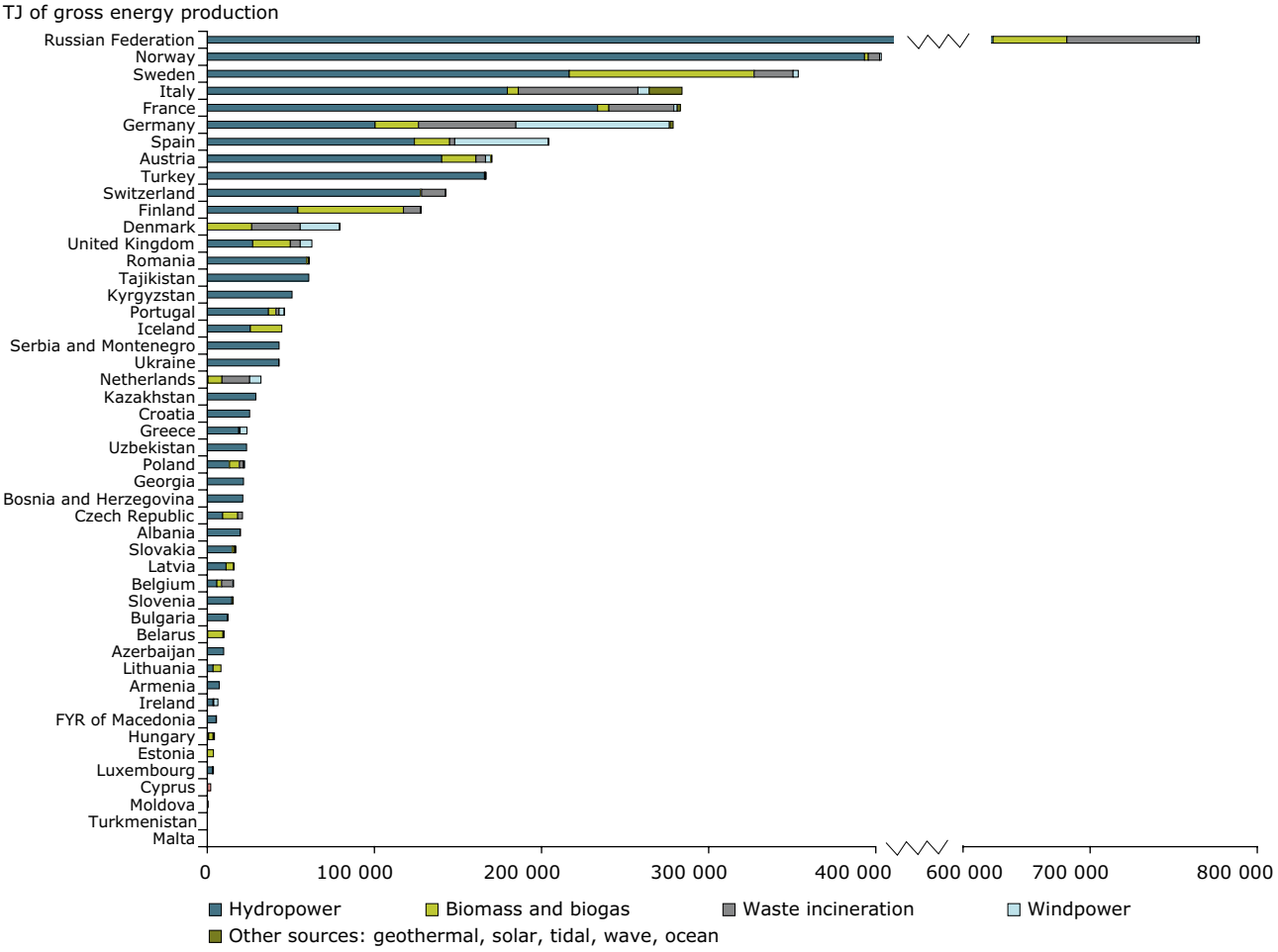

**Source:** Food and Agricultural Policy Research Institute, 2005.

Section 4.4), globalisation of the world economy with the opening of markets (see Section 4.2), increasing individualism, new technologies, targeting of marketing and advertising, smaller households and, in some regions, an ageing population (see Section 4.3) (EEA, 2005b).

Both household and public sector consumption are closely linked to GDP across the pan-European region, where expenditure on consumption by households exceeds that of the public sector by more than a factor of three — highlighting the relative importance of household consumptions in shaping environmental pressures. Per capita household spending has increased across the region: in WCE, it increased by around a quarter between 1990 and 2005 while in many SEE and EECCA countries household expenditure only recovered to 1990 levels in the early 2000s but is now growing by up to 10 % per year. The largest shares of household expenditure in WCE are for housing — including water and, particularly, energy consumption — transport, food and recreation. In contrast, in EECCA food still represents by far the highest share of household expenditure, but this is decreasing as a percentage as incomes grow (EEA, 2007a).

Although expenditure on food across the region appears to be decoupled from growth in incomes and per capita GDP, a number of trends in food consumption are partially offsetting this (Kristensen, 2004). Of key importance, from an environmental perspective, is a shift in demand from local and seasonal foods to imported, non-seasonal fruit and vegetables, and a general globalisation of the food market. Across the region, wheat consumption per capita is expected to remain more or less stable, but per capita meat consumption is projected to increase in all regions except EU-15 ([10]) (see Figure 4.6). However, it should be noted that

**Figure 4.7 Renewable energy production by country, 2005**




**Source:** UNEP/GRID Arendal, based on International Energy Agency, 2007.

([10]) Nonetheless, per capita meat consumption in EECCA and SEE is projected to stay well below EU-15 levels for the foreseeable future.

these projections usually do not take into account sudden market developments, such as the increases in the price of staple foods experienced recently ([11]).

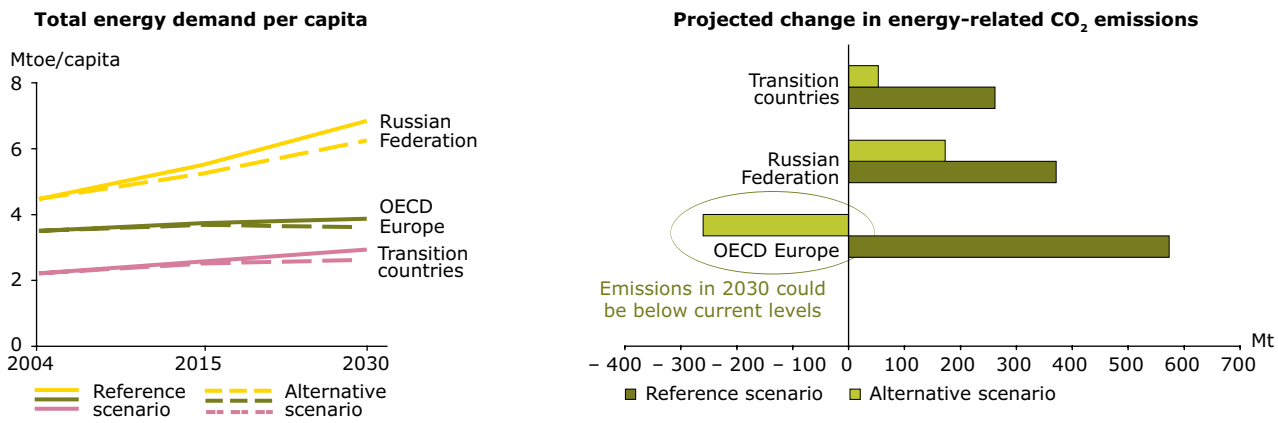
The most significant environmental impacts of food consumption are indirect, and relate to agricultural production, industrial processing of food, and retailing. While the EU has paid considerable attention to the environmental consequences of food production and food safety, providing basic food remains a challenge in a number of countries in Central Asia and the Caucasus. However, it should be noted here that in EECCA and SEE, levels of artificial fertiliser and pesticide use in agriculture are now significantly lower than in WCE ([12]). It should also be noted that the current interest in the production of first generation biofuels may add further uncertainties — in particular regarding the economic, social and environmental effects of competition for agricultural land between biofuel and food crops.

Energy consumption has been increasing since the 1990s, and with it greenhouse gas (GHG) emissions from the energy sector, as this remains dominated by fossil fuels. And although the share of renewable energy has grown significantly and is expected to grow further, renewables are anticipated to provide only a fraction of the energy used in Europe for the foreseeable future (see Figure 4.7). Thus, according to a reference scenario which assumes no new policies and measures, the trends of increasing energy consumption and resulting GHG emissions are expected to continue, and in particular in the Russian Federation, where energy consumption is expected to grow by 50 % between 2004 and 2030 (see Figure 4.8). Also, increases are expected at a global level and in many rapidly industrialising nations including Brazil, China and India (IEA, 2006).

Transport, the volumes of which remain closely tied to economic growth, is an important element of consumption and energy use, with GHG emissions from transport growing rapidly in Europe. Moreover, transport volumes continue to shift to less environmentally friendly modes, notably road and air, with passenger air travel and road freight projected to be the fastest-growing transport modes to 2050. The large increases in the motorway networks in SEE and the EU-10 have been accompanied by a steady growth in car ownership and increasing amounts of road freight movements across the region (see Annexes 2 and 3). Economic restructuring in EECCA led to a decrease in transport in some cases; however, transport volumes are expected to increase as economies grow over the coming decades (see Figure 4.9).

While both energy and transport demands are projected to grow steadily over the coming decades, several factors are bound to influence the energy

**Figure 4.8 Total energy demand projections and projected change in energy-related $CO_2$ emission for two scenarios, 2004–2030**




**Note:** OECD Europe (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom); Transition countries (EECCA exluding the Russian Federation, plus SEE excluding Turkey, plus Estonia, Latvia, Lithuania, Slovenia, Cyprus and Malta).

**Source:** International Energy Agency, 2006.

([11]) See, for example, http://news.bbc.co.uk/2/hi/uk_news/6909469.stm.

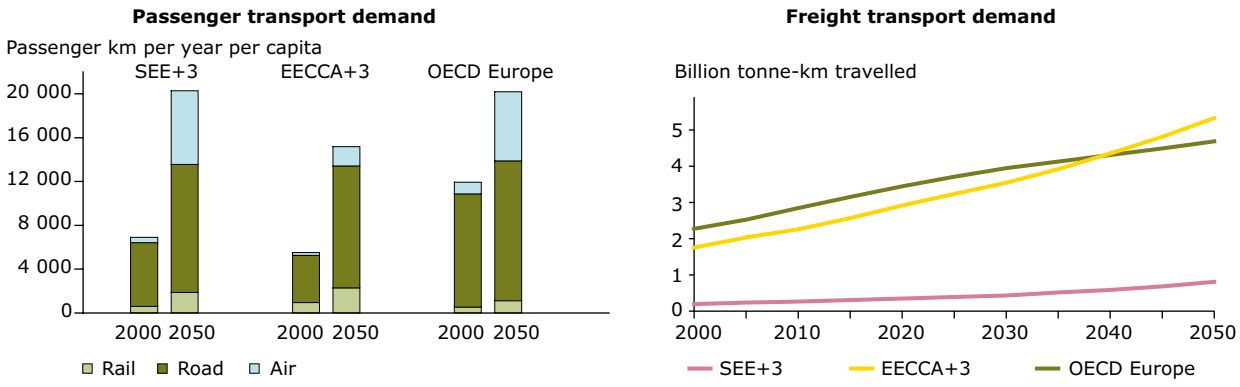
([12]) This suggests an opportunity for greater production and export of organic-labelled produce from these regions, and — in the longer term — prospects for a larger domestic market for organically grown food.

and transport sectors in the coming years. As noted above, one important factor is that of energy policy. In its 2006 *World Energy Outlook*, the International Energy Agency (IEA), for example, sketched an alternative policy scenario under which all the countries in the world implement all the energy security and energy-saving policies currently under consideration to tackle $CO_2$ emissions through to 2030. This is contrasted with the Agency's reference, or business-as-usual, scenario under which countries implement all policies adopted by 2006 only (see Figure 4.8). The alternative scenario includes the promotion of more efficient new vehicles; the increased use of biofuels; improved efficiency in household appliances, office lighting and industrial motors; and the construction of nuclear power plants. Following this scenario it would be possible to avoid more than 6 Gt of global $CO_2$ emissions in 2030 (i.e. equivalent to the current annual emissions of USA and Canada combined), and total emissions in OECD Europe could be below today's level by 2030. Improved end-use efficiency of electricity and fossil fuels would account for two-thirds of the avoided emissions in 2030, the rest coming from increased use of less carbon-intensive sources. Overall, this alternative policy scenario indicates a reduction in world primary energy demand in 2030 of 10 % and a reduction in $CO_2$ emissions of 16 %, compared with the 'reference' scenario (IEA, 2006).

These two IEA scenarios show considerable uncertainty as to the future pathways of energy- and transport-related environmental impacts. At the European Council meeting in March 2007, leaders of the European Union pledged to targets that go beyond this. These include a 20 % reduction in $CO_2$ emissions by 2020 (30 % if other developed nations take similar steps) and 20 % energy saving compared with 2020 projections, with 20 % of all energy used coming from renewable sources — but it seems that current approaches will not suffice to reach these goals (EEA, 2005b). Meanwhile, recent policy strategies in the Russian Federation appear to be going in the opposite direction. For example, its *National Energy Strategy to 2020* ([13]) foresees an increase in the mining of coal and its use in power generation, allowing more natural gas to be exported, while its *National Transport Strategy to 2025* ([14]) calls for the development of more highways and a greater motorisation of the economy.

For both energy and transport, the prospect of future technological developments provides additional uncertainties. However, in both sectors, new technologies take a long time to reach the market. Additionally, the long lifetimes of power plants, 30 years and more, also mean that existing technologies take a long time to be replaced with newer, more efficient ones. Thus the key question is whether the past pace of technical change will continue in the coming decades or whether we might witness technological breakthroughs such as harnessing nuclear fusion as a new energy source, or hydrogen as a new fuel.

**Figure 4.9 Passenger and freight transport demand projections, 2000 and 2050**




**Note:** OECD Europe (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom); EECCA+3 (EECCA plus Estonia, Latvia, Lithuania); SEE+3 (SEE excluding Turkey, plus Poland, Slovakia, Slovenia).

**Source:** WBCSD, 2004.

([13]) National energy strategy of the Russian Federation until 2020 — available at www.mte.gov.ru/docs/32/103.html.
([14]) National transport strategy of the Russian Federation until 2025 — available at www.mintrans.ru/pressa/TransStrateg_VV.htm.

Geopolitics, including the effect of possible unexpected events, can also influence energy and transport futures. The most recent *World Energy Outlook* notes that the threat to world energy security is growing and that the 'rising oil and gas demand, if unchecked, would accentuate the consuming countries' vulnerability to a severe supply disruption' (IEA, 2006). Whether this would alter future energy and transport demand and developments is an uncertainty not included in most projections.

Energy use, and in particular transport, strongly affect local and transboundary air pollution as well as GHG emissions. Without new policies and new technology, neither the GHG reduction goal of the EU nor its broader goal of limiting climate change to a 2 °C temperature rise appear achievable. Furthermore, energy and transport create significant environmental impacts throughout their lifecycles — ranging from the impacts of oil and natural gas extraction to those of road infrastructure on landscapes and habitats. Additionally, the management of radioactive waste and the decommissioning of out-of-service nuclear power plants remain issues that need to be addressed as wastes accumulate and a number of nuclear power are scheduled to be decommissioned across the pan-European region between now and 2030.

Selected indicators:

- Total energy consumption (Annexes 2 and 3)
- Final energy consumption (Annexes 2 and 3)
- Electricity consumption (Annexes 2 and 3)
- Renewable share in total energy consumption (Annexes 2 and 3)
- International tourist arrivals (Annexes 2 and 3)
- Passenger transport (Annexes 2 and 3)
- Car ownership (Annexes 2 and 3)
- Freight transport demand (Annexes 2 and 3)
- Water withdrawals (Annex 2)
- Municipal waste generation (Annex 2)
- Meat consumption (Annex 2)
- Cereals (wheat) consumption (Annex 2)

## 4.6 Land use and natural resources

The pan-European is rich in natural resources (see Figure 4.10). However, throughout the pan-European region, natural resource use exceeds local availability ([15]). But the region is not alone in this; in 2002, the global ecological footprint was 2.2 global hectares ([16]) per person (gha/p), against a global availability or biocapacity of 1.8 gha/p, and was some three times the footprint of the 1960s (WWF, 2006). For most pan-European sub-regions, consumption is estimated to be well above the respective region's ability to replenish resources and absorb wastes: this effectively implies that the majority of the region is running an ecological deficit. In 2002, the Caucasus's ecological footprint amounted to about 1.2 versus a biocapacity of 1.1; for Central Asia it was 2.2 versus 1.9, for South Eastern Europe 2.2 versus 1.6, and for Western and Central Europe 4.7 versus 2.3. Only Eastern Europe seems to be living within its ecological means, with a footprint 3.9 and a biocapacity of 5.5 (see EEA, 2007a) ([17]).

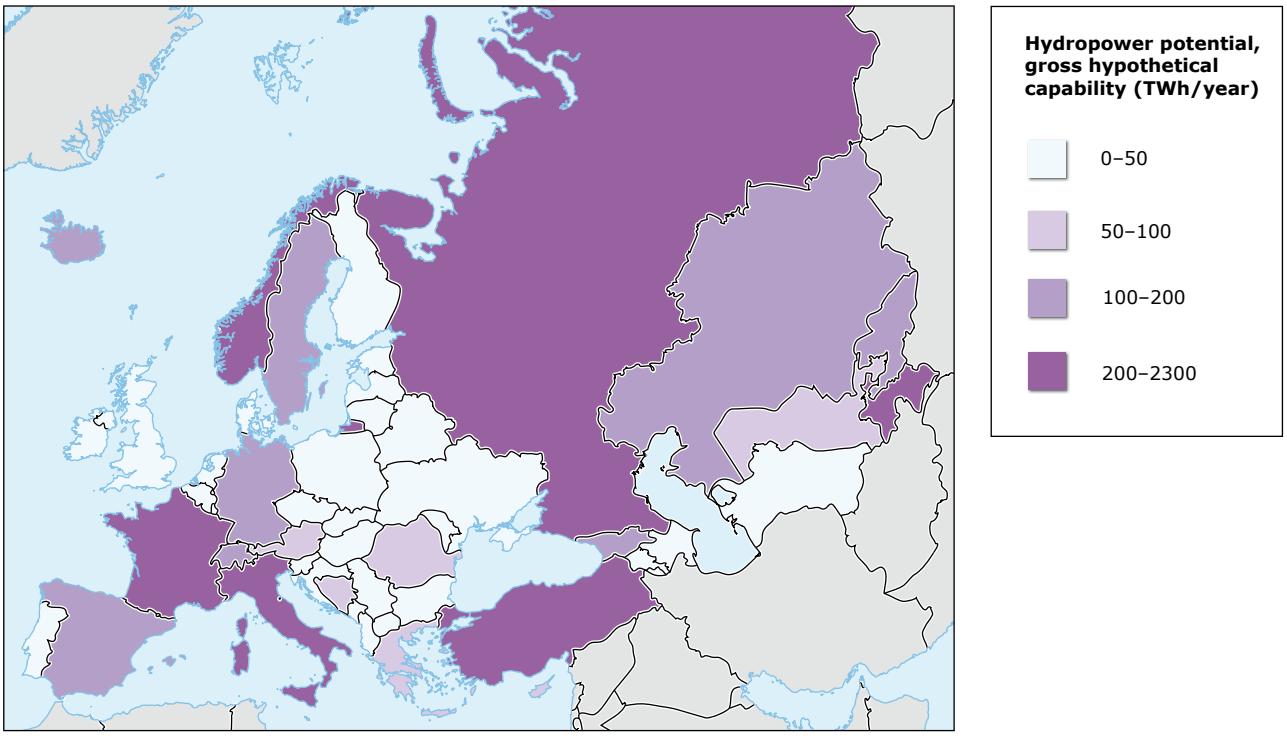
Resource use is expected to continue to increase in the coming years, both globally and across the pan-European region. Current trends project EU resource use, for example water withdrawals, energy consumption, and timber, to rise steadily to 2020. Several EECCA and SEE countries are also expected to see growing impacts from mining and production of basic metals and industrial minerals (EEA, 2007a). And although water management, energy efficiency and technology-based development are key future concerns, particularly in EECCA and SEE, considerable uncertainty remains about both the magnitude of the increase and the patterns of future natural resource use across the pan-European region (see, for example, Box 4.6).

An important reflection of where and how natural resources are used is given by land-use patterns. In the EU, agriculture covers almost 55 % of all land area: arable land and permanent crops account for almost one-third, while pastures and mosaic landscapes add more than 20 %. Overall, the area of agricultural land in the EU and across much of the pan-European region has decreased in recent decades although the management of remaining areas has intensified. In EECCA, parts of the EU-10

([15]) As measured by the Global Footprint Network (GFN) in the ecological footprint (WWF *et al.*, 2005), see www.footprintnetwork.org.
([16]) A global hectare is a hectare with a world-average ability to replenish resources and absorb wastes; note that the ecological footprint and biocapacity measures currently omit water availability and water withdrawals.
([17]) Figures for ecological footprint and biocapacity are given as global hectares per person (gha/p).

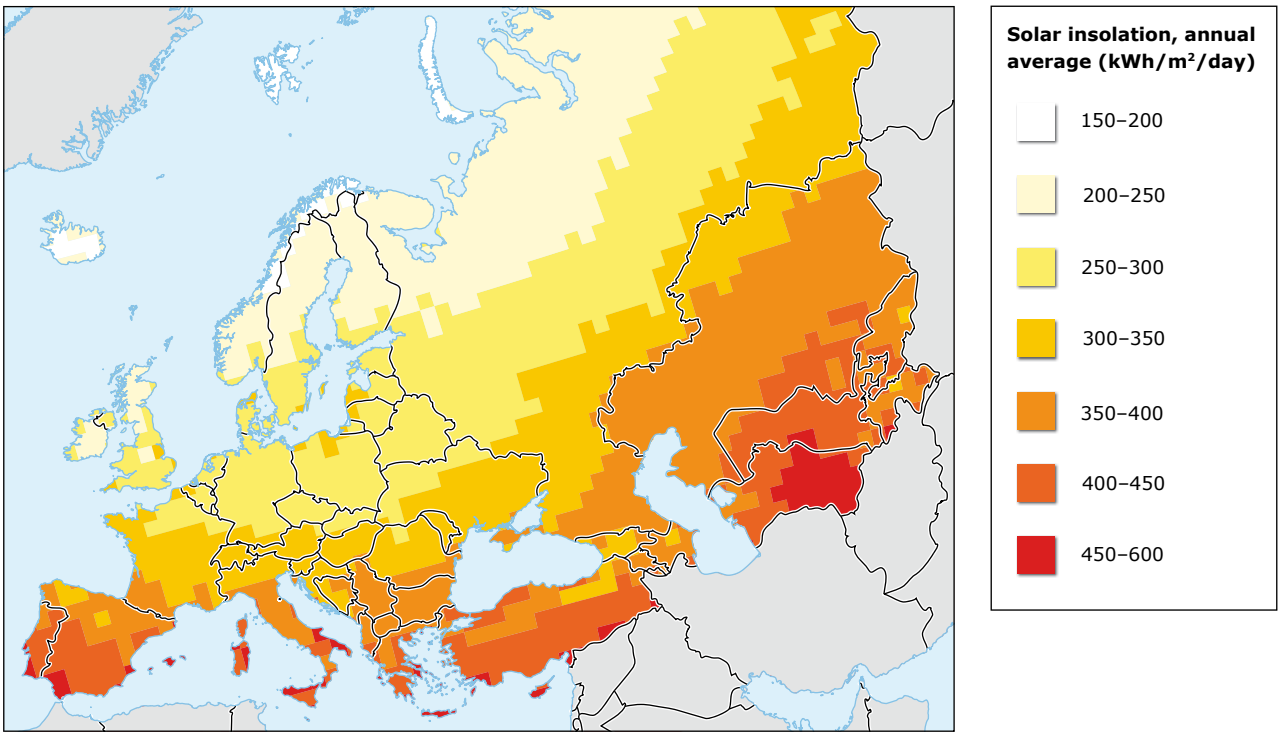
## Figure 4.10 Distribution of natural resources in the pan-European region for selected issues

**a) Hydropower potential, gross hypothetical capability**




**Source:** UNEP/GRID Arendal.

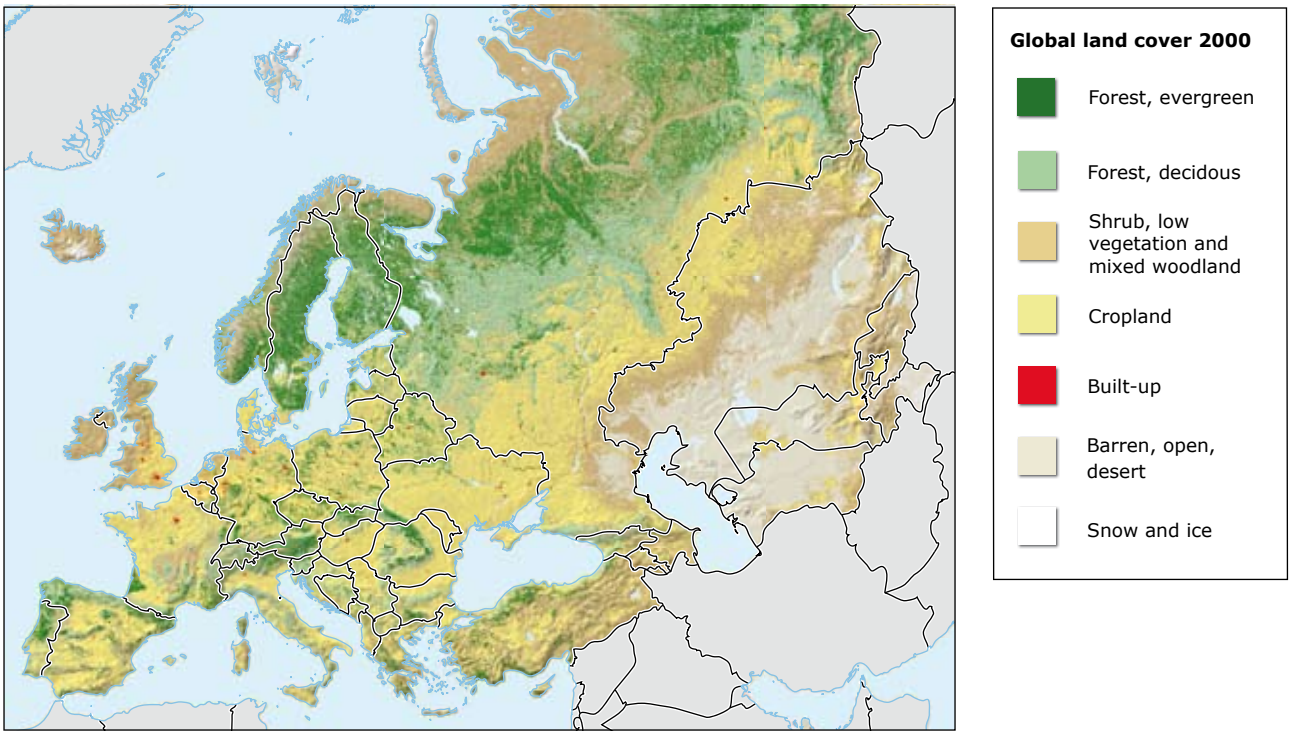
**b) Solar insolation, annual average**




**Source:** UNEP/GRID Arendal.

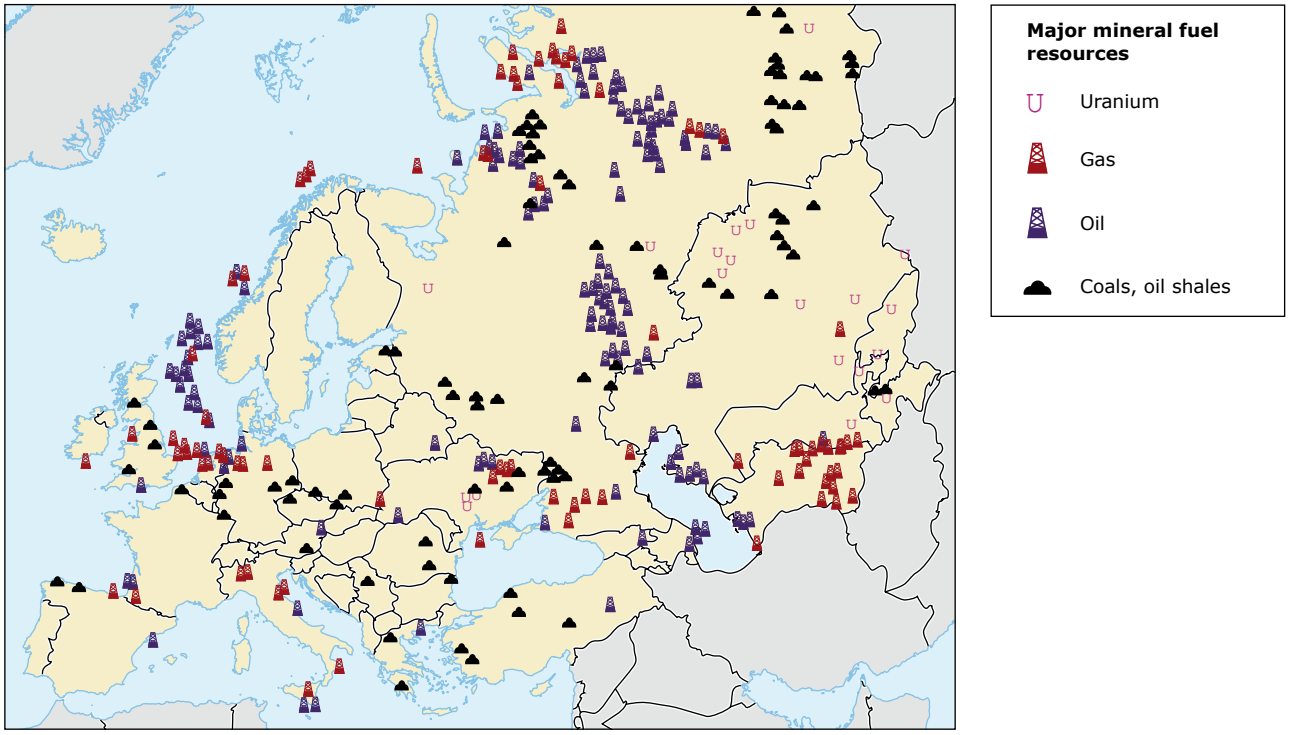
**Figure 4.10 Distribution of natural resources in the pan-European region for selected issues (contd)**

**c) Global land cover 2000**




**Source:** UNEP/GRID Arendal.

**d) Major mineral fuel resources**




**Source:** UNEP/GRID Arendal.

**Box 4.6 Scenarios of use of natural resources to 2050**

The WWF's Living Planet Report 2006 highlights that if we continue on our current trajectory, even optimistic United Nations projections with moderate increases in population, food and fibre consumption, and $CO_2$ emissions suggest that by 2050 humanity will demand resources at double the rate at which the Earth can generate them. This, and two other options are explored in three scenarios:

*Business-as-usual* — looks at the consequences if several moderate United Nations projections are combined. The increase in the footprint is driven by modest rates of growth in both population and demand for biocapacity. By 2050, the total ecological footprints of cropland and $CO_2$ increase by 60 %, the demand for grazing land and fishing grounds by 8 %, and the use of forests by 110 %.

*Slow-shift* — shows the results of a concerted effort to gradually bring humanity out of overshoot — i.e. a higher footprint than available biocapacity — by 2100, and establish a modest biocapacity buffer to slow biodiversity loss. To achieve this, global $CO_2$ emissions will have to be cut by 50 % by the end of the century and the harvest of wild fish needs to be reduced by 50 % in order to bring the total wild catch down to a potentially sustainable level. These, and other changes, combine to reduce the global ecological footprint in 2100 to 15 % below that in 2003.

*Rapid-reduction* — depicts an aggressive effort to move humanity out of overshoot by 2050. This scenario assumes a reduction in $CO_2$ emissions of 50 % by 2050 and 70 % by 2100. The absolute consumption of cropland and grazing land rises by only 15 % by 2100. Under median population projections, this requires a 23 % decrease in per person cropland and grazing land footprints. The rapid-reduction scenario results in humanity's footprint being 40 % smaller in 2100 than in 2003.

**Source:** WWF, 2006.

and SEE, privatisation and economic restructuring have led to land abandonment, greater rural poverty and emigration from rural areas. These two trends — intensification and abandonment — are currently unfolding side by side.

Several forces are bound to influence the future of land use and agriculture in the pan-European region, with both agricultural and environmental policies playing an important role. The EU has reformed its Common Agricultural Programme (CAP) to include rural development and environmental objectives, and further reforms are expected in the coming years. The future of EU agricultural policy is likely to affect SEE, where two countries are already Member States and others are candidate countries. In EECCA, the policy questions are more complex: in Central Asia, for example, the links between water management, agriculture and irrigation policies are key questions for the future. While some countries have improved their water management, international cooperation across the region is necessary.

However, the future of agriculture is only one of several key factors that drive the future of land use and landscapes across Europe. The EEA's PRELUDE project, for example, identified a series of driving forces of land-use change and developed a number of scenarios in which key uncertainties governing future land-use changes are explored (see Box 4.7). Besides the future role of policies in shaping land use, key uncertainties highlighted include demographic patterns (see Section 4.3), economic growth (see Section 4.4) and lifestyle changes, technological developments, use of bio-energy, and future feedbacks from environmental change to land use (EEA, 2007b).

Future technological development may also play an important role in determining demand for and type of future agricultural land (Rounsevell *et al.*, 2005). The next generation of genetically-modified organisms (GMO) crops, for example, may be more attractive: rather than merely providing pesticide resistance, they may also offer higher yields and increased nutrient values in food — and thus alter the future setting of agriculture. However, the use of GMOs is likely to be closely tied to public opinion and policy approval, which adds additional uncertainty. While the EU and many SEE countries currently closely regulate GMO crops, other countries in the pan-European region may decide to adopt them. Future availability and acceptance of GMOs are not the only technology-related uncertainties that need to be addressed in long-term agricultural outlooks: farming in the region may well become more professional and more knowledge-based in general — whether it employs GMO-based or other advances, or relies on organic production.

**Box 4.7 PRELUDE scenarios**

The European Environment Agency's PRELUDE project focused on possible changes in rural landscapes over the coming 30 years. The project developed five scenarios for the future which investigate both structural changes and a disruptive event that could shape the future of agriculture and landscapes.

*Europe of Contrasts (Great Escape Scenario)* — A future driven by financial competition. Agriculture becomes even more intensified and more land is abandoned. Agricultural intensification and urban sprawl change the rural landscape, and some nature reserves are lost.

*Europe of Harmony (Evolved Society Scenario)* — Following an energy crisis, a Europe of greater harmony evolves with a change in lifestyles, a return to rural living and community involvement. Agriculture is high-tech and at the same time increasingly organic. Overall farmland areas do not change greatly.

*Europe of Structure (Clustered Networks Scenario)* — The forces of globalisation, the needs of an ageing society and policies for strong land-use planning combine. While older rural communities struggle, new urban areas are developed in the countryside. Agriculture is marginalised, and many agriculture areas are abandoned. Natural habitats develop throughout the countryside, but high nature-value farmland largely disappears.

*Europe of Innovation (Lettuce Surprise U Scenario)* — A decentralised and high-tech Europe evolves following a major food security crisis. Agriculture is advanced but clean and relatively small-scale. Agricultural land area decreases, as do the sector's overall impacts: as a result, biodiversity, soil and water quality all improve.

*Europe of Cohesion (Big Crisis Scenario)* — Environmental disasters lead to strong, centralised policy responses. Agriculture reduces its surpluses and focuses on environmental stewardship. Soil, water and air quality improve.

**Source:** EEA, 2007b and www.eea.europa.eu/prelude.

The potential future demand and production of bioenergy also add uncertainties, and is closely related to the developments governing future energy and transport demand (see Section 4.5). Finally, climate change is expected to have a profound influence on agriculture and land use throughout the pan-European region, requiring agriculture and land use to adapt. Potentially, carbon sequestration in soils could offer new income opportunities to farmers throughout the region. While this could help address climate change, it could also bring new environmental pressures that would need to be well managed. But there are two certainties: the future of land use and agriculture will influence a range of environmental issues, and play an important role in how global environmental changes pan out.

Selected indicators:

- Total fertiliser consumption (Annex 3)
- Water withdrawals (Annex 2)

## 4.7 Global environmental change

Besides socio-economic developments, possible feedbacks from global environmental changes, driven themselves in part by Europe's socio-economic drivers, are also likely to influence the state of the pan-European environment in the coming decades. Key global environmental changes include climate change, biodiversity loss, changes in nutrient loading of inland waters and oceans, increasing water stress, and land degradation. In addition, global environmental change may have a profound impact on future migration patterns (see Section 4.3), economic development (see Section 4.4), consumption patterns (see Section 4.5) and land use (see Section 4.6).

Recent scientific findings confirm that global climate change is becoming a reality, and its impacts are already being seen around the world (see EEA, 2007a and IPCC, 2007a). Across the pan-European region, data show that annual average temperatures in 2005 were 1.4 °C higher than pre-industrial levels (EEA, 2007a). Already today, glaciers across the pan-European region, such as those in the Alps and Central Asia, have

retreated. And permafrost degradation is creating infrastructural problems and may exacerbate climate change by releasing large quantities of methane (UNEP/GRID Arendal, 2006).

Arctic ice cover is shrinking rapidly (see Box 4.9). The melting of snow and ice is expected to further accelerate climate change, as ice-free surfaces — land and sea alike — tend to have less solar reflection, and more heat is absorbed. Retreating northern ice caps may open new shipping routes, providing new opportunities for trade and transport (see Figure 4.11). Also, this may result in easier access to natural resources in the Arctic region. However, this could have considerable impact on a very fragile ecosystem: many plant and animal species adapted to the arctic climate are at risk of extinction (also due to invasive species and global warming). Either way, climate change is bound to change the way we think about the Arctic (ACIA, 2004; UNEP, 2007c).

Rainfall may increase in northern latitudes and in mountain areas in Central Asia over the coming decades, but decreases may occur elsewhere. In SEE, temperatures are expected to increase, especially in summer months; rainfall is projected to decrease in the summer in most parts of the region and when it does come, it could be more intense. In Northern Europe, summer temperatures in particular are expected to increase, with warm periods, including heat waves, expected to be more intense and more frequent. Western and Northern Europe may face increased chances of extreme precipitation events. Also, in many parts of EECCA, water scarcity is likely to increase.

In addition, the seasonal variation of river discharges — especially those fed by snow and ice melt — is likely to change, and this would have consequences for water availability in many pan-European river basins (EEA, 2007c). Meanwhile, water shortages could affect summer tourism in southern European countries, as warmer summers in northern countries make them more enticing holiday destinations.

Significantly, EEA's *Europe's environment — The fourth assessment* concludes that, even if global emissions of GHGs were immediately and drastically reduced, the impacts of climate change are still projected be felt (EEA, 2007a). However, several important uncertainties remain that will affect how climate change and other global environmental changes play out in the coming decades.

A first uncertainty concerns international governance: the concerted policy actions that will be taken, notably global agreements on GHG emissions and biodiversity. Also, at an institutional scale, the future role of global organisations is unclear. Indeed, the issue of who should oversee and coordinate international environmental policy development remains somewhat open; several recent international assessments explored different approaches to addressing environmental concerns and questioned whether we should rely on the power of markets or task international policy to take the lead on these matters (see, for example, Box 4.8).

The expected severity of climate change impacts is a second uncertainty: according to the IPCC, this 'will

**Box 4.8 UNEP's Global Environment Outlook (GEO) scenarios**

GEO emphasizes that the next 30 years will be as important as the past 30 for shaping the future of our environment. It develops and analyses four scenarios to explore what the future could be, depending on fundamentally different approaches to policy-making. The scenarios span developments in many overlapping and interlinked areas, including population, economics, technology and governance.

*Markets First* — The Markets First scenario envisages a world which adopts the market-driven values and expectations that prevail in industrialised countries, with the powers of the state to regulate society, the economy and the environment becoming overwhelmed by expanding demands.

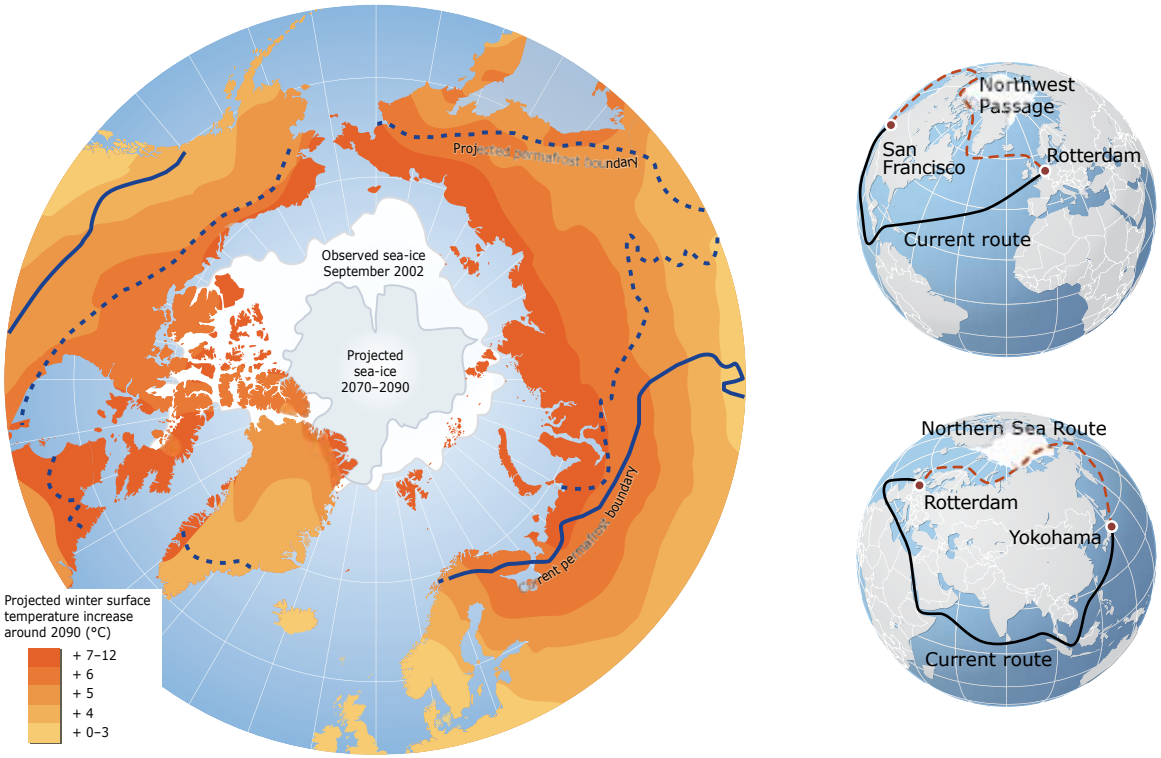
*Policy First* — In a Policy First world, strong actions are undertaken by governments in an attempt to reach specific social and environmental goals.

*Security First* — This scenario assumes a world of great disparities, where inequality and conflict prevail, brought about by socio-economic and environmental stresses.

*Sustainability First* — Pictures a world in which a new development paradigm emerges in response to the challenge of sustainability, supported by new, more equitable values in which consensus is reached on what needs to be done to satisfy basic needs and realise personal goals without beggaring others or spoiling the outlook for posterity.

**Source:** UNEP, 2002.

**Figure 4.11 Climate change in the Arctic: projected changes in sea ice and permafrost boundary due to climate change, 2000 to 2090; and possible future alternative shipping routes**




**Source:** UNEP/GRID Arendal (based on Arctic Climate Impact Assessment (ACIA), 2004 (left); UNEP, 2007c (right)).

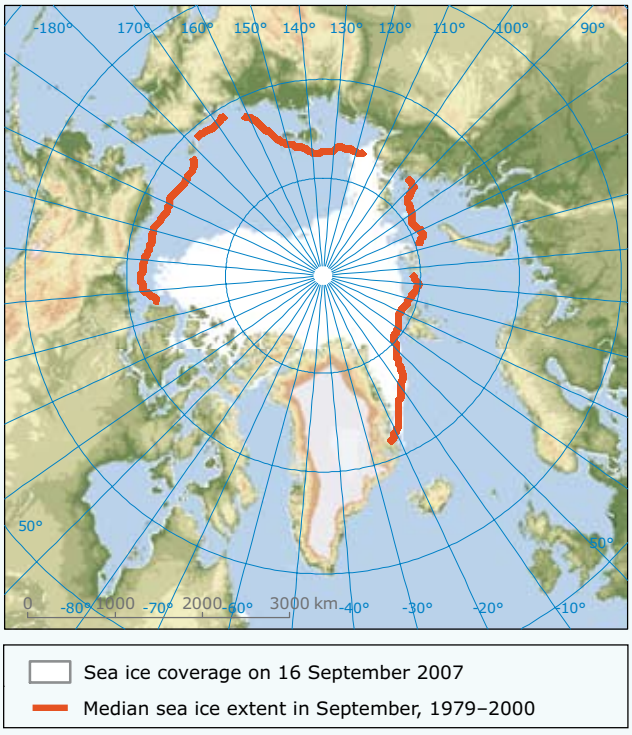
### Box 4.9 Arctic ice cover in September 2007

The European Space Agency reports that 'the area covered by sea ice in the Arctic has shrunk in September 2007 to its lowest level since satellite measurements began nearly 30 years ago, opening the Northwest Passage — a long-sought short-cut between Europe and Asia' (www.esa.int).

While several recent assessments have projected sea-ice to shrink considerably (see, for example, Figure 4.11), the melting observed over the last few years has exceeded most existing projections significantly.

Some uncertainty regarding the underlying processes remains: much of the debate now centres around the role of feedback mechanisms, such as the increased heat-uptake by the ocean as sea-ice retreats, or the climatic effects of a thinner ice layer. Also, the issue whether the melting of the ice cover has critical thresholds or 'tipping points' remains unresolved.

Thus, these new data raise concerns that the Arctic ocean might be free of ice (during summers) sooner than projected only a few years ago.




**Source:** Based on data from Spreen *et al.*, 2007; and data from the National Snow and Ice Data Center (http://nsidc.org).

**Box 4.10 Millennium Ecosystem Assessment scenarios: biodiversity and economic growth**

The *Millennium Ecosystem Assessment* developed four scenarios to explore possible futures for ecosystems and well-being at the global scale. The scenarios combine both narrative and simulation approaches. In all the scenarios, there is biodiversity loss, but this varies across the four — along with the results for human well-being.

*Order from strength* — This scenario depicts a world focused on security and protection, fragmented on a regional basis. Ecosystem problems are dealt with on a reactive basis. Of the four scenarios, in this one economic growth is the lowest (annual incomes reach just USD 6 000 per capita in EECCA in 2050) while population growth and biodiversity loss are the highest.

*Global orchestration* — A global society that focuses on trade and economic liberalisation. Economic growth is strong (EECCA income reaches USD 15 000 per capita by 2050). While steps are taken to reduce poverty and inequality, ecosystem problems are dealt with on a reactive basis.

*Adapting mosaic* — Regional, watershed-scale ecosystems are the focus of political and economic activity. Power shifts to local institutions, many of which take the lead for ecosystem management. Economic growth rates are low, but increase with time; population is nearly as high as the Order from strength scenario.

*TechnoGarden* — This globally-connected world relies on environmentally sound technology. There is strong attention to ecosystem problems — often using highly managed, engineered ecosystems to provide services. Economic growth is high, population is in the mid-range of the four scenarios and biodiversity loss is low.

Land-use changes are expected to have the largest impact on biodiversity in all the scenarios, followed by climate change (a threat in particular for river ecosystems) and nitrogen deposition.

**Source:** MA, 2005b.

vary with the amount and timing of climate change and, in some cases, the capacity to adapt' (IPCC, 2007b).

A third uncertainty highlighted by the IPCC is adaptation: 'A wide array of adaptation options is available, but more extensive adaptation than is currently occurring is required to reduce vulnerability to future climate change. There are barriers, limits and costs, but these are not fully understood' (IPCC, 2007b).

Meanwhile, the *Millennium Ecosystem Assessment* warns that, while economic well-being has often improved, humans have drastically reduced ecosystems and biodiversity around the world. The assessment warns that 'the degradation of ecosystem services could grow significantly worse during the first half of this century' (MA, 2005a). The loss of biodiversity and ecosystem services continues at both global and European levels. A variety of pressures, from urban sprawl to the abandonment of extensive, high-nature-value farming, is reducing biodiversity in Europe. In addition, the number of invasive alien species in Europe, as elsewhere, continues to increase (EEA, 2007a). The future of biodiversity is closely linked to that of land use and development — and also to climate change.

The loss of biodiversity threatens ecosystem services that benefit people around the world, ranging from fishery resources to freshwater and natural hazard regulation, such as watershed protection. Ecosystems provide nutrient cycling necessary for agriculture and forestry, while in many parts of the pan-European region, including SEE, the Caucasus and Central Asia, natural biodiversity includes genetic resources for commercial crops such as wheat and fruit. Biodiversity also provides less tangible cultural services across the region; not only for recreation and tourism, but also historical and spiritual benefits as well as a sense of regional and national identity. The *Millennium Ecosystem Assessment* developed a series of global scenarios for ecosystems highlighting the level of globalisation and the type of policy approaches as the main uncertainties (see Box 4.10).

Selected indicators:

- Greenhouse gas emissions (Annex 3)
- Projection of temperature changes (Annex 2)
- Projection of precipitation changes (Annex 2)
- Mean species abundance (Annex 2)
- Water withdrawals (Annex 2)

# 5 Some reflections on dealing with uncertainty

## 5.1 Glimpsing into an uncertain future

The previous sections provide a number of glimpses into the future of the environment in the pan-European region. Based on the available literature and forward-looking studies, they discuss selected environmental outlooks and highlighted some of the related uncertainties. The overview given, however, is brief and far from exhaustive. Nevertheless, it illustrates quite clearly the diversity of plausible future scenarios that we can discern today — and demonstrates the inherent uncertainty in forecasting long-term changes within complex socio-economic, technological and environmental systems.

For some areas, future developments seem somewhat less uncertain and some issues and possible future pathways are better understood than for others. In particular, for those issues with relatively simple and well-understood cause-effect relationships, we might dare to forecast future changes. Also for those issues that are subject to considerable delays between the unfolding of the underlying driving forces and the resulting changes, we can construct projections with some confidence. Prominent examples of this type of issues are demographic projections, which can be firmly based on current fertility and mortality rates, and thus allow the forecasting of demographic patterns up to a generation ahead with some confidence ([18]). However, even demographic projections are not entirely certain, as future trends may easily be entirely upset by sudden discontinuities or surprising events.

However, for most environmental issues, future changes are much more difficult to determine, and often depend heavily on how the driving forces of socio-economic systems unfold and how society responds to environmental challenges in the years to come. In earlier reviews, three distinct sources of indeterminacy have been identified: ignorance, surprise, and volition (Raskin *et al.*, 2002). Ignorance here refers to limits of scientific knowledge of current conditions and system dynamics. Surprise is the uncertainty due to the inherent unpredictability of complex systems, which can exhibit emergent phenomena and structural shifts. Volition refers to the inevitable uncertainty that is introduced when human actors are internal to the system under study, i.e. when the future is subject to human choices that have not yet been made (MA, 2005b).

Generally speaking, multi-causal or complex systems are considerably more prone to indeterminism than mono-causal or linear systems. As a result, uncertainty seems to be greater for some environmental concerns, such as biodiversity loss than for others, such as ozone depletion. Nevertheless, the three principal sources of indeterminacy listed above complicate forward-looking assessments on virtually every environmental issue.

Thus, in order to overcome the complexity and uncertainty in the discussion of any future pathway (especially when looking more than just a few years ahead), modern forward-looking assessments commonly build on developing and analysing multiple futures. Indeed, this report shows that a wide range of future studies have become available for the pan-European region during the last few years — to this extent, this report's findings complement those of earlier reports such as reviews focusing on global-level studies or Western Europe (see, for example, EEA 2000 or EEA, 2001a).

Despite the growing number of forward-looking studies that are available across the region, it should be stressed that very few of these have taken environmental concerns as their entry point, and even fewer assess plausible environmental futures in an integrated manner. There are examples of such integrated forward-looking environmental assessments for parts of Europe, often using land use, such as PRELUDE (EEA, 2007b) and EURuralis (WUR *et al.*, 2007), or air emissions such as the

([18]) An exception to this are projections of migration, which can only be made with lower degrees of confidence.

'Clean Air for Europe' initiative (i.e. EEA, 2005b) as entry points. However, across the region there remains a lack of integrated forward-looking studies — particular for a range of complex issues such as consumption patterns, climate change adaptation and ecosystem services.

## 5.2 Using forward-looking studies

Responding to environmental challenges across the pan-European region in a robust manner requires a clear understanding of the uncertainties that surround our outlooks on future developments. This report has highlighted just a selection of the many formidable uncertainties that complicate robust planning and strategising. As highlighted above, several different approaches exist to help structure our thinking about plausible future developments and related uncertainties. Chapter 2 introduced scenario-based assessment as an example of such forward-looking approaches, and distinguished projections from more explorative scenarios. The factors that govern which of these approaches is best suited to analyse a specific issue include the degree of uncertainty that needs to be accounted for, the complexity of the system underlying the respective issue, and — not least — the purpose of the assessment at hand.

Forward-looking studies can serve a range of purposes, and have been used within the realms of science and research, in the area of education and information, and to support strategic planning and decision-making by providing a platform for thinking through the implications of various options and decision pathways. In the context of the last of these, in particular, projections and more explorative scenario studies have different roles to play: projections allow the development of reference scenarios when uncertainty about future developments is relatively low. Such projections can provide a clear frame for decisions, and a back-drop against which different policy options can be tested. Conversely, approaches such as scenario analysis, which allow thinking through a wider range of alternative pathways, are well suited to informing strategic discussion about future options, especially where uncertainty about a possible future decision-context ([19]) is high — and in particular when looking at longer term developments.

Indeed, scenario-based studies help thinking about timescales beyond one or two legislative periods — which is necessary where key trends can change significantly in the medium- to long-term — and to broaden our view considerably — which is necessary as discontinuities or surprises are bound to alter current trends. Long-term scenarios help to create a common language and a platform for different communities to jointly discuss and learn about complex problems and the uncertainties that surround them. Also, scenario-based planning approaches allow for more profound and integrated stakeholder participation in strategic development processes as they allow the voicing of conflicting opinions and world views. A wide participation during the development of scenarios can bring together a multitude of perspectives and expertise to enhance the information basis, relevance and originality. Generally speaking, involving a wide range of stakeholders in the scenario development process can thus greatly enhance the credibility and legitimacy of scenarios developed as decision support tools (EEA, 2007b).

In the past, forward-looking assessments of all sorts have helped decision-makers respond to both short-term and long-term environmental concerns. In particular in the area of climate change, both projections and explorative scenario studies have helped to structure our understanding of the challenges ahead, and to think through the implications of different emission pathways or energy systems. Also in other fields, future studies have provided the basis for decisions — albeit often less obviously so. It is impossible to arrive at projections that eliminate uncertainty about future trends entirely. For most issues this would require invoking certainties about future prospects that we do not and, arguably, cannot have. And even where we might have reasonable confidence in existing projections, there is still a good chance that the 'real future' will differ from any forecast we make today. However, this need not paralyse us into inaction; instead, we need to ensure that we arrive at robust decisons by reflecting on prevailing trends and uncertainties in a structured manner.

([19]) The decision-context is usually outside the immediate sphere of influence of a specific decision-unit (be it an individual, a company, an organisation or even a country), yet it sets the boundary conditions against which any decision will be taken (Zurek and Henrichs, 2007).

# 6 Concluding remarks

Recent assessments of the state of, trends in and prospects for our environment show increasing concern about unfolding environmental challenges in the pan-European region (EEA, 2005a, 2005b, 2007a; *inter alia*, see Annex 1). Many of these are expected to worsen considerably unless action is taken. Prominent examples highlighted in this report include climate change and biodiversity loss, as well as health risks posed by air, water and soil pollution or waste generation. In addition, there are other issues that give rise to mounting unease, such as the state of our marine environment and the outlook on transport or energy, water and food security. How these and other as yet unknown challenges may evolve over the course of the next 20 or 30 years will certainly depend on whether and how we react to counter or minimise them.

As most environmental issues are driven or affected by underlying socio-economic trends, the future prospects of political stability, economic trends, trade flows, use of natural resources, demographic structures or consumption patterns will all undoubtedly affect how environmental concerns play out. Thus the same uncertainties that complicate projecting socio-economic trends also hamper our ability to foresee environmental futures.

Recent forward-looking studies have nevertheless drawn attention to a number of overarching European and global uncertainties: How will globalisation and economic liberalisation develop over the next few decades? (MA, 2005, *inter alia*). Are we moving towards an age of continued global cooperation or is the underlying future theme self-reliance and regional independence? (IPCC, 2000, *inter alia*). To what degree will we rely on market forces, policy, security provisions or the principles sustainability to address environmental problems? (UNEP, 2002, *inter alia*). And will key environmental decisions be taken at the global, European, national or local scale? (EEA, 2007b, *inter alia*).

Forward-looking studies set out to explore such uncertainties in a structured manner. However, while a growing number of them have become available across the pan-European region, this report demonstrates that very few forward-looking studies have taken environmental concerns as their main point of analysis, and even fewer assess plausible environmental futures in an integrated manner. Furthermore, a lack of environmental indicators of future trends is apparent, in particular for priority issues such as those identified in the EEA's *Europe's Environment — The fourth assessment* (EEA, 2007a).

This lack of forward-looking indicators is especially evident in the areas of water quality, the state of biodiversity, the impacts of climate change and the use of natural resources. Some economic sectors, such as energy and transport, seem to be better covered than others, such as agriculture and tourism. However, even where outlooks and forward-looking indicators are available, they are not always well suited to evaluating the full dimension of the environmental issues at stake.

In general, responding to unfolding environmental challenges in a robust manner requires a clear understanding of the uncertainties that surround all outlooks on future developments. Therefore this report stresses the need to support policy processes with forward-looking assessments that address uncertainties in a systematic manner using appropriate approaches. While this need can be met in more than one way, among the most important approaches advocated here are the following.

- *By fostering well-designed and sound forward-looking assessments that integrate societal, technological, environmental, economic and demographic issues.* Such assessments are particularly useful where they are geared towards issues on the current policy agenda — for example adaptation to climate change, consumption patterns or ecosystem services — and address uncertainties and options for the future in a systematic way, using appropriate methodologies and techniques. To best support policy development, forward-looking assessments should be tailored

specifically to fit their respective objectives at the appropriate geographical scale, rather than merely borrowing or downscaling from ready-made assessments.

- *By adapting existing information systems to regularly capture data on emerging issues, and by including more forward-looking perspectives and projections in national environmental reporting*. The EEA's effort to capture available information within the EEA Indicator Management System (IMS) should provide analyses of the relevance of existing forward-looking indicators to policy issues, as well as assessments of the prevailing gaps in data availability and methodological approaches. A key aim of IMS is the routine inclusion of future perspectives in the regular environmental reporting mechanisms, complementing indicators on past trends with future perspectives.

- *By encouraging the active involvement of regional and national institutions in the development of forward-looking studies*. Most of the existing supranational studies, particularly those that cover EECCA and SEE countries, have been organised by international organisations, rather than regional or national entities. This often results in an emphasis on the wider international perspective, with rather general outcomes that can only contribute indirectly to specific policy processes. Thus, the involvement and leadership of regional and national institutions in carrying out forward-looking assessments is needed to increase both their regional and political relevance.

- *By increasing the expertise and resources available to build and carry out forward-looking studies — both at supra-national and national levels*. To this end, cooperation between countries and international organisations is vital to enabling the development of hands-on experience and sharing of best practice. The EEA, in cooperation with several of its member countries and other international organisations, has, for example, organised national and international workshops to improve institutional capacity among its partners.

In short, faced with complexities and uncertainties, we need to significantly strengthen institutional capacity at national, regional and international levels in order to produce the relevant, credible and scientifically sound forward-looking assessments that are sorely needed to support those who make environmental policies today.

# References


ACIA — Arctic Climate Impact Assessment, 2004. *Impacts of a warming Arctic*. Cambridge University Press, United Kingdom.

Amann, M.; Bertok, I.; Cofala, J.; Gyarfas, F.; Heyes, C.; Klimont, Z.; Schöpp, W.; Winiwarter, W. 2005a. *Baseline Scenarios for the Clean Air for Europe (CAFE) Programme*. International Institute for Applied Systems Analysis (IIASA).

Amann, M.; Bertok, I.; Cabala, R.; Cofala, J.; Heyes, C.; Gyarfas, F.; Klimont, Z.; Schöpp, W.; Wagner F., 2005b. *A further emission control scenario for the Clean Air For Europe (CAFE) programme*. CAFE Report No 7. International Institute for Applied Systems Analysis (IIASA). October 2005. http://www.iiasa.ac.at/rains/CAFE_files/CAFE-D28.pdf.

Belousov, A.R., 2005. *The Russian Long-Term Economic Trends: Russia's Economic Scenarios to 2020*, Centre for Macroeconomic Analysis & Short-Term Forecasting, Moscow. Available at: www.forecast.ru.

Benoit, G.; Comeau, A. (eds), 2005. *A sustainable future for the Mediterranean: the Blue Plan's environment and development outlook* (Méditerranée : les perspectives du Plan Bleu sur l'environnement et le développement). Earthscan, 450 p. Available at www.planbleu.org.

Economist Intelligence Unit, 2005. *Long-term prospects for the European transition economies and some implications for the tourism industry Laza Kekic*, Economist Intelligence Unit, Belgrade, 20 June 2005.

EEA — European Environment Agency, 2007a. *Europe's environment — The fourth assessment*. EEA, Copenhagen.

EEA — European Environment Agency, 2007b. *Land-use scenarios for Europe: Qualitative and quantitative analysis on a European scale*. EEA Technical report No 9/2007. EEA, Copenhagen.

EEA — European Environment Agency, 2007c. *Climate change and water adaptation issues*. EEA Technical report No 2/2007.

EEA — European Environment Agency, 2005a. *The European environment — State and outlook 2005*. EEA, Copenhagen.

EEA — European Environment Agency, 2005b. *European environment outlook*. EEA Report No 2/2005. EEA, Copenhagen.

EEA — European Environment Agency, 2001a. *Scenarios as tools for international environmental assessments*. EEA, Copenhagen.

EEA — European Environment Agency, 2001b. *Late lessons from early warnings: the precautionary principle 1896–2000*. EEA, Copenhagen.

EEA — European Environment Agency, 2000. *Cloudy crystal balls: An assessment of recent European and global scenario studies and models*. EEA, Copenhagen.

EEA — European Environment Agency, 1995. *Europe's environment*. EEA, Copenhagen.

EEA/ETC-RWM — European Environment Agency/ European Topic Centre for Resource and Waste Management, 2007. *Projection of municipal waste for selected EECCA countries*. Copenhagen.

EECCA Strategy — Environmental partnerships in the UNECE region: Environment strategy for countries of Eastern Europe, Caucasus and Central Asia (submitted by the Steering Group on Environment Strategy for countries of Eastern Europe, Caucasus and Central Asia through the Ad Hoc Working Group of Senior Officials at the Fifth Ministerial conference, Kiev, Ukraine, 21–23 May 2003).

EMEP, 2005. Emission Data reported to LRTAP Convention and NEC Directive, Initial review for HMs and POPs (by V. Vestreng; K. Breivik; M. Adams; A. Wagner; J. Goodwin; O. Rozovskaya; J. M. Pacyna). MSC-W Technical Report 1/05.

Erzan, R.; Kuzubas, U.; and Yildiz, N., 2004. *Growth and Immigration Scenarios for Turkey and the EU*,

EU-Turkey Working Papers, No. 13/December, Centre for European Policy Studies, Brussels. Available at www.ceps.be.

Eurostat 2005. *Eurostat News release 48/2005*, Luxemburg, 8 April 2005.

FAO — United Nations Food and Agriculture Organization, 2003. *World Agriculture: Towards 2015/2030 — A FAO Perspective*. FAO, Rome.

FAPRI — Food and Agricultural Policy Research Institute, 2005. *U.S. and World Agricultural Outlook*, Food and Agricultural Policy Research Institute, Iowa State University and the University of Missouri-Columbia.

IEA — International Energy Agency, 2006. *World Energy Outlook 2006*. IEA, Paris.

IEA — International Energy Agency, 2007. Renewables by country/region (country profiles). Available at www.iea.org/textbase/stats/prodresult.asp?PRODUCT=Renewables.

IIASA — International Institute for Applied Systems Analysis, 2004. *Emission, Scenario: CP_CLE_Aug04* (November 2004). www.iiasa.ac.at/web-apps/apd/RainsWeb/.

Internet World Stats, 2007. Internet World Stats: Usage and Population Statistics. Miniwatts Marketing Group. (see www.internetworldstats.com, cited data, accessed in April 2007).

IPCC — Intergovernmental Panel for Climate Change, 2007a. *Climate Change — Fourth Assessment Report*.

IPCC — Intergovernmental Panel on Climate Change, 2007b. *Working Panel II: Climate Change 2007: Impacts, Adaptation and Vulnerability* (Summary for Policy-makers), 13 April 2007.

IPCC — Intergovernmental Panel for Climate Change, 2000. *Special Report on Emission Scenarios*.

IUCN (International Union for Nature Conservation), 2006a. *IUCN 2006 Red List of threatened species*. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, the United Kingdom.

Lehner, B.; Czisch, G.; Vassolo, S., 2005. The impact of global change on the hydropower potential of Europe: A model-based analysis. *Energy Policy*, 33, 839–855.

Lehner, B.; Henrichs, T.; Doll, P.; Alcamo, J., 2001. *Eurowasser — Model-based assessment of European water resources and hydrology in the face of global change*. Kassel World Water Series Report No 5. University of Kassel, Kassel.

Kristensen, P., 2004. Household consumption of food and drinks. Background paper for the European Environment Agency. Danish National Environmental Research Institute, Roskilde.

MA — Millennium Ecosystem Assessment, 2005a. *Ecosystems and human well-being: Synthesis*. Island Press, Washington DC, USA.

MA — Millennium Ecosystem Assessment, 2005b. Ecosystems and human well-being: Scenarios, Volume 2. Island Press, Washington DC, United States.

MNP — Netherlands Environment Assessment Agency, 2006. *Cross-roads of Planet's Earth's Life — Exploring means to meet the 2010 biodiversity target*. MNP report 555050001/2006, Bilthoven.

OECD — Organisation for Economic Cooperation and Development, 2007a. *Going For Results — Progress in Environmental Management in Eastern Europe, Caucasus and Central Asia*. OECD/EAP Task Force — ENV/EPOC/EAP(2007)1/PROV.

OECD — Organisation for Economic Cooperation and Development, 2007b. *OECD Environment Outlook* (Analysis of environmental pressures and impacts of the baseline for the second OECD Environmental Outlook as developed by the Netherlands Environmental Assessment Agency, 2006).

OECD — Organisation for Economic Cooperation and Development, 2006. *Live longer, work longer*, OECD, February 2006. Available at www.oecd.org/dataoecd/32/50/36218997.pdf.

Omasov M. N. (editor), 2005. *Kyrgyzstan 2025 — Strategies and Development Scenarios*. International Institute for Strategic Studies under President of the Kyrgyz Republic and the Friedrich Ebert Foundation. Available at www.fes.uz/Country/kg.htm.

Raskin, P.; Banuri, T.; Gallopın, G.; Gutman, P.; Hammond, A.; Kates, R.; Swart, R., 2002. *Great Transition: The Promise and Lure of the Times Ahead*. SEI-B/Tellus Institute, Boston. Available at www.tellus.org/seib/publications/Great_Transitions.pdf.

Rounsevell *et al*., 2005. *Future scenarios of European agricultural land use*. I. Estimating changes in crop productivity, Agriculture, Ecosystems and Environment Vol. 107, No. 2/3.

Shell, 2005. *Shell Global Scenarios to 2025: Executive Summary and Excerpts*. Shell International Limited.

Skovgaard, M.; Moll, S.; Møller Andersen, F.; Larsen, H., 2005. Outlook for waste and material flows — Baseline and alternative scenarios. ETC/RWM working paper 2005/1, European Topic Centre on Resource and Waste Management: Copenhagen. http://waste.eionet.eu.int/publications/wp1_2005.

Spreen, G.; Kaleschke, L. and Heygster, G., 2007. Sea ice remote sensing using AMSR-E 89 GHz channels, *J. Geophys. Res*., doi:10.1029/2005JC003384 (data available at http://iup.physik.uni-bremen.de:8084/amsr/amsre.html).

UNDP — United Nations Development Programme, 2007. *Environmental Policy in South East Europe*.

UNDP — United Nations Development Programme, 2006. *Human Development Report 2006*. UNDP, New York, USA.

UNECE/UNESCAP, 2004. *Strengthening co-operation for rational and efficient use of water and energy resources in Central Asia*. Available at www.unece.org or www.unescap.org.

UNEP — United Nations Environment Programme, 2007a. Global Environment Outlook 4 (in press).

UNEP — United Nations Environment Programme, 2007b. Carpathians Environment Outlook (in preparation).

UNEP — United Nations Environment Programme, 2007c. *Global Outlook for Ice and Snow*. UNEP, Nairobi.

UNEP — United Nations Environment Programme, 2002. *Global Environment Outlook 2*. Earthscan Publications Ltd., London.

UNEP/GRID Arendal, 2006. *Planet in Peril: An Atlas of Current Threats to People and the Environment*. Earthprint. Available www.grida.no/products.aspx?m=23&amid=140.

United Nations Population Division, 2007. Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, *World Population Prospects: The 2006 Revision and World Urbanization Prospects: The 2005 Revision.* Available at http://esa.un.org/unpp.

US National Intelligence Council, 2004. Project, Global Trends 2020, Workshop, Budapest, 25–27 April 2004. Available at www.cia.gov/nic (The views expressed are those of individual participants. They are posted for discussion purposes only and do not represent the views of the U.S. Government).

WBCSD — World Business Council for Sustainable Development, 2004. *The Sustainable Mobility Project 2030*. Available at /www.wbcsd.org/DocRoot/D4x4mJCw0t7TFqTwpwtA/WBSCD4pp_English.pdf.

WCED — World Commission on Environment and Development, 1987. *Our common future*. Oxford University Press, Oxford, the United Kingdom.

World Bank, 2006. *Migration and Remittances: Eastern Europe and the Former Soviet Union*. World Bank, Washington DC, USA.

World Tourism Organization, 2001. *Tourism 2020 Vision: Global Forecast and Profiles of Segments*. World Tourism Organization.

WTO — World Trade Organization, 2006. *International Trade Statistics 2006*. WTO Publications, Geneva, Switzerland.

WUR (Wageningen UR), MNP (Dutch environmental assessment agency), LEI (Agricultural Economics Institute, The Hague), 2007. *EURuralis*. Available at www.eururalis.nl.

WWF International, Global Footprint Network and Netherlands Committee for the World Conservation Union (NC-IUCN), 2005. *Europe 2005: The Ecological Footprint*. WWF Gland, Switzerland.

WWF — Worldwide Fund for Nature, 2006. *Living Planet Report 2006*. WWF International, Gland, Switzerland.

Zurek, M.; Henrichs, T., 2007. Linking scenarios across geographical scales in international environmental assessments. *Technological Forecasting and Social Change*.

# Annex 1 Overview of forward-looking studies in the pan-European region

An EEA literature review identified nearly 300 recent, forward-looking studies of relevance to the pan-European region. The review, which was not exhaustive (it was carried out in 2006, included studies in English, Russian and South Eastern European national languages only, and focused on public studies), indicated that this is a rich area of work, but one with many gaps and needs for further work. The literature review included future studies at the global level with relevance for the pan-European region, as well as studies that cover only part of the region. It focused on future studies that are directly relevant to the environment, sustainable development, transport and energy — thus there could well be further studies that the review did not identify, especially studies at the national level or in other languages other than Russian and English. A more detailed review focused on national-level studies in the SEE region and in any of the region's national languages. However, these country-related studies (around 100) are not presented in this annex. A comprehensive overview of all studies identified is available on the EEA website (www.eea.europa.eu/themes/scenarios).

**Table A 1.1 The pan-European region, sub-regions and countries**

| Region (group) | Sub-groups | | Countries |
|---|---|---|---|
| Western and Central Europe (WCE) | EU-25 | EU-15 | Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Ireland (IE), Italy (IT), Luxembourg (LU), Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE), United Kingdom (UK) |
| | | EU-10 | Cyprus (CY), Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Malta (MT), Poland (PL), Slovakia (SK), Slovenia (SI) |
| | European Free Trade Association (EFTA) | | Iceland (IS), Liechtenstein (LI), Norway (NO), Switzerland (CH) |
| | Other WCE countries | | Andorra (AD), Monaco (MC), San Marino (SM) |
| EECCA countries | Caucasus | | Armenia (AM), Azerbaijan (AZ), Georgia (GE) |
| | Central Asia | | Kazakhstan (KZ), Kyrgyzstan (KG), Tajikistan (TJ), Turkmenistan (TM), Uzbekistan (UZ) |
| | Eastern Europe | | Belarus (BY), Republic of Moldova (MD), Russian Federation (RU), Ukraine (UA) |
| South Eastern Europe (SEE) | Western Balkans | | Albania (AL), Bosnia-Herzegovina (BA), Croatia (HR), The Former Yugoslav Republic of Macedonia (MK), Serbia (RS), Montenegro (ME) |
| | Other SEE countries | | Bulgaria (BG)*, Romania (RO)*, Turkey (TR) |

**Note:** * Bulgaria and Romania joined the European Union on 1 January 2007.

## A — Global scale studies

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| Asian economic crisis and the long-term global food situation | Rosegrant and Ringler, 2000 (IFPRI — www.ifpri.org) | Agriculture | Global | 2020 |
| 2020 Global Food Outlook: trends, alternatives and choices | Rosegrant *et al*., 2000 (IFPRI — www.ifpri.org) | Agriculture | Global | 2020 |
| Prospects for global food security: a critical appraisal of past projections and predictions | McCalla and Revorendo, 2001 (IFPRI — www.ifpri.org) | Agriculture | Global | 2020 |
| The Unfinished Agenda: Perspectives on Overcoming Hunger, Poverty, and Environmental Degradation | Pinstrup-Andersen and Pandya-Lorch (eds.), 2001 (IFPRI — www.ifpri.org) | Agriculture | Global | 2020 (2030, 2050) |
| Global Food Projections to 2020: Emerging Trends and Alternative Futures | Rosegrant *et al*., 2001 (IFPRI — www.ifpri.org) | Agriculture | Global | 2020 |
| World Agriculture: Towards 2015/2030. An FAO perspective | FAO, 2003 (FAO — www.fao.org) | Agriculture | Global | 2015, 2030 |
| New Risks and Opportunities for Food Security: Scenario Analyses for 2015 and 2050 | Von Braun *et al*., 2005 (IFPRI — www.ifpri.org) | Agriculture | Global | 2015, 2030 |
| OECD Agricultural Outlook: 2005–2014 | OECD, 2005 (OECD — www.oecd.org; FAO — www.fao.org) | Agriculture | Global | 2014 |
| International Assessment of Agricultural Science and Technology for Development (the AgAssessment) | World Bank, 2008 (forthcoming) (The World Bank — www.worldbank.org) | Agriculture | Global | 2050 |
| Reaching Sustainable Food Security for All by 2020: Getting the Priorities and Responsibilities Right | IFPRI, 2002 (IFPRI — www.ifpri.org) | Agriculture; Environment | Global | 2020 |
| IPCC Special Report — Emissions Scenarios | IPCC, 2000 (Intergovernmental Panel on Climate Change — www.ipcc.ch) | Climate change | Global | 2020, 2050, 2100 |
| Analysis of Post-2012 Climate Policy Scenarios with Limited Participation | Russ *et al*., 2005 (Institute for Prospective Technological Studies — www.jrc.es) | Climate change | Global | Beyond 2012 |
| Scenarios of World Anthropogenic Emissions of Air Pollutants and Methane up to 2030 | Cofala *et al*., 2005 (International Institute for Applied Systems Analysis — www.iiasa.ac.at) | Climate change | Global | 2030 |
| Climate Change 2007: The Physical Basis of Climate Change | IPCC, 2007 (Intergovernmental Panel on Climate Change — www.ipcc.ch) | Climate change | Global | 2100 |
| Climate Change 2007: Mitigation of Climate Change | IPCC, 2007 (Intergovernmental Panel on Climate Change — www.ipcc.ch) | Climate change | Global | 2030, 2100 |
| Climate Change 2007: Impacts, Adaptation and Vulnerability | IPCC, 2007 (Intergovernmental Panel on Climate Change — www.ipcc.ch) | Climate change | Global | 2030, 2100 |
| Fourth Assessment Report (AR4) | IPCC, 2007 (Intergovernmental Panel on Climate Change — www.ipcc.ch) | Climate change | Global | – |
| Population and Scenarios: Worlds to Win? | Hilderink, 2004 (MNP/RIVM — www.mnp.nl/en/index.html) | Demography | Global | 2100 |
| World Population Prospects: 2006 Revision | UN Population Division, 2007 (UN Department of Economic & Social Affairs — www.un.org/esa) | Demography | Global | 2100 |

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| The Future of the Global Economy: Towards a Long Boom? | OECD, 2000<br>(OECD — www.oecd.org) | Economy | Global | 2020, 2030 |
| Global Economic Prospects — Managing the next wave of globalization | World Bank, 2007<br>(The World Bank — www.worldbank.org) | Economy | Global | 2030 |
| Projected Costs of Generating Electricity — 2005 Update | EIA/OECD, 2005<br>(EIA — www.iea.org; OECD — www.oecd.org) | Energy | Global | 2050 |
| World Energy Outlook 2005 Edition — Middle East and North Africa Insights | IEA/OECD, 2005<br>(IEA — www.iea.org; report available at www.worldenergyoutlook.org) | Energy | Global | 2010, 2020, 2030 |
| World Energy Outlook 2006 | IEA, 2006<br>(IEA — www.iea.org; report available at www.worldenergyoutlook.org) | Energy | Global | 2030 |
| World Energy Outlook 2007 Edition — China and India Insight | IEA, 2007 (forthcoming)<br>(IEA — www.iea.org; report available at www.worldenergyoutlook.org) | Energy | Global | 2030 |
| World energy, technology and climate policy outlook — WETO 2030 | European Commission, 2003<br>(European Commission — http://ec.europa.eu/index_en.htm) | Energy & Climate change | Global | 2030 |
| Development of a model of the World Refining for the POLES model: the OURSE model | Lantz *et al*., 2005<br>(Institute for Prospective Technological Studies — www.jrc.es) | Energy & Climate change | Global | 2020 |
| Pathways to 2050 — Energy and Climate Change | WBCSD, 2005<br>(World Business Council Sustainable Development — www.wbcsd.ch) | Energy & Climate change | Global | 2050 |
| International Energy Outlook 2007 | US EIA, 2007 (forthcoming)<br>(US Energy Information Administration — www.eia.doe.gov) | Energy & Climate change | Global | 2030 |
| Energy to 2050: Scenarios for a Sustainable Future | IEA/OECD, 2003<br>(IEA — www.iea.org; OECD — www.oecd.org) | Energy; Environment | Global | 2050 |
| OECD Environmental Outlook | OECD, 2001<br>(OECD — www.oecd.org) | Environment | Global | 2020 |
| Quality and the Future: Sustainability outlook | RIVM, 2004<br>(MNP/RIVM — www.mnp.nl/en/index.html) | Environment | Global | 2100 |
| Ecosystems and Human Well-being: Scenarios, Volume 2 | MA, 2005<br>(Millenium Ecosystem Assessment — www.ma-web.org) | Environment | Global | 2100 |
| Great Transition: The Promise and Lure of the Times Ahead -A report of the Global Scenario Group | Raskin *et al*., 2002<br>(SEI — www.sei.se; GSG — www.gsg.org) | Environment | Global | 2050 |
| Global Scenario Group Futures — Technical Notes | Kemp-Benedict *et al*., 2002<br>(SEI — www.sei.se) | Environment | Global | 2100 |
| Global Environmental Outlook 3 — Past, present and future perspectives | UNEP, 2002<br>(UNEP — www.unep.org) | Environment | Global | 2032 |
| Global Environment Outlook 4 (GEO-4) | UNEP, 2007 (forthcoming)<br>(UNEP — www.unep.org) | Environment | Global | 2015/2050 |
| Second OECD Environmental Outlook | OECD, 2008 (forthcoming)<br>(OECD — www.oecd.org) | Environment | Global | 2030 |
| Exploring past and future changes in the ecological footprint for world regions | van Vuuren and Bouwman, 2005 | Environment | Global | 2050 |
| The GEO-3 Scenarios 2002–2032: Quantification and analysis of environmental impacts | Potting and Bakkes (eds), 2004<br>(MNP/RIVM — www.mnp.nl/en/index.html) | Environment | Global | 2032 |

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| Fish to 2020: Supply and Demand in Changing Global Markets | Delgado *et al*., 2003<br>(IFPRI — www.ifpri.org; World Fish Center — www.worldfishcenter.org) | Fisheries | Global | 2020 |
| Fish as food: projections to 2020 under different scenarios | Delgado *et al*., 2002<br>(IFPRI — www.ifpri.org) | Fisheries | Global | 2020 |
| Global Scenarios to 2020 — Public Summary | Shell, 2002<br>(Shell Corporation — www.shell.com) | General | Global | 2020 |
| Shell Global Scenarios to 2025 The Future Business Environment — Trends, Trade-offs and Choices | Shell, 2005<br>(Shell Corporation — www.shell.com) | General | Global | 2025 |
| Emerging Systemic Risks in The 21st Century: An Agenda for Action | OECD, 2003<br>(OECD — www.oecd.org) | General | Global | 2050 |
| Mapping the Global Future | NIC, 2004<br>(National Intelligence Council — www.dni.gov/nic/NIC_home.html) | General | Global | 2025 |
| State of the Future | Glenn and Gordon, 2006<br>(American Council for the United National University — www.acunu.org) | General | Global | – |
| The Global Technology Revolution: Bio/Nano/Materials Trends | Antón *et al*., 2001<br>(RAND/National Defense Research Institute — www.rand.org) | Technology & Innovation | Global | 2015 |
| The Creative Society of the 21st Century | OECD, 2000<br>(OECD — www.oecd.org) | Technology & innovation | Global | 2050 |
| Fuel Cells, Impact and consequences of Fuel Cells technology on sustainable development | Oertel *et al*., 2003<br>(Institute for Prospective Technological Studies — www.jrc.es) | Transport | Global | 2010 |
| Mobility 2030: Meeting the challenges to sustainability | WBCSD 2004<br>(World Business Council Sustainable Development — www.wbcsd.ch) | Transport | Global | 2030 |
| Prospects for Hydrogen and Fuel Cells | IEA, 2005<br>(IEA — www.iea.org) | Transport | Global | 2050 |
| Infrastructure to 2030: Telecom, Land Transport, Water and Electricity | OECD, 2006<br>(OECD — www.oecd.org) | Transport | Global | 2030 |
| Potential for Hydrogen as a Fuel for Transport in the Long Term (2020 — 2030) | Altmann *et al*., 2004<br>(Institute for Prospective Technological Studies — www.jrc.es) | Transport | Global | 2020–2030 |
| World Water Vision: Making; Water Everybody's Business | Cosgrove and Rijsberman, 2000<br>(World Water Council (WWC) — www.worldwatercouncil.org) | Water | Global | 2025 |
| Global Water Outlook to 2025: Averting an Impending Crisis | Rosegrant *et al*., 2002<br>(IFPRI — www.ifpri.org) | Water | Global | 2025 |
| World Water and Food to 2025: Dealing with Scarcity | Rosegrant *et al*., 2002<br>(IFPRI — www.ifpri.org) | Water | Global | 2025 |
| Water for food Water for life — A Comprehensive Assessment of Water Management in Agriculture | IWMI, 2007<br>(International Water Management Institute — www.iwmi.cgiar.org) | Water | Global | 2025 (quant), 2050 (qual.) |

## B — Pan-European scale studies

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| Assessment of the potential biomass supply in Europe using a resource-focused approach | Ericsson and Nilsson, 2006. | Agriculture; Energy | EU-15, EU-10, plus BY and UA | 2100 |
| Modelling of Emissions of Air Pollutants and Greenhouse Gases from Agricultural Sources in Europe | Klimont and Brink, 2004<br>(International Institute for Applied Systems Analysis — www.iiasa.ac.at) | Air; Climate change; Agriculture | WCE, SEE plus RU, UA, MD | 2020 |
| Impacts of a Warming Arctic: Arctic Climate Impact Assessment | ACIA, 2004 | Climate change | Arctic | 2100 |
| Assessing effects of forecasted climate change on the diversity and distribution of European higher plants for 2050 | Bakkenes *et al*., 2002 | Climate change; Biodiversity | WCE, SEE | 2050 |
| Carbon pricing and the diffusion of renewable power generation in Eastern Europe: A linear programming approach | Pettersson, 2007 | Climate change; Energy | UA, HR, the European part of RU, MK, RS | 2020 |
| Restructuring and Privatizing the Coal Industries in Central and Eastern Europe and the CIS | World Energy Council, 2000<br>(World Energy Council — www.worldenergy.org) | Energy | EU-10 and EECCA | 2050 |
| The future of gas infrastructures in Eurasia | Klaassen *et al*., 2001 | Energy | WCE, SEE, EECCA plus Asia | 2020 |
| European Forest Sector Outlook Study | UNECE/FAO, 2005<br>(UNECE — www.unece.org; FAO — www.fao.org) | Forestry | WCE, SEE, Eastern Europe | 2010, 2020 |
| Sustainable management regimes for Europe's forests a projection with EFISCEN until 2050 | Nabuurs, Paivinen and Schanz, 2001 | Forestry | WCE, SEE | 2050 |
| Exploring challenges for managing Europe's seas | ELME, 2007<br>(ELME — www.elme-eu.org) | Marine | WCE, SEE, EECCA | – |
| Arctic Shipping 2030: Driving forces that will determine opportunities and risks. | Brunstad, 2007<br>(ECON Consultancy — www.econ.no) | Marine; Climate change; Transport | Arctic | 2030 |
| An Integrated Analysis of Changes in Water Stress in Europe | Henrichs, Lehner and Alcamo, 2002 | Water | WCE, SEE, Eastern Europe | 2070 |

## C — Western and Central Europe scale studies

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| IPTS/ESTO Studies on Reforms of Agriculture, Education and Social Systems within the Context of Enlargement and Demographic Change in the EU | IPTS, 2002<br>(Institute for Prospective Technological Studies — www.jrc.es) | Agriculture | WCE | 2050 |
| Prospects for agricultural markets and income 2004 — 2011 for EU-25 | European Commission, 2004<br>(DG Agriculture — http://ec.europa.eu/agriculture) | Agriculture | EU-25 | 2011 |
| Forecast of food, farming and fertilizer use in the European Union 2006–2016 | EFMA, 2006<br>(European Fertilizer Manufacturers Association — www.efma.org) | Agriculture | WCE | 2016 |
| From Economic Activities to Ecosystem Protection in Europe. An Uncertainty Analysis of Two Scenarios of the RAINS Integrated Assessment Model | Suutari *et al*., 2001<br>(International Institute for Applied Systems Analysis — www.iiasa.ac.at) | Air | WCE | 2010 |
| Baseline Scenarios for the Clean Air for Europe (CAFE) Programme | Amann *et al*., 2005<br>(International Institute for Applied Systems Analysis — www.iiasa.ac.at) | Air | EU-15 | 2020 |
| Assessment of the Potential Effects and Adaptations for Climate Change in Europe: The Europe ACACIA Project | Parry *et al*., 2000<br>(University of East Anglia — www.uea.ac.uk/cm/home) | Climate change | WCE | – |
| ACROPOLIS: Assessing Climate Response Options: Policy Simulations — Insights from using national and international models | European Commision, 2002<br>(European Commission — http://ec.europa.eu/index_en.htm) | Climate change | WCE | 2050 |
| Advanced Terrestrial Ecosystem Analysis and Modelling (ATEAM) | Schroter *et al*., 2004<br>(Potsdam institute for climate impact research — www.pik-potsdam.de) | Climate change | WCE | 2020, 2050, 2080 |
| Greenhouse Gas Reduction Pathways in the UNFCCC Process up to 2025 — policymakers summary and technical report | Criqui, Kitous and Berk, 2003<br>(European Commission — http://ec.europa.eu/index_en.htm) | Climate change; Energy | WCE | 2025, 2050 |
| Cost effectiveness of $CO_2$ mitigation in transport. An outlook and comparison to cost effectiveness of measures in other sectors | Kampman *et al*., 2006<br>(CE Netherlands Solutions — www.ce.nl) | Transport; Climate change | EU-25 | 2010, 2030 |
| Demography in the Mediterranean Region — Situation and Projections. Translation of: La démographie en Méditerranée. Situation et projections | Attane, Courbage, 2001<br>(UNEP Regional Activity Centre: Blue Plan — www.planbleu.org/indexUK.html) | Demography | Mediterranean region | 2025 |
| Low Fertility and Population Ageing: Causes, Consequences, and Policy Options | Grant *et al*., 2004<br>(RAND Europe — www.rand.org) | Demography | Case studies in FR, DE, PL, ES, SE | 2050 |
| Population projections: Trend scenario, national and regional level — base year 2004 | Eurostat, 2005<br>(Eurostat — www.ec.europa.eu/eurostat) | Demography | WCE | 2051 |
| Four Futures of Europe | de Mooij and Tang, 2004<br>(Central Planning Bureau (CPB) — www.cpb.nl/eng) | Economy | WCE | 2040 |
| Biofuel Production Potential of EU-Candidate Countries | Kavalov *et al*., 2003<br>(Institute for Prospective Technological Studies — www.jrc.es) | Energy; Agriculture | EU-10 | 2020 |

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| Four Futures for Energy Markets and Climate Change | Bollen *et al*., 2004<br>(Central Planning Bureau (CPB) — www.cpb.nl/eng | Energy; Climate change | WCE | 2040, 2050 |
| European Energy and Transport: Trends to 2030 | Mantzos *et al*. , 2003<br>(European Commission, DG Energy and Transport — http://ec.europa.eu/dgs/energy_transport/index_en.html) | Energy; Transport | WCE | 2030 |
| European Energy and Transport Trends to 2030 — Scenarios on key drivers | Mantzos *et al*., 2004<br>(European Commission, DG Energy and Transport — http://ec.europa.eu/dgs/energy_transport/index_en.html) | Energy; Transport | WCE | 2030 |
| Four scenarios for Europe | UNEP/RIVM, 2003<br>(UNEP — www.unep.org; MNP/RIVM — www.mnp.nl/en/index.html) | Environment & Sustainability | WCE | 2030 |
| Generic Scenarios; Specific Scenarios skeletons on Energy, Industry/Harbor, Agriculture, Fisheries | Römgens B. *et al*., 2003<br>(Wadden Sea Forum — www.waddensea-forum.org) | Environment & Sustainability | Wadden Sea (in DE and NL) | 2020 |
| The European environment — State and outlook 2005 | EEA, 2005<br>(European Environmental Agency (EEA) — www.eea.europa.eu) | Environment & Sustainability | WCE | 2030 |
| Integrated Visions for a Sustainable Europe | Rotmans *et al*., 2001<br>(International Centre for Integrated Studies — www.icis.unimaas.nl) | Environment & Sustainability | WCE | 2050 |
| Foresight Futures 2020: Revised Scenarios and Guidance | DTI, 2002 | General | UK focus | 2020 |
| Final Report of European and Mediterranean scenarios: upscaling the results from the Target Area scenarios | Kok *et al*., 2004<br>(International Centre for Integrated Studies — www.icis.unimaas.nl) | Land use | 4 areas in ES, GR, IT, PT | 2030 |
| Integrated futures for Europe's mountain regions: Reconciling biodiversity conservation and human livelihoods | Mitchley, Price, Tzanopoulos, 2006 | Land use | 6 areas in FR, NO, CH, UK, SK, GR | – |
| Future Land Use in Europe: Trends, Challenges and Policy. | Knickel and Kok, 2003 | Land use | WCE | – |
| The EURURALIS Study: Technical document (version 1.0) http://www.eururalis.nl/ | Klijn *et al*., 2005<br>(Wageningen University & Research Centre (NL) and partners — available at www.eururails.nl) | Land use; agriculture | WCE | 2030 |
| Spatial Scenarios and Orientations in relation to the ESDP and Cohesion Policy | ESPON, 2006<br>(European Spatial Planning Observatory Network — www.espon.eu) | Land use; Economy | WCE | 2015, 2030 |
| Spatial Visions and Scenarios — Thematic Study of INTERREG and ESPON activities | ESPON, 2007<br>(European Spatial Planning Observatory Network — www.espon.eu) | Land use; Economy | WCE | 2015, 2030 also 2020, 2100 |
| PRELUDE: Land use scenarios for Europe | EEA, 2005<br>(European Environmental Agency (EEA) — www.eea.europa.eu) | Land use; Agriculture | WCE | – |
| PRELUDE: Land use scenarios for Europe — modelling at the regional scale. | EEA, 2007<br>(European Environmental Agency (EEA) — www.eea.europa.eu) | Land use; Agriculture | Case studies in EE, NL, Northern IT | 2035 |
| A Sustainable Future for the Mediterranean — The Blue Plan's Environment and Development Outlook | Benoit and Comeau (eds.), 2005<br>(UNEP Regional Activity Centre: Blue Plan — www.planbleu.org) | Marine environment & Sustainability | Mediterranean region | 2025 |

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| Europe in 2020 | NIC, 2004<br>(US National Intelligence Council — www.dni.gov/nic/NIC_home.html) | Politics | WCE | 2020 |
| Four Future scenarios for the European Union — Reflections from the perspective of 'Path Dependence' | Langer, 2005<br>(Europe2020 — www.europe2020.org) | Politics | WCE | 2020 |
| Assessing the environmental potential of clean material technologies | Phylipsen *et al*., 2002<br>(Institute for Prospective Technological Studies — www.jrc.es) | Technology & Innovation; Environment & Sustainability | WCE | 2020, 2030 |
| The Future of Manufacturing in Europe 2015–2020: The challenge for sustainability scenario report | Geyer *et al*., 2003<br>(Institute for Prospective Technological Studies — www.jrc.es) | Technology & Innovation; Environment & Sustainability | WCE | 2020 |
| Environment-Related Structural Indicators in New Member States and Candidate Countries: A Prospective Analysis | Christidis *et al*., 2004<br>(Institute for Prospective Technological Studies — www.jrc.es) | Technology & Innovation; Environment & Sustainability | EU-10 plus BG, RO | 2030 |
| The Future Impact of ICTs on Environmental Sustainability | Erdmann *et al*., 2004<br>(Institute for Prospective Technological Studies — www.jrc.es) | Technology & Innovation; Environment & Sustainability | WCE | 2020 |
| EXPEDITE Expert -system based Predictions of Demand for Internal Transport in Europe | Jong *et al*., 2002<br>(RAND Europe and partners — www.rand.org) | Transport | WCE | 2020 |
| TEN-STAC: Scenarios, Traffic Forecasts, and Analyses of Corridors on the Trans-European Transport Network | TEN-STAC, 2004<br>(TEN-STAC — /www.nea.nl/ten-stac) | Transport | WCE | 2020 |
| Hybrids for road transport: Status and prospects of hybrid technology and the regeneration of energy in road vehicles. | Christidis *et al*. (eds.), 2005<br>(Institute for Prospective Technological Studies — www.jrc.es) | Transport; Environment & Sustainability | WCE | 2020 |
| TREMOVE | European Commission (DG Environment)<br>(http://ec.europa.eu/dgs/environment/index_en.htm) | Transport; Environment & Sustainability | WCE | 2020 |
| TRIAS: Sustainability Impact Assessment of Strategies Integrating Transport, Technology and Energy Scenarios | European Commission (JRC), 2006 | Transport; Environment & Sustainability | WCE | 2030 |
| Territorial Impact of EU Transport and TEN Policies | ESPON, 2005<br>(European Spatial Planning Observatory Network — www.espon.eu) | Transport; Land use | WCE | 2021 |
| Future Transport of Goods: Scenarios for Europe's future transport of goods in the Baltic Region | CIFS, 2002<br>(Copenhagen Institute of Futures Studies — www.iff.dk/en) | Transport; Marine environment | Baltic region | 2015 |
| Trends in Vehicle and Fuel Technologies: Scenarios for Future Trends | Pelkmans and Christidis (eds), 2003<br>(Institute for Prospective Technological Studies — www.jrc.es) | Transport; Technology & innovation | WCE | 2020 |
| Dynamics of the introduction of new passenger car technologies: The IPTS transport technologies model | Christidis *et al*., 2003<br>(Institute for Prospective Technological Studies — www.jrc.es) | Transport; Technology & innovation | WCE | 2030 |
| Vision 2020 and Challenges | ERTRAC, 2004<br>(European Road Transport Research Advisory Council — www.ertrac.org) | Transport; Technology & Innovation | WCE | 2020 |
| GALILEO impacts on road transport | Schmidt *et al*., 2005<br>(Institute for Prospective Technological Studies — www.jrc.es) | Transport; Technology & Innovation | WCE | 2020 |

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| Intelligent Infrastructure Futures: The Scenarios — Towards 2055 | Curry *et al*., 2006<br>(UK Government: Foresight Programme — www.foresight.gov.uk) | Transport; Technology & Innovation | UK focus | 2055 |
| Techno-Economic Outlook on Waste Indicators in Enlargement Countries (TEO WASTE) | Bodo *et al*., 2003<br>(Institute for Prospective Technological Studies — www.jrc.es) | Waste | EU-10 | 2020 |
| Scenarios of household waste generation in 2020 | Tukker *et al*., 2003<br>(Institute for Prospective Technological Studies — www.jrc.es) | Waste | WCE | 2020 |

## D — South Eastern Europe scale studies

| Title | Author(s) and year of publication | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| Future Climate Change Policy in the Accession and Candidate Countries: Looking beyond 2012 | Ecologic and others, 2006 (www.ecologic-events.de) | Climate change | Acceeding & candidate countries | 2012, 2050 |
| Economic Performance and Structure of Southeastern European Countries | Totev, 2002 | Economy | AL, BG, MK, GR | – |
| Long-term prospects for the European transition economies and some implications for the tourism industry | Economist Intelligence Unit (www.eiu.com) | Economy; Tourism | Western Balkans (and Central Europe) | 2025 |
| Review of electricity supply and demand in Southeast Europe | Atur and Kennedy, 2004 (World Bank — www.worldbank.org) | Energy | AL, BA, BG, HR, MK, RO, RS, ME | 2012 |
| Potential of solar electricity generation in the European Union member states and candidate countries | Šúri, Hulda, Dunlopa and Ossenbrinka, 2004 | Energy | EU Member States & candidate countries | – |
| Sustainable development after Johannesburg and Iraq: The global situation and the cases of Slovenia and Croatia | Blinc, Zidanšek and Šlaus, 2004 | Environment & Sustainability | SI, HR | – |
| Carpathian Environmental Outlook | UNEP (GRID-Geneva and ROE), 2007 (UNEP — www.grid.unep.ch/index.php) | Environment & Sustainability | CZ, HU, PL, RO, RS, ME, SK, UA | – |
| Facing the Future: The Balkans to the Year 2010 | Bugajski, 2001 (Center for European Integration Studies (ZEI) — www.zei.de/index_e.html) | Politics | Balkans | 2010 |
| Do All Roads Lead to Brussels? Analysis of the Different Trajectories of Croatia, Serbia-Montenegro and Bosnia-Herzegovina | Massari, 2005 | Politics | HR, RS, ME, BA | – |

## E — Eastern Europe, Caucasus and Central Asia scale studies

| Title | Reference | Thematic focus | Geographic coverage | Time horizon |
|---|---|---|---|---|
| EECCA | | | | |
| Eurasia 2020: Global Trends 2020 Regional Report | National Intelligence Council, 2004 (US NIC — www.dni.gov/nic/NIC_home.html) | Economy | Eurasia | 2020 |
| CIS Energy Outlook | Energy Research Institute of the Russian Academy of Sciences, 2001 (www.energo21.com/index.html) | Energy | EECCA | 2020 |
| The Future of Caspian Petroleum Offshore Industry | RPI Inc, 2005 (RPI Inc — www.rpi-inc.com) | Energy | Russia | 2020 |
| Caucasus | | | | |
| Caucasus Environment Outlook (CEO) | UNEP/GRID Tbilisi, 2002 (UNEP/GRID — www.grida.no) | Environment & Sustainability | Caucasus | 2032 |
| Central Asia | | | | |
| Food Policy Reforms in Central Asia: setting the research priorities | Babu and Tashmatov (eds), 2000 (IFPRI — www.ifpri.org) | Agriculture | Central Asia | 2020 |
| Food security in Central Asia: Economic Opportunities, Policy Constraints and Future Challenges | Babu and Rhoe, 2001 (IFPRI — www.ifpri.org) | Agriculture | Central Asia | 2020 |
| Central Asia's Economy: Mapping Future Prospects to 2015 | Dowling and Wignaraja, 2006 | Economy | Central Asia | 2015 |
| The Future of Central Asian Gas | RPI Inc, 2002 (RPI Inc — www.rpi-inc.com) | Energy | Central Asia | – |
| Central Asia: A major emerging energy player in the 21st century | Dorian, 2006 | Energy | Central Asia | 2015 |
| Strengthening Co-operation for Rational and Efficient Use of Water and Energy Resources in Central Asia | UNECE/UNESCAP, 2004 (UNECE — www.unece.org; UNESCAP — www.unescap.org) | Energy; Water | Central Asia | 2020 |
| Millennium Development Goals for Health in Europe and Central Asia — Relevance and Policy Implications | The World Bank, 2004 (The World Bank — www.worldbank.org) | Environment & Sustainability | Europe & Central Asia | – |
| Central Asia Human Development Report 2005 | UNDP Regional Bureau for Europe and the Commonwealth of Independent States, 2006 | Environment & Sustainability | Central Asia | 2025 |
| Water-related Vision for the Aral Sea Basin for the year 2025 | UNESCO, 2000 (UNESCO — www.unesco.org) | Water | Central Asia plus Afghanistan, Iran | 2025 |
| Aral Sea Basin Case Study | The Dialogue on Water and Climate (http://dialogue.icwc-aral.uz) | Water | Central Asia | 2020 |
| Irrigation in Central Asia: Social, Economic and Environmental Considerations | The World Bank, 2003 (The World Bank — www.worldbank.org) | Water | Central Asia | 2010, 2015 for some analysis |

# Annex 2 Overview of forward-looking environmental indicators

This annex presents forward-looking indicators on the state of the environment in the pan-European region. The indicators are derived from studies developed by a number of international organisations. Different organisations use different regional definitions, which makes it difficult to provide a coherent overview of future pan-European developments. In this annex, however, an attempt is made to cluster indicators by three sub-regions: Western and Central Europe (WCE), South Eastern Europe (SEE) and Eastern Europe, Caucasus, and Central Asia (EECCA) ([a]).

The forward-looking indicators below are presented as percentage change and only give an indication of expected future developments, while Annex 3 provides more detailed assessments of several driving force and pressure indicators.

**Table A 2.1 Forward-looking indicators for the pan-European region**

| Indicator | Source | Time | WCE region | | EECCA region | | SEE region | |
|---|---|---|---|---|---|---|---|---|
| Population (number of people) | United Nations Population Division, 2007. | 2000 to 2030 | WCE | + 1 % | EECCA | – 6.1 % | SEE | + 16 % |
| GDP (USD per capita) | OECD, 2007b. | 2005 to 2030 | EU-15<br>EU-10 | + 64 %<br>+ 141 % | EECCA | + 182 % | SEE w/o Turkey | + 141 % |
| Working age (16–65) population per person over 65 (number of people) | United Nations Population Division, 2007. | 2000 to 2020 | WCE | – 53 % | EECCA | – 51 % | SEE | – 61 % |
| Emissions of acidifying pollutants (Gg $SO_2$/year) | EMEP, 2005. | 2000 to 2020 | EU-25 | – 63 % to – 85 % | EECCA | – 1.5 % | SEE | – 33 % |
| Emissions of acidifying pollutants (Gg $NO_x$/year) | EMEP, 2005. | 2000 to 2020 | EU-25 | – 46 % to – 69 % | EECCA | + 48 % | SEE | – 16 % |
| Emissions of acidifying pollutants (Gg $NH_3$/year) | EMEP, 2005. | 2000 to 2020 | EU-25 | – 5 % to – 42 % | EECCA | + 36 % | SEE | + 5 % |
| Emissions of ozone precursors (Gg $NO_x$/year) | EMEP, 2005. | 2000 to 2020 | EU-25 | – 46 % to – 69 % | EECCA | + 48 % | SEE | – 16 % |
| Emissions of ozone precursors (Gg HMVOC/year) | EMEP, 2005. | 2000 to 2020 | EU-25 | – 45 % to – 62 % | EECCA | + 38 % | SEE | – 26 % |

([a]) Regional groupings used in Annex 2 are defined in Annex 1 (see Table A.1.1) unless specified otherwise.

| Indicator | Source | Time | WCE region | | EECCA region | | SEE region | |
|---|---|---|---|---|---|---|---|---|
| Emission of PM (Gg $PM_{2.5}$/year) | EMEP, 2005. | 2000 to 2020 | EU-25 | – 39 % to – 73 % | EECCA | – 2.4 % | SEE | – 13 % |
| Emission of PM (Gg $PM_{10}$/year) | | 2000 to 2020 | EU-25 | – 38 % to – 67 % | EECCA | – 2.6 % | SEE | – 15 % |
| Meat consumption (kg/year/capita) | FAPRI, 2005. | 2005 to 2015 | EU-15<br>EU-10 | + 0.3 %<br>+ 16 % | EECCA | + 13 % | SEE | + 18 % |
| Cereals (wheat) production (kg/year/capita) | | 2005 to 2025 | EU-15<br>EU-10 | + 2.5 %<br>+ 11 % | EECCA | + 5 % | SEE | + 5 % |
| Municipal waste generation (quantities) | EEA/ETC-RWM, 2007. | 2005 to 2020 | EU-15<br>EU-10 | + 26 %<br>+ 11 % | EECCA-7 ([b]) | + 138 % | RO and BG | + 6 % |
| Water withdrawals ($km^3$/year) | Lehner *et al*., 2001. | 1995 to 2070 | Western Europe ([c]) w/o Austria<br>CZ, HU, PL, SK, SL<br>Baltic States ([d]) | – 18 %<br>+ 202 %<br>+ 130 % | Eastern Europe | + 130 % | SEE w/o Turkey | + 202 % |
| Renewable energy consumption (Mtoe) | IEA, 2006 ([f]). | 2004 to 2030 | OECD Europe ([e])<br>Baltic States ([d]) plus MT, CY | + 118 % to + 155 %<br>+ 61 % to + 75 % | EECCA w/o Russian Fed.<br>Russian Fed. | + 61 % to + 75 %<br>+ 10 % to + 15 % | Western Balkans + Bulgaria | + 61 % to + 75 % |
| Electricity consumption (toE/capita) | IEA, 2006 ([f]). | 2004 to 2030 | OECD Europe ([e])<br>Baltic States ([d]) plus MT, CY | + 18 % to + 38 %<br>+ 46 % to + 62 % | EECCA w/o Russian Fed.<br>Russian Fed. | + 46 % to + 58 %<br>+ 55 % to + 70 % | Western Balkans + Bulgaria | + 46 % to + 58 % |
| Total energy consumption (toE/capita) | IEA, 2006 ([f]). | 2004 to 2030 | OECD Europe ([e])<br>Baltic States ([d]) plus MT, CY | + 10 %<br>+ 32 % | EECCA w/o Russian Fed.<br>Russian Fed. | + 32 %<br>+ 52 % | Western Balkans + Bulgaria | + 32 % |
| Final energy consumption (Mtoe/capita) | IEA, 2006 ([f]). | 2004 to 2030 | OECD Europe ([e])<br>Baltic States ([d]) plus MT, CY | + 17 %<br>+ 41 % | EECCA w/o Russian Fed.<br>Russian Fed. | + 41 %<br>+ 51 % | Western Balkans + Bulgaria | + 41 % |
| GHG emissions ($CO_2$-equivalents) | NCC, 1997–2007 ([g]). | 2000 to 2020 | EU-15<br>EU-10 | + 6.5 %<br>+ 14 % | EECCA | + 15 % | SEE | + 14 % |

([b]) EECCA-7: Armenia, Azerbaijan, Belarus, Kyrgyzstan, Republic of Moldova, Russian Federation and Ukraine.
([c]) Western Europe: EU-15 plus Iceland, Malta, Norway and Switzerland.
([c]) Baltic States: Estonia, Latvia and Lithuania.
([e]) OECD Europe: EU-15 plus Czech Republic, Hungary, Iceland, Liechtenstein, Norway, Poland, Slovakia, Switzerland and Turkey.
([f]) Data extracted from tables for reference and alternative policy scenario projections, modified by the EEA.

| Indicator | Source | Time | WCE region | | EECCA region | | SEE region | |
|---|---|---|---|---|---|---|---|---|
| Energy-related $CO_2$ emissions ($CO_2$/capita) | IEA, 2006 ([f]). | 2004 to 2030 | OECD Europe ([e]) | + 6 % to + 14 % | EECCA w/o Russian Fed. | + 9 % to + 25 % | Western Balkans + Bulgaria | + 9 % to + 25 % |
| | | | Baltic States ([d]) plus MT, CY | + 9 % to + 25 % | | | | |
| Temperature change (°C) | NCC, 1997–2007 ([g]). | 2000 to 2050 | EU-25 | + 1 °C to + 3.0 °C | EECCA | + 1 °C to + 3.0 °C | SEE | + 1 °C to + 3.4 °C |
| Precipitation change (mm) | NCC, 1997–2007 ([g]) and EEA, 2005b. | 2000 to 2050 | EU-25 | + 2 % to + 3 % | EECCA | – 6.1 % to + 35 % | SEE | – 5.4 % to + 26 % |
| Passenger transport demand (passenger km) | WBCSD, 2004. | 2000 to 2050 | OECD Europe ([e]) | + 145 % | EECCA | + 267 % | SEE w/o Turkey | + 248 % |
| | | | PL, SK, SI | + 248 % | | | | |
| Freight transport demand (tonne km) | WBCSD, 2004. | 2000 to 2050 | OECD Europe ([e]) | + 105 % | EECCA | + 194 % | SEE w/o Turkey | + 303 % |
| | | | PL, SK, SI | + 303 % | | | | |
| Car ownership (number/1 000 people) | WBCSD, 2004. | 2000 to 2050 | OECD Europe ([e]) | + 46 % | EECCA | + 347 % | SEE w/o Turkey | + 174 % |
| | | | PL,SK, SI | + 174 % | | | | |
| Fertiliser consumption (million tonnes) | FAO, 2003. | 1997/1999 to 2030 | Western Europe ([b]) | + 18 % | EECCA | + 32 % | AL, BA, BG, HR | 32 % |
| | | | Baltic States ([d]) plus MT, CY | + 32 % | | | | |
| Mean species abundance (number of species) | MNP, 2006. | 2000 to 2050 | EU-25 | – 12 % | EECCA | – 5 % | n/a | |
| Tourist arrivals (number of tourists) | World Tourism Organization, 2002. | 2000 to 2020 | WCE | + 82 % | EECCA | + 280 % | SEE | + 289 % |
| | | | EU-10 | + 280 % | | | | |

([g]) NCC: National communications on climate change to UNFCCC.

# Annex 3 Forward-looking environmental indicators — international comparisons

This annex contains a selection of forward-looking indicators that offer a broad overview of expected future developments of environmental drivers and pressures. To provide a better understanding of expected developments, the indicators for the pan-European region are presented in comparison with other regions, such as USA, Canada, India and China. The time horizon is mostly 2020 or 2030, while for transport it is extended to 2050. A similar, but shorter version of these forward-looking indicators is also presented in Annex 3 of *Europe's environment — The fourth assessment* (EEA, 2007a).

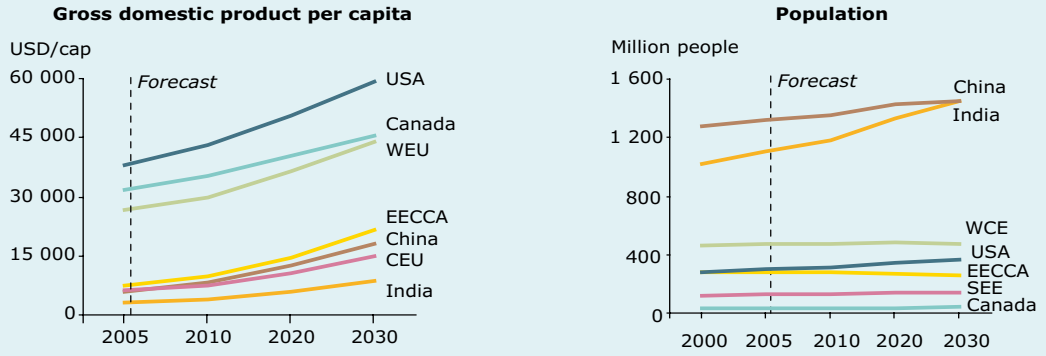
The indicators have been selected on the basis of two main criteria: their relevance to the thematic chapters of the EEA's *Europe's environment — The fourth assessment*, and the availability of data. The sources of information for the forward-looking indicators are other organisation that are publishing outlooks for specific thematic areas which also cover the regions in question: Western and Central Europe (WCE), South Eastern Europe (SEE), Eastern Europe, Caucasus and Central Asia (EECCA). The countries and groupings used in this annex therefore do not always match those used in the EEA's *Europe's environment — The fourth assessment*; the regional definitions used by these organisations are presented alongside the respective indicators and are also used in the corresponding map presentations (where applicable).

**THEME:** **Socio-economy**
**INDICATOR:** **Gross domestic product & Population**

**Key messages**

In a no new policies scenario ([a]), GDP is projected to continue to grow in absolute and per-capita terms in the whole pan-European region, more rapidly in the eastern parts, such as EECCA and SEE. Globally WEU, USA and Canada are projected to continue to have the highest GDP per capita. WEU is expected to approach the levels of USA and Canada. However, the fastest-growing economies are expected to be China, India and EECCA.

Total world population is projected to grow, with wide regional variations. China and India are likely to have the largest populations and maintain one of the highest growth rates in the world (especially India). In contrast, the EECCA population is forecasted to fall below the 2005 level. Other European regions are expected to have a small increase in population, taking migration factors into account.

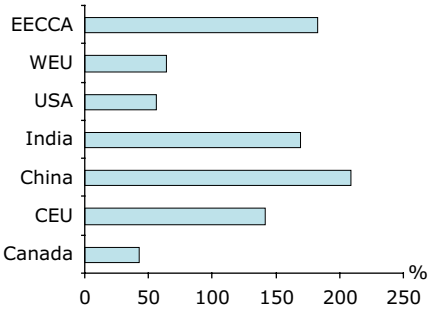



**Definitions**

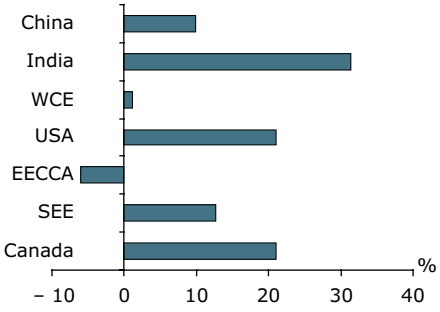
**Gross domestic product (GDP)** is the sum of gross value added by all resident producers in an economy, plus any product taxes, minus all subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets and degradation of natural resources. It is expressed in constant 2000 USD.

**Population** includes all residents regardless of legal status and citizenships.

**Projected percentage change in GDP per capita from 2005 to 2030**




**Projected percentage change in total population from 2005 to 2030**




## Outlook to 2030

- GDP per capita is projected ([a]) to increase globally, most rapidly in EECCA, China, India and CEU. Although GDP per capita in WEU grows much more slowly (by 64 %) than in CEU (141 %) and EECCA (182 %), absolute values of GDP per capita in WEU in 2030 remain more than twice those in other European countries. USA is expected to have the highest GDP per capita in 2030, followed by Canada and WEU. China continues to be among the most impressively developing economies, with the highest increase in GDP per capita from 2000 to 2030 (more than 200 %). India stays below the world average, though with a large increase (169 %) from 2005 to 2030.
- Population growth in Europe from 2005 to 2030 is expected to vary between regions. The WCE population grows by only 1.1 % to around 477 million. The highest growth (16 %) is projected for SEE, from 127 million in 2005 to more than 142 million in 2030. The population in EECCA decreases by 6.1 %, from 277 million in 2005 to 260 million by 2030. The most-populated countries, India and China, continue to grow with the largest increase (31 %) in India, with population overtaking that in China around 2030. The total population of Canada and USA increases from 330 million in 2005 to 400 million by 2030.

**Note:**

a) Projections are based on the baseline OECD scenario. The baseline is a no new policies scenario by design, without anticipating deliberate interventions requiring new or intensified policies in response to the projected developments. Population indicators were adopted from the most recently published UN demographic projection, and economic developments were taken from the economic baseline elaborated with the ENV Linkages model of the OECD.

**Geographical coverage:**

**GDP: Western Europe** (WEU — Austria, Belgium, Denmark, Finland, France, Germany, Gibraltar, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom); **Central Europe** (CEU — Hungary, Poland, Czech Republic, Slovakia, Estonia, Latvia, Lithuania, Slovenia, Malta, Cyprus, Bulgaria, Romania, Albania, Bosnia and Herzegovina, Croatia, the Former Yugoslav Republic of Macedonia, Serbia and Montenegro); **EECCA** (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan); **USA; Canada; India; China**.

**Population: Western and Central Europe** (WCE — Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, the United Kingdom); **EECCA** (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Ukraine, Uzbekistan); **SEE** (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Former Yugoslav Republic of Macedonia, Romania, Serbia and Montenegro, Turkey); **Canada; USA; India; China**.

**Source:**

**GDP:** OECD, 2007b.

**Population:** United Nation Population Division 2007.

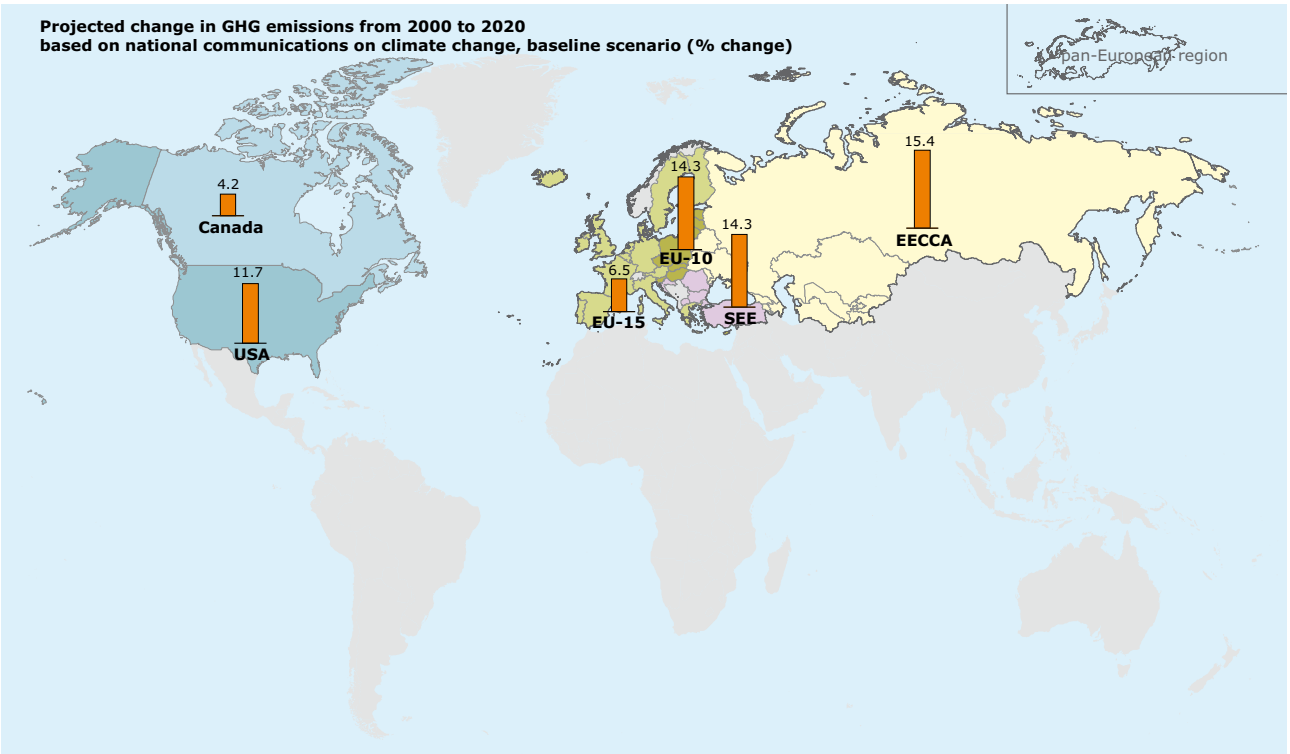
**THEME:** **Climate change**
**INDICATOR:** **Greenhouse gas emissions**

**Key messages**

With current trends and policies ([a, c]), GHG emissions per capita are projected to increase until 2020 in the EU-10, EECCA and SEE more than in EU-15, Canada and USA. In absolute terms, US GHG emissions per capita are expected to stay the highest in the world ([b]).

Global energy-related emissions of $CO_2$ ([c]), the largest contributor to total GHG emissions, are projected to increase by 29 % up to 2030. China is assumed to be the main engine for this growth. In terms of energy-related emissions per capita, the Russian Federation is projected to come close to the current largest emitter, USA.

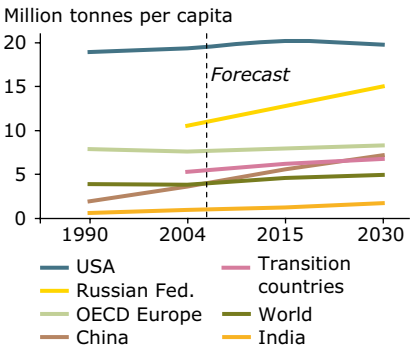
However, if countries were to adopt all the energy security and energy-saving policies that they are currently considering to tackle $CO_2$ emissions ([d]), total emissions avoided by 2030 could equal more than the current emissions of USA and Canada combined (or 16 % of the 2030 emissions in the IEA reference scenario). In OECD Europe in 2030, energy-related $CO_2$ emissions could be less than today's level.



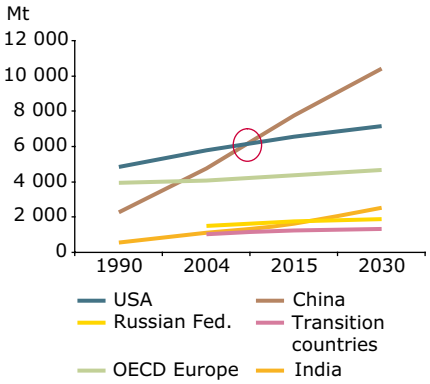

**Definition**

**Greenhouse gas emissions** (total) refer to the sum of carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), perflourocarbons (PFCs), hydroflourocarbons (HFCs) and sulphur hexafluoride ($SF_6$), weighted using their 100-year global warming potentials. National totals exclude emissions from natural resources and international bunker fuel emissions.

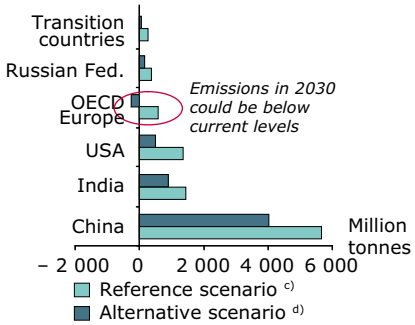
**IEA estimates and projections of energy-related $CO_2$ emissions per capita from 1990 to 2030** [c)]




**IEA estimates and projections of energy-related $CO_2$ emissions from 1990 to 2030**




**Projected change in energy-related $CO_2$ emissions for IEA reference and alternative scenarios, 2004–2030**




## Outlook to 2020/2030

- The biggest increases in total GHG emissions per capita in the pan-European region from 2000 to 2020 are projected for EECCA (at least 15 %), the New-10 and SEE, and the smallest for the EU-15 (about 6.5 %).
- In terms of total energy-related $CO_2$ emissions, China is expected to overtake USA before 2010.
- Energy-related $CO_2$ emissions per capita (which form 90 % of total $CO_2$ emissions per capita) are expected to increase in all regions. The most striking growth from 2004 to 2030 is projected for China, doubling to 7 tonnes per capita, to approach OECD Europe (8 tonnes) in 2030, and for India where there is a projected increase of 75 %.
- USA is expected to stabilise its per capita energy-related $CO_2$ emissions at about 20 tonne per capita, still the highest in the world. The Russian Federation, with a 47 % increase from 2004 to 2030 (15 tonnes in 2030), is projected to approach USA.
- With additional policies and technical measures ([d]) it would be possible to avoid 6.3 Gtonnes of global $CO_2$ emissions in 2030. Emissions in OECD Europe in 2030 could be less than today's level. Improved end-use efficiency of electricity and fossil fuels would account for two-thirds of the avoided emissions in 2030, the rest coming from increased use of less carbon-intensive sources.

**Note:**

a) Baseline scenarios presented in the National Communications of Climate Change (NCC). They include the GDP and population growth projections and the policies adopted in the country on the date of production of the NCC.

b) On January 10, 2007 the European Commission presented a package on Climate Change and Energy which basically was endorsed by the European Council 9 March 2007. It includes targets for the reduction of GHGs by 2020. This will influence the reported projections for the coming years.

c) Projections are based on the IEA reference scenario, which takes into account government policies enacted and adopted by mid-2006 regardless of the implementation. Potential future measures are not considered. The reference scenario assumes a world average population growth of 1 % per year (for 2004–2030) and a world average GDP growth of 3.4 % per year (for 2004–2030). It is further assumed that energy-supply and energy use technologies become steadily more efficient, though at varying speeds for each fuel and each sector.

d) IEA alternative policy scenario presents the situation if countries were to adopt all the energy security and energy policies they are currently considering.

**Geographical coverage:**

**Projected change in GHG emissions:** see Table A 1.1 (Annex 1), plus USA and Canada.

**Projected energy-related $CO_2$ emissions: Transition countries**, excluding the Russian Federation (Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Serbia and Montenegro, the Former Yugoslav Republic of Macedonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, Romania, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Cyprus, Malta); **the Russian Federation; OECD Europe** (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the United Kingdom); **USA; India; China**.

**Source:**

**Projected change in GHG emissions:** National communications on climate change to UNFCCC, 1997–2007. Note: SEE: no data for AL, BA and CS; EECCA: no data for TJ all years, no data for MO for 2000, no data for AM, GE, TM, UZ, UA for 2020, for which 2010 figures are used for AM, GE, TM, UZ and 2015 for UA.

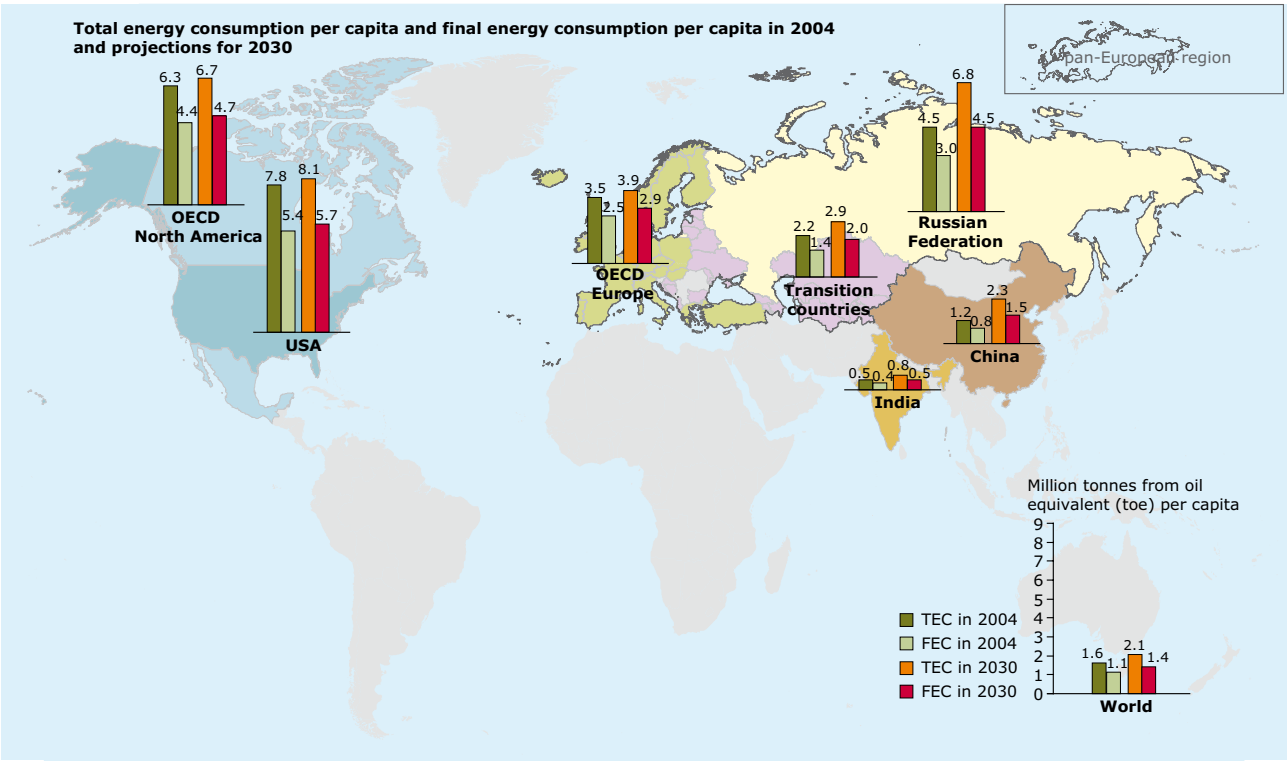
**Projected energy-related $CO_2$ emissions:** IEA, 2006.

**THEME:** **Energy**
**INDICATOR:** **Total energy consumption & Final energy consumption**

### Key messages

If current technological trends continue and government policies that have been adopted are implemented ([a]), world average total (TEC) and final (FEC) energy consumption per capita are projected to increase by about 27.5 % between 2004 and 2030. The major part of this increase is expected to come from China, India and the transition countries, which include the Russian Federation and other EECCA countries, SEE and some EU-10 Member States.

In contrast to OECD Europe and North America, total energy consumption per capita is growing faster than final energy consumption per capita in the Russian Federation, India and China, reflecting the use of less efficient technologies, mostly for power generation.

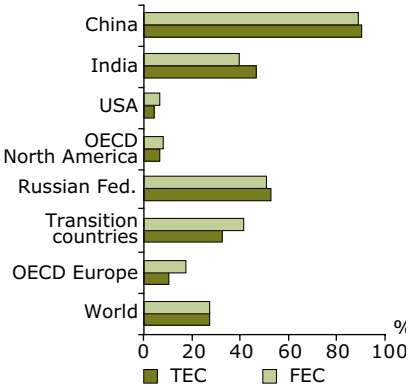



### Definitions

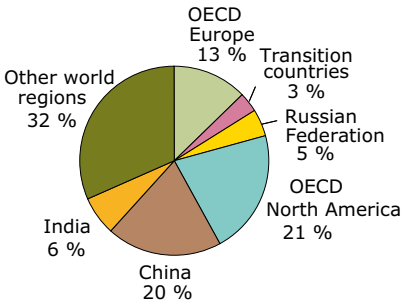
**Total energy consumption** is made up of production plus imports, minus exports, minus international marine bunkers plus/minus stock changes. It is also called Total primary energy supply or Gross inland energy consumption and represents the quantity of all energy necessary to satisfy inland consumption.

**Final energy consumption** covers all energy supplied to the final consumer for all energy uses. It is usually disaggregated into the final end-use sectors: industry, transport, households, services and agriculture.

**Projected percentage changes in TEC per capita and FEC per capita from 2004 to 2030**




**Projected regional share in world TEC in 2030**




## Outlook to 2030

- The Russian Federation is projected to have the highest increase in TEC (52 %) and FEC (51 %) per capita from 2004 to 2030. TEC and FEC per capita in the other transition countries, which include EECCA (excluding the Russian Federation), SEE and some EU-10 Member States, are also projected to increase (TEC by 32 %, FEC by 41 %), by less than in the Russian Federation but more than in OECD Europe (TEC by 10 %, FEC by 17 %). At the same time, absolute values of TEC and FEC per capita in these other transition countries are projected to remain the lowest in Europe (2.9 toe TEC, 1.9 toe FEC), and levels in OECD Europe to remain 50 % higher than in the Russian Federation and more than 100 % higher than in the other transition countries.
- Globally, China is projected to have the most significant increase in TEC (90 %) and FEC (89 %) per capita, and USA the smallest increase (TEC by 4 %, FEC by 6 %) to 2030. This, however, is not expected to remove current regional inequalities. For example, FEC per capita in 2030 in USA (5.7 toe) is expected to remain almost four times that in China (1.5 toe) and more than ten times that in India (0.5 toe).
- In contrast to Europe and North America, TEC is growing faster than FEC in the Russian Federation, India and China, reflecting the use of less efficient technologies, mostly for power generation.
- World TEC is projected to grow by 53 %, from 11 204 Mtoe in 2004 to 17 095 Mtoe in 2030. The fast-growing economies of Asia, Latin America and Africa are expected to account for 70 % of this increase, the OECD countries for almost a quarter and the transition countries for the remaining 6 %. China's share of world TEC is projected to increase from 15 % to 20 %.

**Note:**

a) Projections are based on the IEA reference case scenario, which takes into account government policies enacted and adopted by mid-2006, even though many of these have not been fully implemented. Possible, potential or even unlikely future measures are not considered. The reference scenario is based on the UNSTAT projections of population growth (world average growth 1 % per year for 2004–2030) and OECD and International Monetary Fund projections for economic development (world average growth 3.4 % for 2004–2030). It is assumed that energy supply and energy use technologies become steadily more efficient, though at varying speeds for each fuel and each sector, depending on the potential for efficiency gains and the stage of technology development and commercialisation. New policies — excluded from the reference scenario — would be needed to accelerate deployment of more efficient and cleaner technologies.

**Geographical coverage:**

**Transition countries**, excluding the Russian Federation (Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Serbia and Montenegro, the Former Yugoslav Republic of Macedonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, Romania, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Cyprus, Malta); **the Russian Federation; OECD Europe** (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the United Kingdom); **OECD North America** (Canada and Mexico); **USA; India; China**.

**Source:**

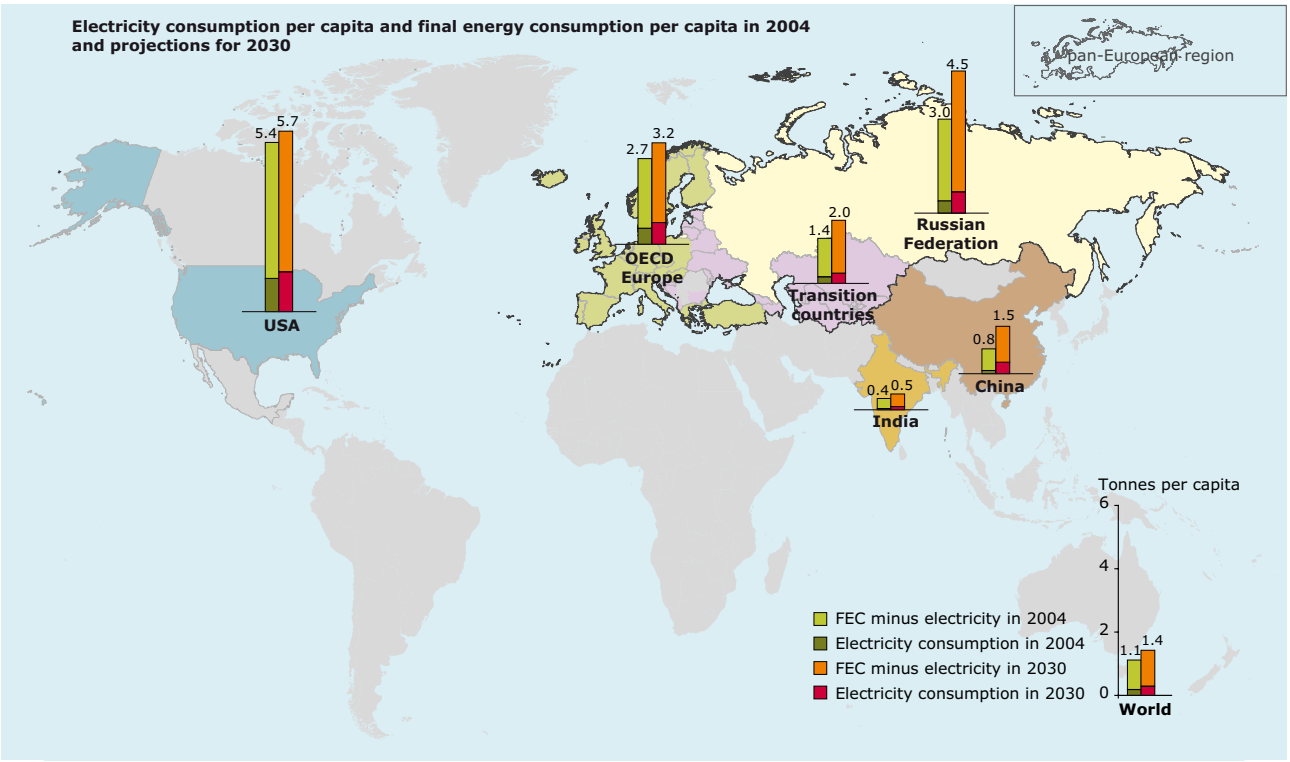
IEA, 2006.

**THEME:** **Energy**
**INDICATOR:** **Electricity consumption**

### Key messages

If current technological trends continue and government policies that have been adopted are implemented ([a]), electricity consumption per capita is expected to continue to grow in all regions/countries. The increase in the pan-European region from 2004 to 2030 is projected to be much smaller (up to 70 %) than in the Asian countries (200 % in China), but substantially higher than in USA (19 %).

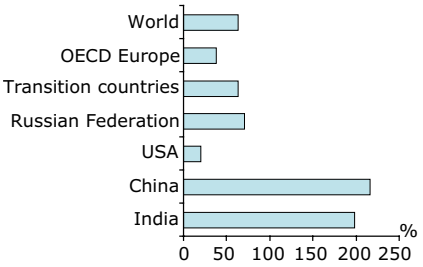
The share of electricity consumption in total final energy consumption is projected to continue to grow worldwide, with the largest increases in China and India.



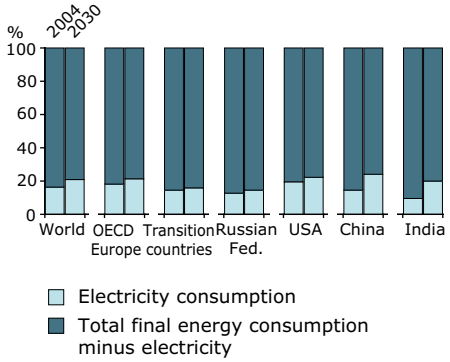

### Definition

**Electricity consumption** is based on calculated consumption; this equals the energy supplied minus transmission and distribution losses.

**Projected percentage change in per capita electricity consumption from 2004 to 2030**




**Share of electricity consumption in final energy consumption by region in 2004 and projections for 2030**




## Outlook to 2030

- The highest increase in electricity consumption per capita in the pan-European region from 2004 to 2030 is projected for the Russian Federation (about 70 %), followed by the other transition countries (about 58 %), and OECD Europe (38 %). This would result in electricity consumption per capita in the Russian Federation almost reaching the same level as OECD Europe by 2030 (0.65 toe per capita compared with 0.69), while other transition countries would still lag behind (0.31 toe per capita).
- The percentage change in per capita electricity consumption from 2004 to 2030 is expected to remain the lowest in USA (about 20 %), but USA is still projected to have the highest per capita consumption (1.25 toe per capita), three times the world average.
- Asia is projected to be the main engine for global growth in electricity consumption. The increase in per capita electricity consumption from 2004 to 2030 would be the highest in China and India, reaching almost 200 %. This would double the share of electricity consumption in final energy consumption in these countries.

**Note:**

a) Projections are based on the IEA reference case scenario, which takes into account government policies enacted and adopted by mid-2006, even though many of these have not been fully implemented. Possible, potential or even unlikely future measures are not considered. The reference scenario is based on the UNSTAT projections of population growth (world average growth 1 % per year for 2004–2030) and OECD and International Monetary Fund projections for economic development (world average growth 3.4 % for 2004–2030). It is assumed that energy supply and energy use technologies become steadily more efficient, though at varying speeds for each fuel and each sector, depending on the potential for efficiency gains and the stage of technology development and commercialisation. New policies — excluded from the Reference scenario — would be needed to accelerate deployment of more efficient and cleaner technologies.

**Geographical coverage:**

**Transition countries**, excluding the Russian Federation (Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Serbia and Montenegro, the Former Yugoslav Republic of Macedonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, Romania, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Cyprus, Malta); **the Russian Federation; OECD Europe** (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the United Kingdom); **USA; India; China**.

**Source:**

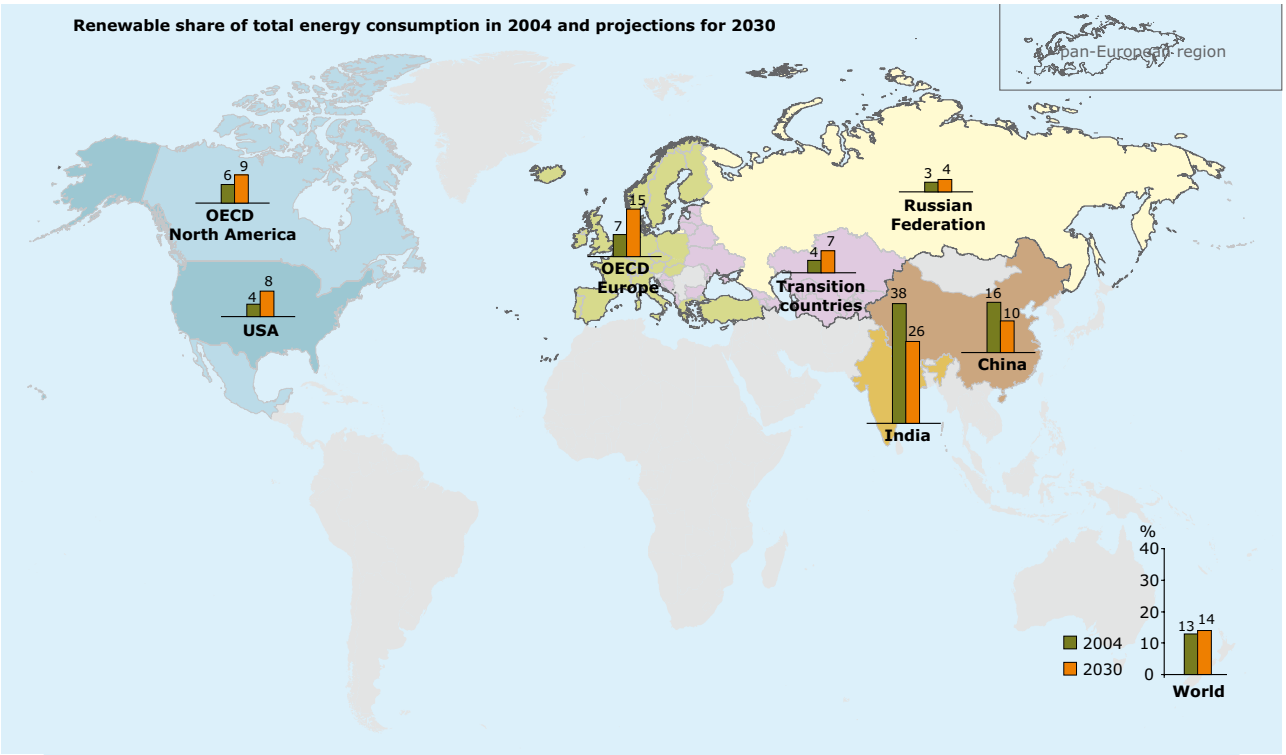
IEA, 2006.

**THEME:** **Energy**
**INDICATOR:** **Renewable share in total energy consumption**

### Key messages

If current technological trends continue and government policies that have been adopted are implemented ([a]),the use of renewable energy in the pan-European region is projected to increase, mainly because of the large increase in OECD Europe. Global renewable energy consumption is projected to increase from 1 475 Mtoe in 2004 to 2 349 Mtoe in 2030. The share of renewables in TEC is projected to increase slightly (from 13 % in 2004 to 14 % in 2030), mainly because of the expected efforts in Europe and North America.

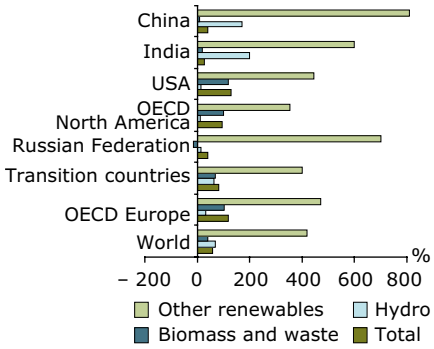
Although biomass would lose part of its share to other forms of energy, it is projected to continue to dominate the renewables market in all the regions except the Eastern part of Europe. Hydropower is expected to remain the second largest renewable source, but to remain the most important in the Eastern part of Europe (about 50 % in 2030). Non-hydro renewables ([b]) are projected to grow the fastest, but with their share in total energy consumption still only reaching 1.7 % in 2030 — up from 0.5 % today.



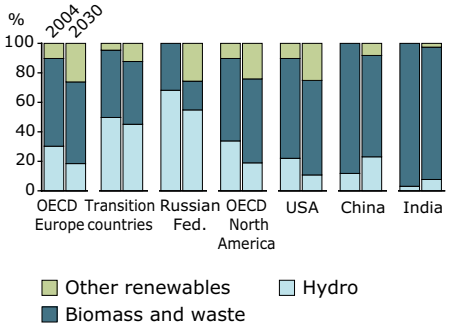

### Definition

**Renewable share of total energy consumption**. Renewable sources include hydro, geothermal, solar thermal, solar photovoltaic, tide, wind, solid biomass, renewable municipal waste and gas from biomass. They do not include industrial waste, non-renewable municipal, and pumped storage production.

**Projected percentage change in renewables consumption by type from 2004 to 2030**




**Fuel shares in total renewable consumption in 2004 and projections for 2030**




## Outlook to 2030

- The use of renewables in the pan-European region is projected to increase, mainly because of the contribution of OECD Europe, where the share of renewables in total energy consumption is projected to more than double between 2004 and 2030, providing government policies adopted and enhanced by mid-2006 are implemented. Projections for the rest of Europe show a smaller increase (from 4 % in 2004 to 7 % in 2030) in the transition countries, including EECCA (excluding the Russian Federation), SEE and some EU-10 Member States, with the share in the Russian Federation increasing from 3 % in 2004 to 4 % in 2030.

- OECD North America shows similar trends to OECD Europe but on a smaller scale. The share of renewables in total energy consumption is projected to increase from 6 to 9 % over the period, with the largest increase in the USA (from 4 % in 2004 to 8 % in 2030).

- India is projected to remain the largest user of renewable energy with 26 % of renewables in its energy mix, but this would be considerably smaller than in 2004 (38 %). A decline in renewable use is also projected for China, from 16 % in 2004 to 10 % in 2030. These declines are because of the replacement of biomass for cooking and heating by modern commercial energy.

- Biomass is projected to continue to dominate the renewables market in all the regions except the transition countries (including the Russian Federation), but its growth is projected to be the lowest and its share of total renewables to decline continuously. The use of hydropower is projected to increase significantly in India and China, increasing its share of total renewables; in the Eastern part of Europe it maintains the major share in spite of a small absolute decline. Other renewable energy technologies, including wind, solar, geothermal, wave and tidal energy, are projected to show the fastest increase in all world regions and increasingly affect the renewable energy mix.

**Note:**

a) Projections are based on the IEA reference case scenario, which takes into account government policies enacted and adopted by mid-2006, even though many of these have not been fully implemented. Possible, potential or even unlikely future measures are not considered. The reference scenario is based on the UNSTAT projections of population growth (world average growth rate 1 % per year for 2004–2030) and OECD and International Monetary Fund projections for economic development (world average growth rate 3.4 % per year for 2004–2030). It is assumed that energy-supply and energy use technologies become steadily more efficient, though at varying speeds for each fuel and each sector, depending on the potential for efficiency gains and the stage of technology development and commercialisation. New policies — excluded from the reference scenario — would be needed to accelerate deployment of more efficient and cleaner technologies.

b) Non-hydro renewables — solar, geothermal, wind, tide and wave energy.

**Geographical coverage:**

**Transition countries**, excluding the Russian Federation (Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Estonia, Serbia and Montenegro, the Former Yugoslav Republic of Macedonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, Romania, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Cyprus, Malta); **the Russian Federation; OECD Europe** (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, Turkey, the United Kingdom); **OECD North America** (Canada and Mexico); **USA; India; China**.

**Source:**

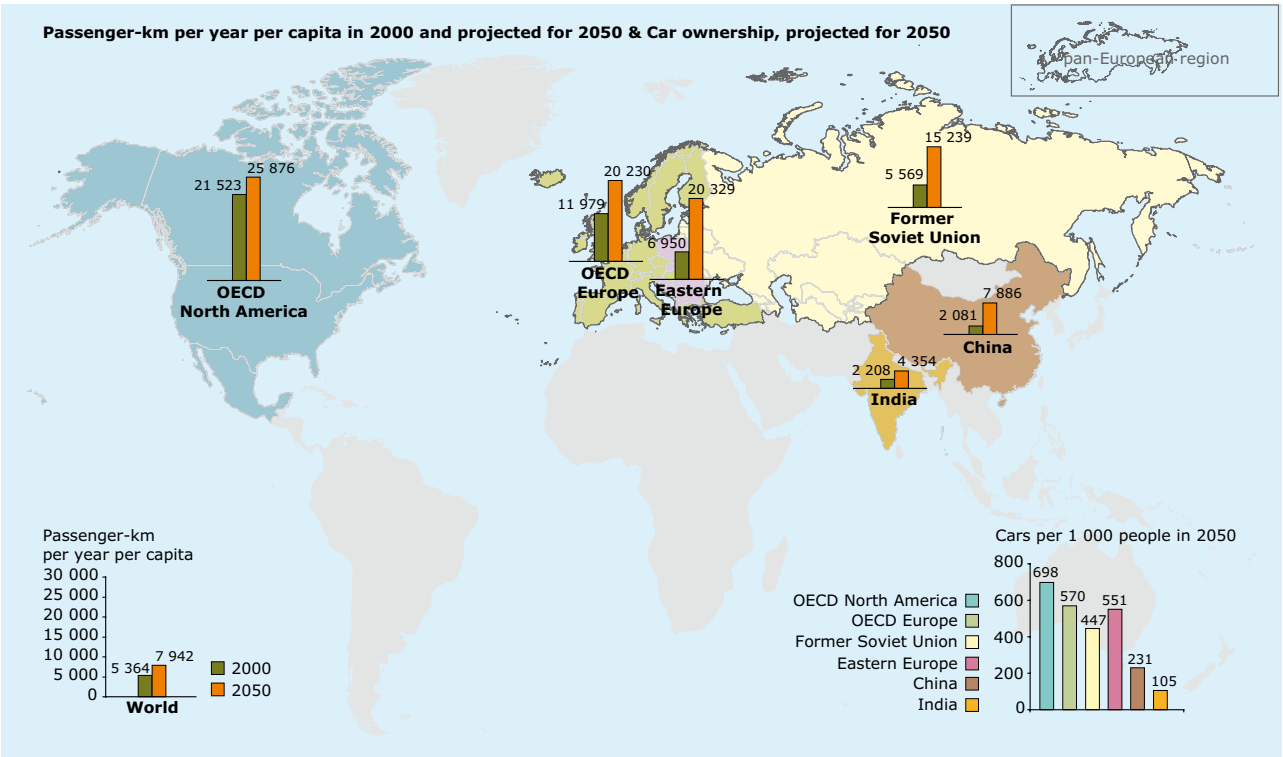
IEA, 2006.

**THEME:** **Transport**
**INDICATOR:** **Passenger transport & Car ownership**

### Key messages

If present policies and technological trends continue ([a]), passenger transport will continue to grow worldwide, but more rapidly in the fast-growing economies of Eastern Europe, China and India.

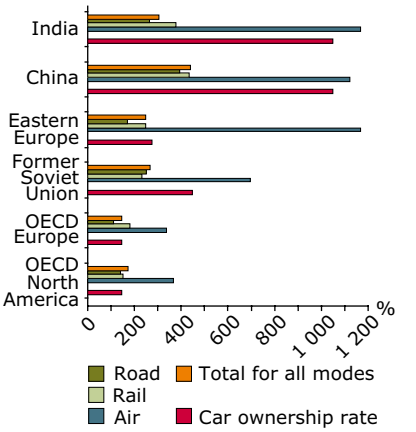
Transport modal shares are expected to shift in a less sustainable direction. Air passenger transport is projected to be the fastest-growing mode. This and road passenger transport together are likely to continue to be the biggest contributors to transport-related $CO_2$ emissions.



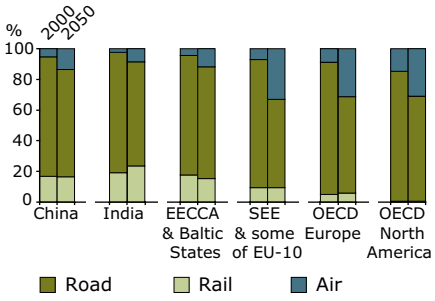

### Definition

**Passenger transport & Car ownership**; passenger cars refer to motor vehicles other than two-wheelers, intended for the carriage of passenger and designed to seat no more than nine people (including the driver).

**Projected percentage change in passenger transport by mode and car ownership rate from 2000 to 2050**




**Modal split in 2000 and projected modal split in 2050**




## Outlook to 2050

- An increase in passenger-km per capita of around 260 % is expected in non-EU Europe. This is more than in the EU and OECD North America and less than in China and India. Passenger-km per capita per year in Eastern Europe is projected almost to triple from 2000 to reach the OECD Europe level (about 20 000 passenger-km per capita per year) in 2050, while it will remain much lower in the EECCA countries (i.e. the Former Soviet Union).
- Although passenger travel per capita in China is expected to remain rather low compared with countries in OECD Europe and OECD North America, it is expected to have the second biggest share of transport volumes in the world (11 608 billion passenger-km per year), after OECD North America (15 111 billion).
- In terms of modal shifts, air passenger transport is projected to be the fastest-growing mode in all world regions (ranging from a 1 167 % increase in India to 337 % in OECD Europe). Passenger rail is assumed to be the second most rapidly growing mode of personal transport, with the biggest increase in China and India. Road transport is expected to continue increasing at moderate rates, but losing its share in the total due to increased air transport, which is projected to increase from around 10 % to one third of total passenger transport.
- Car ownership is expected to increase globally, however at a faster rate in Eastern Europe, the EECCA countries and China. In Eastern Europe and the EECCA countries (i.e. the Former Soviet Union), car ownership per 1 000 is projected to exceed today's level in OECD Europe (390 cars/1 000). Car ownership in China increases from 13 to 230 cars/1 000 in the period 2000 to 2050.

**Note:**

a) Projections are based on the reference case scenario. The reference case projects one possible set of future conditions, based on recent trends. Adjustments are made for expected deviations from recent trends due to factors such as existing policies, population projections (UNSTAT), income projections (IEA) and expected availability of new technologies. Expectations of other future changes in trends, such as saturation of vehicle ownership, are also incorporated. In general, no major new policies are assumed to be implemented beyond those already implemented in 2003, and no major technological breakthroughs.www.wbcsd.org/web/publications/mobility/smp-model-document.pdf

**Geographical coverage:**

**OECD Europe** (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom); **OECD North America** (USA, Canada, Mexico); **Former Soviet Union** (Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan); **Eastern Europe** (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Former Yugoslav Republic of Macedonia, Poland, Romania, Slovakia, Slovenia, Serbia and Montenegro); **India; China**.

**Source:**

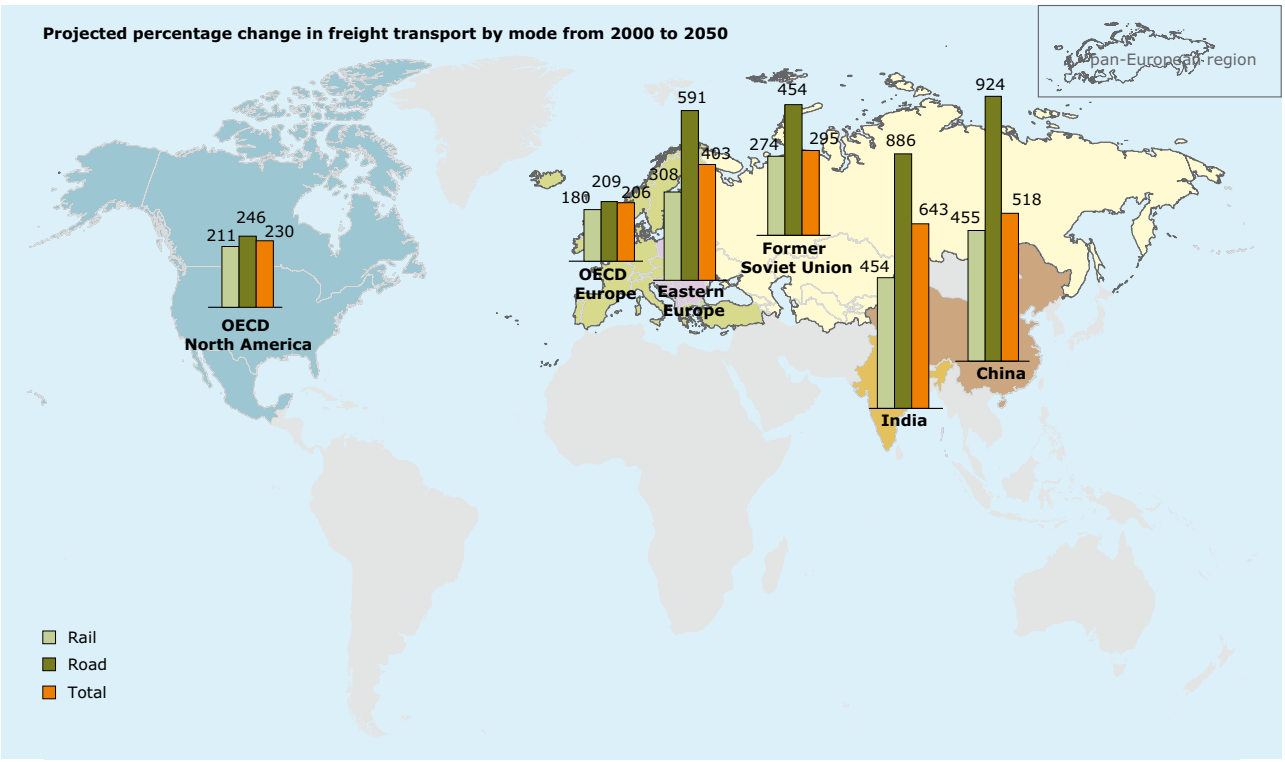
WBCSD, 2004.

**THEME:** **Transport**
**INDICATOR:** **Freight transport demand**

### Key messages

If present policies and technological trends continue ([a]), freight transport is projected to continue to grow worldwide. In the Pan-European region the most significant growth is expected in Eastern Europe, while worldwide a more rapid increase is projected in the fast-growing economies of China and India.

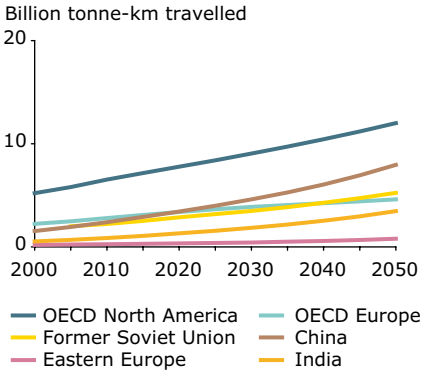
Worldwide road transport is expected to grow faster than rail transport. This is expected to lead to substantial shifts of the modal split of freight transport towards less sustainable modes.



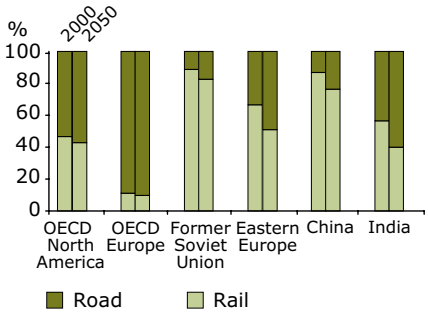

### Definition

**Freight transport demand** refers to the total volume of freight transport by inland transport modes in 'tonne-km traveled'. Modal split of freight transport in tonne-km traveled is defined as the share of transport by a certain transport mode (road, rail, water borne transport) in total inland transport.

**Projections of total freight transport activity from 2000 to 2050**




**Freight transport modal split in 2000 and projected split in 2050**




## Outlook to 2050

- In terms of modal shifts, road is projected to be the fastest-growing freight transport mode in all world regions (ranging from an 824 % increase in China to 109 % in OECD Europe) resulting in a decrease in the share of rail transport. OECD-Europe currently has the smallest share of rail in total freight transport and its share is expected to drop from 11 % in 2000 to 9.5 % in 2050. In EECCA countries (i.e. the Former Soviet Union) rail is projected to remain the dominant mode of freight transport; however its share also drops, from 88 % in 2000 to 82 % in 2050. The most significant decrease in the share of rail in freight transport in the pan-European region is expected to be in Eastern Europe, falling from 63 % in 2000 to 50 % in 2050. Similar trends are expected in other parts of the world.

**Note:**

a) Projections are based on the reference case scenario. The reference case projects one possible set of future conditions, based on recent trends. Adjustments are made for expected deviations from recent trends due to factors such as existing policies, population projections (UNSTAT), income projections (IEA) and expected availability of new technologies. Expectations of other future changes in trends, such as saturation of vehicle ownership, are also incorporated. In general, no major new policies are assumed to be implemented beyond those already implemented in 2003, and no major technological breakthroughs (www.wbcsd.org/web/publications/mobility/smp-model-document.pdf).

**Geographical coverage:**

**OECD Europe** (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom); **OECD North America** (USA, Canada, Mexico); Former Soviet Union (Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan); **Eastern Europe** (Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Former Yugoslav Republic of Macedonia, Poland, Romania, Slovakia, Slovenia, Serbia and Montenegro); **India; China**.

**Source:**

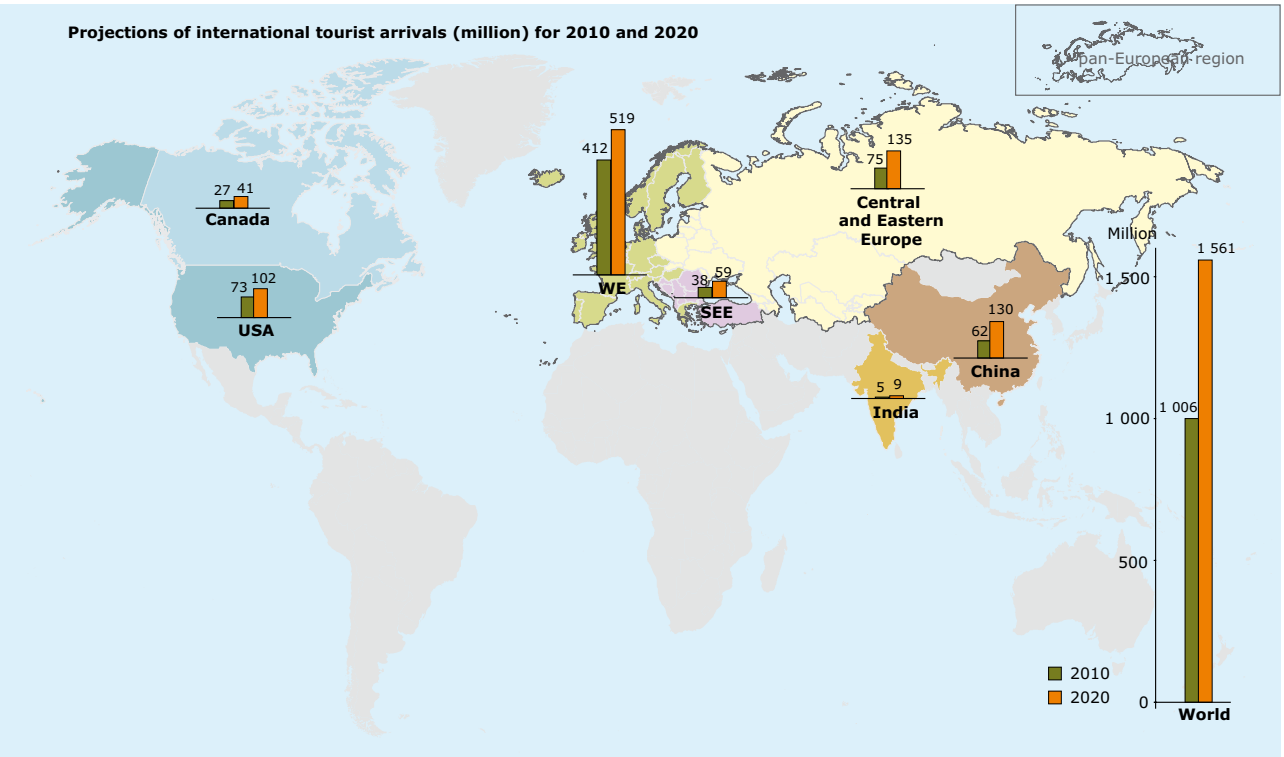
WBCSD, 2004.

**THEME:** **Tourism**
**INDICATOR:** **International tourist arrivals**

### Key messages

If current economic, social and industry trends continue ([a]), tourism in the pan-European region and worldwide will grow at an average rate of 4.1 % a year. Very high increases in international tourist arrivals in some SEE and CEE countries could result in additional pressures on the environment.

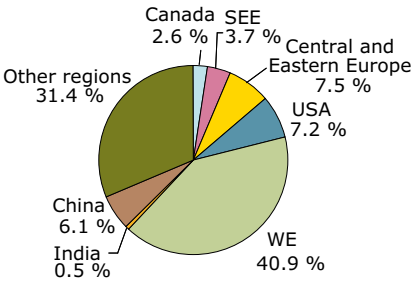
Globally, international tourist arrivals are projected to exceed 1 billion in 2010 and reach more than 1.6 billion in 2020, almost doubling the 2005 level.



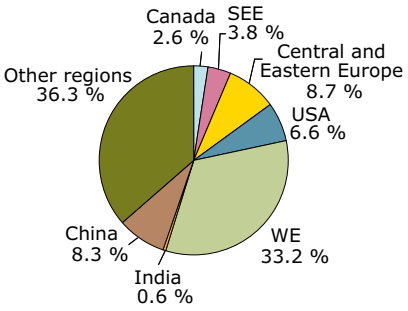

### Definition

**International tourist arrivals** are used to quantify the volume of international tourism. Data refer only to overnight visitors staying at least one night in collective or private accommodation in the country visited.

**World share of international tourist arrivals, 2010**




**World share of international tourist arrivals, 2020**




## Outlook to 2020

- Projections suggest that international tourist arrivals in the pan-European region by 2020 might reach about 717 million. WE is expected continue to be the most visited tourist region in the world with a total of more than 500 million international tourist arrivals in 2020. However, the rate of increase of arrivals over the period 1995-2020 are assumed to the lowest in the pan-European region, at only 2.4 % per year. As a result, the market share of WE is expected to fall from 43 % in 2005 to 33 % in 2020.
- Following past trends, international arrivals in CEE and SEE are projected to show the fastest growth, to almost twice the 2000 levels by 2020. The highest growth rates for 1995–2020 is expected to be in Croatia and Serbia, and Montenegro (8.4 %, and 8.2 % per year, respectively), the Russian Federation (6.8 % per year), Slovenia (6 % per year), Turkey (5.5 % per year), Bulgaria and Romania (both 4.6 % per year). The CEE countries' share of the tourist market is projected to increase from 7.5 % in 2010 to 8.7 % in 2020, partly because of the increased prosperity in these countries.
- International arrivals in India and China, increasing by 5.9 % and 7.8 % per year, respectively, are assumed pass Canada and USA (up to 3.6 % per year), turning the Asian region to the second largest receiving region after WE. The number of international tourist arrivals in China alone is expected to reach 130 million, almost 650 % higher than in 1995. As a result its market share increases to 8.2 % in 2020.

**Note:**

a) Projections are based on the World Tourism Organization's baseline scenario. This takes account of current economic, social and industry trends (including travel forecasts of aircraft manufacturers); considerations are also given to the wide range of individuals and organisations that present views on the future from one perspective or another.

**Geographical coverage:**

**Western Europe** (WE — Austria, Belgium, France, Germany, Luxembourg, Netherlands, Switzerland, Denmark, Finland, Iceland, Ireland, Norway, Sweden, United Kingdom, Greece, Hungary, Italy, Malta, Portugal, Slovenia, Spain, Cyprus, Czech Republic); **SEE** (Albania, Bulgaria, Bosnia and Herzegovina, Croatia, the Former Yugoslav Republic of Macedonia, Romania, Serbia and Montenegro, Turkey); **Central and Eastern Europe** (Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kyrgyzstan, Kazakhstan, Latvia, Lithuania, Republic of Moldova, Poland, the Russian Federation, Slovakia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan); **Canada; USA; India; China**.

**Source:**

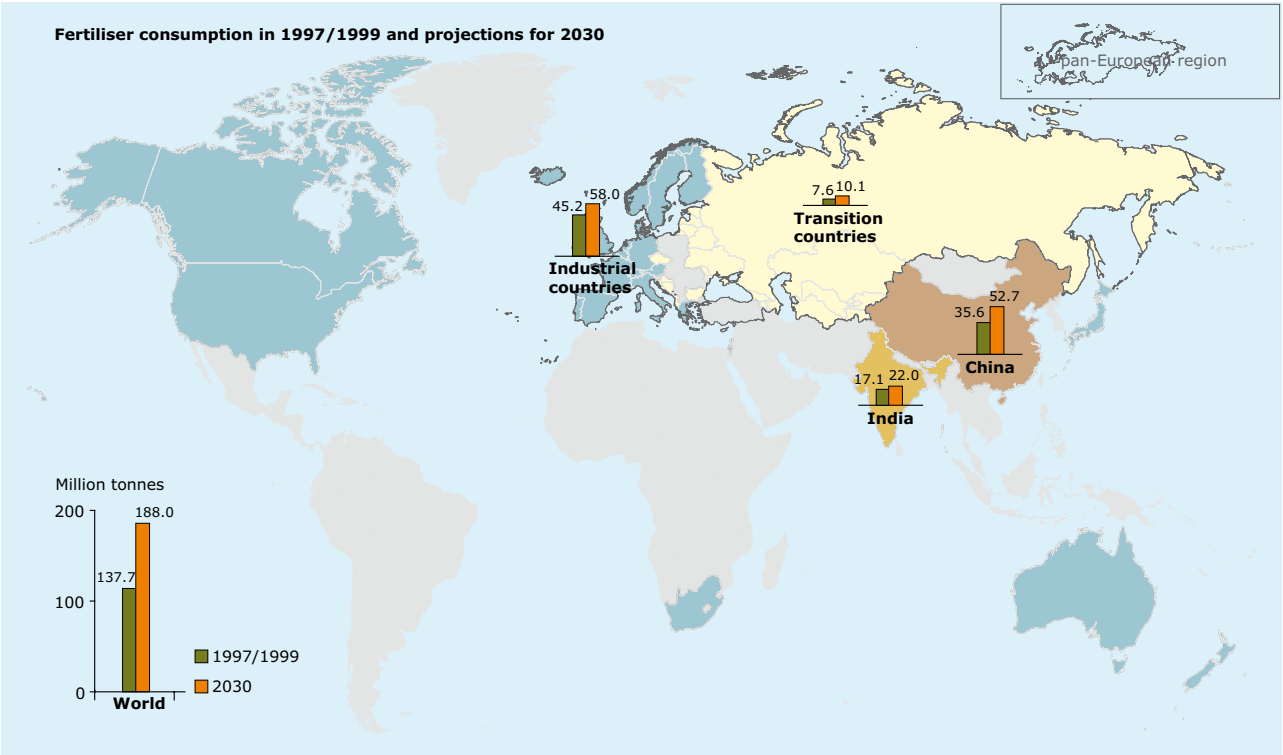
World Tourism Organization, 2001.

**THEME:** **Agriculture**
**INDICATOR:** **Total fertiliser consumption**

### Key messages

The expected growth in populations and economies in all regions implies increasing demand for crops and other agricultural products worldwide. If the current trends continue and if the efficiency of fertiliser use is improved ([a]), this increasing demand leads to an 1 % increase per year in global fertiliser use (37 % increase in total between 1997 and 2030).

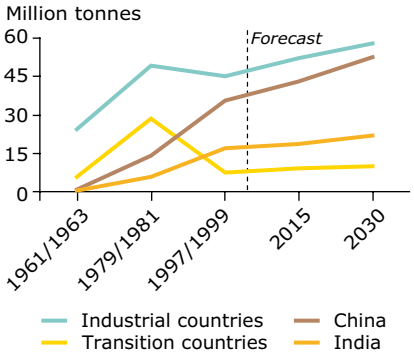
However, fertiliser use in many developing countries is very inefficient. Best practices for fertiliser handling could significantly reduce the environmental pressures associated with nutrient losses. Even modest increases in fertiliser application could cause problems when yield growth stagnates, leading to inefficient use of nutrients and severe pollution.



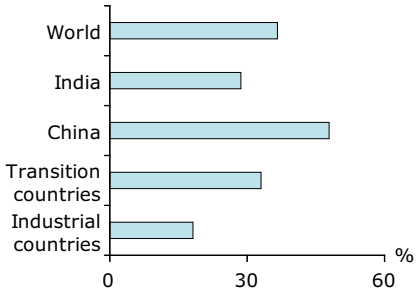

### Definition

**Total fertiliser consumption** refers to the total sum of nitrogen (N), phosphate ($P_2O_5$) and potash ($K_2O$) used in agriculture. The time reference is generally the crop year (July through June).

**Projections of fertiliser consumption**




**Change in fertiliser consumption from 1997/1999 to 2030**




## Outlook to 2030

- If current trends continue and the efficiency of fertiliser use is improved ([a]), global fertiliser use is projected to increase by 37 % from 1997 to 2030. Current transition countries (EECCA, SEE and some EU-10 Member States) are projected to account for only 5 % of world fertiliser use by 2030. However, fertiliser use in these countries is expected to increase by 32 % from 1999 to 2030, more rapidly than in industrialised countries, following the stabilisation of the economic situation during recent years and the projected economic growth in these regions.
- North America, Western Europe and other industrialised countries are projected to account for more than 30 % of all fertiliser use in 2030. The increase in these countries (about 28 % from 1990 to 2030), especially in Western Europe ([b]), is expected to lag significantly behind that in other regions of the world as a result of the implementation of a number of research and regulatory measures to limit pollution from fertilisers; this would, however, not be enough to prevent a serious build-up of nitrate in waters.
- In 2030, China is still likely to be the biggest single consumer of fertilisers — up to 28 % of total world use. Fertiliser consumption there is expected to increase much more rapidly than in other developing countries (by 48 % from 1999 to 2030).

**Note:**

a) Projections are based on the Food and Agriculture Organization vision concerning food, nutrient and agriculture. The vision takes into account current economic, social and industry trends as well as improved efficiency of fertiliser use.

b) The European fertiliser manufacturers association make regular forecasts of fertiliser use in the European Union. These forecasts show a decline of all nutrients for 2012 compared with the base year average (1999–2001) (nitrogen 7 %, phosphorus 13 % and potassium 12 %). It is based on criteria laid down in the current Common Agricultural Policy, but have not taken into account any of the new measures in the European Commission's Mid Term Review which could result in an even bigger decline.
Source: Forecast of food, farming and fertilizer use in the European Union, 2002–2012, EFMA2012.

**Geographical coverage:**

**Industrial countries** (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, the United Kingdom, Iceland, Malta, Norway, Switzerland, Canada, USA, Australia, New Zealand, Israel, Japan, South Africa); **Transition countries** (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, the Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan, Estonia, Latvia, Lithuania, Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic); **China; India**.

**Source:**

FAO, 2003.

European Environment Agency

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