

# THE EUROPEAN ENVIRONMENT

STATE AND OUTLOOK 2010  
SYNTHESIS

European Environment Agency



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## Key messages

Environmental policy in the European Union and its neighbours has followed major improvements in the state of the environment. However, major environmental challenges remain which will have significant consequences for Europe if not addressed.

**What drives us forward, compared to previous EU European environment**

— **Goals and values** remain, as an inherent underpinning of the links between environment, challenges remained with exceptional global megatrends. This has allowed a deeper appreciation of the human-made systems risks and vulnerabilities which threaten ecosystem security, and brought into the mainstream of governments.

The prospects for Europe's environment are mixed but there are opportunities to end a long period of slow progress for air, noise and climate. There include opportunities to improve air, water, resources and biodiversity, energy, climate and environment, and a renewed commitment to the combined principles of prevention and protection, avoiding damage in water and pollution. These overarching findings are supported by the following 10 key messages:

- **Continuing depletion of Europe's stocks of natural capital and flows of ecosystem services will adversely undermine Europe's economy and social cohesion.** Most of the negative changes are driven by growing use of natural resources to satisfy production and consumption patterns. This results in a significant environmental footprint for Europe and elsewhere.
- **Climate change** — The EU has reduced its greenhouse gas emissions and is on track to meet its Paris Pledge of zero emissions. However, global sea level rise and temperature rise are set to increase and will reach 2°C. Greater efforts are needed to mitigate the risks of climate change and put in place adaptation measures to increase European resilience.

- **Nature and biodiversity** — Europe has established an extensive network of protected areas and programmes to reverse the loss of natural species. However, widespread alteration of landscapes, degradation of ecosystems and rare occurrence of natural areas. The EU will not meet its target of halting biodiversity loss by 2030. To improve the situation, we must protect the biodiversity and ecosystem services provided by all soils, particularly addressing agriculture, forestry, regional development, tourism and urban planning.

- **Natural resources and waste** — Environmental regulations and measures have led to increased resource efficiency through a faster decoupling of resource use, emissions and waste generation from economic growth in some areas. However, absolute decoupling remains a challenge, especially for materials. This requires steps not only to improve production processes further, but also to set consumption patterns to reduce environmental pressure.

- **Environment, health and quality of life** — Older and ill populations are exposed to air and noise pollution, and water quality in all water bodies are to ensure good air quality in all urban areas. With respect to water, it is likely to be further degraded and deteriorate and continue to bring harm damage to human health. Together they will be more targeted pollution prevention programmes and the use of precautionary approaches.

- **Goals between the state of Europe's environment and various global megatrends** (such as increasing economic risk). Many key drivers of change are highly interconnected and likely to unfold over decades rather than years. These interconnected areas and trends, many of them outside Europe's direct influence, will have significant consequences and potential risks for the resilience and sustainability of the planet of which we are a part. Greater efforts to address the challenges and associated uncertainties will be needed.

- **The nature of a digitalised economy of natural capital and ecosystem services is a complex, integrating concept for shifting work, environmental pressures from multiple sectors, digital planning, economic modelling and evaluation among others.**

policy implemented at all scales can help balance the need to preserve natural capital and wealth for the economy. A more integrated approach of this sort would also provide a framework for monitoring progress more closely and designing coherent analysis across multiple policy targets.

- **Increased resource efficiency and security can be achieved**, for example, using extended life cycle approaches to reflect the full environmental impacts of products and services. This can reduce Europe's dependence on resources globally and promote innovation. Funding that takes full account of resource use impacts will be important for steering business and consumer behaviour towards more sustainable outcomes. Combining a more precise accounting of their resource needs and environmental pressures would improve coherence, address shared challenges, identify, measure economic and social benefits and help avoid unintended consequences.
- **Implementing environmental policies and strengthening environmental governance will continue to provide benefits.** Better implementation of existing and environmental policies will help ensure that goals are achieved and provide regulatory clarity for businesses. A broader commitment to environmental monitoring and up-to-date reporting of environmental pollutants and wastes, using the best available information and technologies, will raise environmental performance across the board. This includes setting high-ambition standards even through wide action.
- **The transition towards a green European economy will require the implementation of a new set of instruments, of the type and its implementation.** In this context, state interventions will be important, together, regulatory, business and citizens could participate more actively in managing a smooth capital and ecosystem services, creating new and innovative ways to use resources efficiently and delivery sustainable local solutions. Using nature-based and nature-based services, solutions can be developed by taking greater action, such as setting the 2°C climate target.

The overall future outlook is that the best chance to help these goals and flourish.







track how the more detailed analysis that follows show that in some instances, such as ozone and greenhouse gas emissions, there are substantial differences by region, sector and country.

Several key environmental issues are not shown in this summary table, often because they lack suitable targets or because it is necessary to measure progress against more readily agreed targets. Such key issues include, for example, noise, chemicals and hazardous substances, marine and technological issues. They are, however, discussed in subsequent chapters of this report and the results from their analysis have contributed to the conclusions of this report.

The overall emerging picture of progress towards meeting environmental targets, confirms the findings of previous European State of the Environment reports, namely that there have been considerable improvements in many areas, but a number of major challenges remain. This picture is also reflected in the overall European Strategy Report by the European Commission to track up to two-thirds of the Sustainable Indicators as selected areas of good performance or 'overcoming trends', while the remainder point to areas of good performance or of least concern progress has not been assessed at target (17).

#### Links between environmental progress and progress towards environmental objectives

This report describes the state of each trend in the environment in Europe as well as progress for the Union along a central strand of four objectives and issues: climate change, nature and biodiversity, natural resources and energy, and environmental health and quality of life. There is a clear correlation between what points at they are the priorities of several European strategic policies: the EU-Mitigation and Adaptation Programme (17) and the EU Strategy for Sustainable Development (18), and thereby help to make a direct link with the European policy documents.

The analysis points to the fact that today's understanding and perceptions of environmental challenges are changing so Europe can better be seen as a dynamic, single and specific issue. It offers the challenges are increasingly broad, complex and complex, part of a wider

**Table 1.3** Indicators summary table of progress towards meeting environmental targets or objectives, and highlights of related trends over the past 10 years (2) (EOP1)

Environmental Issue	EU-27 target/objective	EU-27 in 2008	EU-27 in 2018
<b>Environmental indicators</b>			
<b>Global average temperature increase</b>	To limit increase to below 2°C (1)	-	(+)
<b>Greenhouse gas emissions</b>	To reduce greenhouse gas emissions by 40% by 2030 (1)	(-)	(-)
<b>Energy efficiency</b>	To reduce primary energy use by 39% by 2030 (1)	(-)	(-)
<b>Renewable energy source</b>	To increase energy generated from renewables by 32% by 2030 (1)	(-)	(-)
<b>Nature and biodiversity</b>			
<b>Change in protected areas</b>	At least 10% of EU territory to be protected (2)	(-)	(+)
<b>Terrestrial species</b>	To reduce terrestrial species loss (3)	(-)	(-)
<b>Marine species</b>	To reduce marine species loss (3)	(-)	(-)
<b>Biodiversity</b>	To halt the loss of biodiversity (4)	(-)	(-)
<b>Terrestrial and marine species</b>	To halt the loss of species (4)	(-)	(-)
<b>Terrestrial and marine species</b>	To reduce further loss of species (4)	(-)	(-)
<b>Environmental health and quality of life</b>			
<b>Climate change and air quality</b>	To reduce health loss from air pollution (5)	(-)	(-)
<b>Water protection</b>	To substantially reduce water pollution (6)	(-)	(-)
<b>Water management</b>	Water recycling in 2020 (7)	(-)	(-)
<b>Water reuse</b>	To reduce water loss (8)	(-)	(-)

**Table 1.3** Indicators summary table of progress towards meeting environmental targets or objectives, and highlights of related trends over the past 10 years (2) (EOP1)

Environmental Issue	EU-27 target/objective	EU-27 in 2008	EU-27 in 2018
<b>Environmental indicators</b>			
<b>Water quality</b>	To achieve good chemical and overall status of water bodies (1)	(-)	(+)
<b>Water pollution</b>	To comply with existing water quality laws and policies (2)	(-)	(-)
<b>Terrestrial and marine species</b>	To halt reduction of biodiversity (3)	(-)	(-)
<b>Terrestrial and marine species</b>	To reduce further loss of species (4)	(-)	(-)
<b>Terrestrial and marine species</b>	To reduce further loss of species (4)	(-)	(-)
<b>Issues</b>			
<b>Climate change</b>	<b>Positive developments</b>	<b>Negative developments</b>	<b>Key developments</b>
(1) Greenhouse gas emissions	Stable	(2) Emissions level	(3) Emissions level
(2) Energy efficiency	Stable progress	(4) Emissions level	(4) Emissions level
(3) Biodiversity	Stable progress	(5) Emissions level	(5) Emissions level
(4) Water quality	Stable progress	(6) Emissions level	(6) Emissions level

Source: EEA (2)

of linked and interdependent functions, provided by different natural and social systems. This does not imply that the environmental concerns which emerged in the previous century, such as how to manage gas management strategies or how best to use land, are no longer important. Rather, it points to trends in increased degree of complexity in the way we understand and respond to environmental challenges.

This report seeks to shed light on these various developments on key characteristics of the complex links between environmental issues. It does so by providing a clear analysis of the links between different environmental challenges, as well as between environmental and societal trends and their respective policies. For example, reducing the rate of climate change requires not only the reduction of greenhouse gas emissions from power plants, but also the reduction of other climate-warming items from transport and agriculture as well as changes to household consumption patterns.

Taken together, trends in Europe and globally point towards a number of critical environmental risks, such as the potential loss or damage to our water systems other than a single element, which can be made worse by a more developed water system. Systems that are more integrated by nature events or built up over time, with the impact of climate change and possibly catastrophic (7).

A number of underlying developments in Europe's environmental policy landscape characterise the current state:

- many of Europe's environmental issues, such as climate change or biodiversity loss, are linked with a complex and often global character;
- they are closely linked to other challenges, such as unsustainable economic loss, that span the natural and economic systems and underline important ecosystem services;
- an environmental challenge now requires to be seen as more and more profound linked to other societal concerns, the interconnected, and that consist of both local and global.





## 2 Climate change

### Climate change could lead to catastrophic impacts if uncontrolled

Since the global climate has been substantially warmer for the past 10 000 years, providing a backdrop for the development of human civilisation, there are now clear signs that the climate is changing (1). This is widely recognised as one of the most pronounced challenges facing humanity. Measurements of the global atmospheric concentration of greenhouse gases (GHG) (2) show marked increases since pre-industrial times, with levels of carbon dioxide (CO<sub>2</sub>) at increasing (the urban) range of the past 100 000 years. The concentration of atmospheric CO<sub>2</sub> has increased from a pre-industrial level of around 280 ppm to more than 400 ppm in 2010 (3).

Increase in GHG concentration are largely due to the use of fossil fuels, although other sources, local land change and agriculture also provide significant but smaller contributions. As a consequence, the average global air temperature in 2012 had risen by 0.7 to 0.8 °C since pre-industrial times (4). Indeed, the Intergovernmental Panel on Climate Change (IPCC) concluded that global warming since the middle of the 20th century is very likely to have been due to human influence (5) (6).

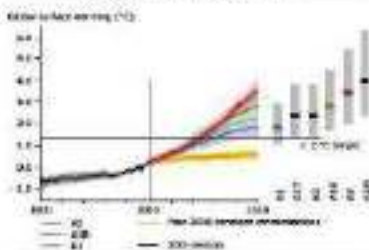
In addition, best estimates of recent projections suggest global mean temperatures could rise by as much as 1.5 to 4.5 °C – or 1.3 to 4.2 °C, taking only account the full, not steady range – over the course of the century if global action to limit carbon emissions proves unsuccessful (7). Recent observations give reason to believe that the rate of growth in GHG emissions and many climate impacts, as approaching the upper boundary of the IPCC range of projections rather than the lower ones (8) (9).

Changes in climate and temperature increase of sea level heights are associated with a wide range of potential impacts, already over the last three decades, warming has had noticeable influence on the global water resources changes including human and natural systems.

– including shifts in precipitation patterns, rising global mean sea level, the onset of glaciers and decline in the extent of Arctic sea ice coverage. Furthermore, it may influence how natural has changed, especially in those at greater altitudes (9).

Other consequences of changing climate conditions include increases in global mean ocean temperatures, widespread melting of snow and ice sheets, increased risks to the urban poor and ecosystems, ocean acidification, and extreme climate events including heat waves. The impacts of climate change are expected to be felt in all regions of the planet, and Europe is no exception. Unless action is taken, climate change are expected to lead to considerable adverse impacts.

Figure 2.4 – Past and projected global surface temperature change (relative to 1962–1990), based on multi-model estimates for selected IPCC scenarios



Note: The bars in the right of the figure indicate the mean estimate (with the error bars) for the likely temperature range for all six IPCC scenarios from 2041–2100 relative to 1962–1990. The error bars reflect the low level of data for the 1950–1979 period, and the 2000–2010 period. The bars represent the 5% to 95% range of the likely temperature range for each scenario. The vertical dashed line indicates the 1.5°C target.

Source: Intergovernmental Panel on Climate Change (IPCC) (7).

In addition, with increasing global temperatures, there is an increasing risk of passing tipping points that may trigger large-scale, nonlinear changes (Chapter 7).

### Europe's commitment to limit global mean air temperature increases to below 2 °C

During the past few decades, evidence to our changing relationship with the climate system is the fastest, widely recognised goal to limit the global mean temperature increase over pre-industrial levels to below 2 °C (10). Meeting this target will require substantial reductions in global GHG emissions, a combination of the atmospheric CO<sub>2</sub> concentration, and applying estimates of global climate sensitivity that surrounding target can be translated into limiting atmospheric CO<sub>2</sub> concentrations to around 350–450 ppm. If all GHG emissions are included, a total of 450–600 ppm CO<sub>2</sub> equivalent is often cited (11) (12).

As indicated above, atmospheric CO<sub>2</sub> concentrations are already close to this level and are currently increasing by about 2 ppm per year (13). Thus, to achieve the below 2 °C target, global CO<sub>2</sub> emissions would need to level off in the present decade and be reduced significantly thereafter (14). In the long run, reaching this target is likely to require stabilisation rates of around 50 % compared to 1990 levels by 2050 globally (15). For the EU-27 and other industrialised countries this translate to emission cuts of 25–40 % by 2020 and 40–60 % by 2050 – if developing countries also cuts their emissions substantially compared to their respective income as a result of such a projection.

However, even a 2 °C global average is guaranteed for limiting all adverse climate change impacts will be subject to uncertainties. The Climate Action Plan, adopted in Commission on Climate Change (EUCCC) Conference of the Parties held in Copenhagen in 2009, sets out the European climate, which calls for an assessment of the impact associated with 2 °C. This assessment is a combination of arrangements that long-term (2050) reference climate values provided by the scenario, including a values or temperature rise of 1.0 °C (16).

### The EU has been reducing its greenhouse gas emissions, and will meet its Kyoto obligations

Meeting the target of limiting global temperature increases to not more than 2 °C will require a concerted global effort – including the fast reduction GHG emissions relative to income. In 2009, the EU was responsible for between 11 and 12 % of global GHG emissions (17) – while being home to 8 % of the world's population. According to current projections taking into account population growth and economic development worldwide, Europe's percentage contribution will decrease, as emissions in emerging economies continue to increase (18).

Annual emissions of GHG in the EU in 2008 corresponded to around 19 tonnes of CO<sub>2</sub> equivalent per person (19). In terms of total emissions, the EU is third power behind China and the USA (20). Nevertheless, the levels in EU GHG emissions relative to emissions developed – measured by gross domestic product (GDP) – in the EU, indicate an overall decoupling of emissions from economic development over time. Between 1990 and 2007, emissions per unit of GDP decreased in the EU-27 by more than a third (21).

However, it should be noted that these emission figures only represent what is emitted within the EU territory, calculated according to agreed international guidelines under UNFCCC. The gap's contribution to global emissions could be greater if European exports of goods and services, with their embedded carbon, are taken into account.

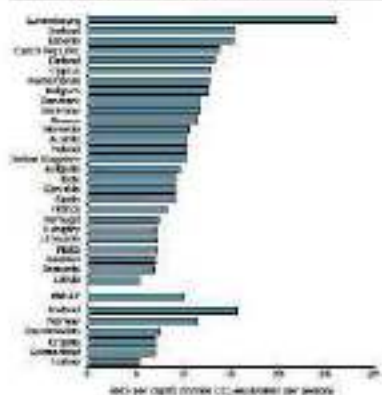
Climate action data confirm that the EU-26 Member States are on track to meet their target of cutting emissions by 8 % compared to base-year levels – 1990 for most countries – during the first commitment period under the Kyoto Protocol, the period from 2008 to 2012. Reductions in the EU-27 have been even greater than in the EU-26, thanks to GHG reductions that by approximately 10 % between 1990 and 2007 (22) (23).

It is worth noting that the UNFCCC system does not include a date that cover all GHG. Many of the emissions covered under the Montreal Protocol, such as chlorofluorocarbons (CFCs), are also potent GHGs. The phasing out of climate-changing ozone-depleting



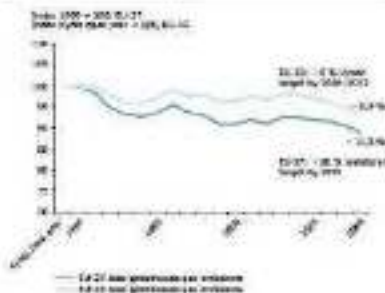
countries (GCC) under the Montreal Protocol has contributed, following to a very slight decrease in GHG emissions (the largest since) GHG emissions globally by over 10% (the reduction expected through phase-out with the phase-out of the Kyoto Protocol by the end of 2011 (\*).

Figure 2.2 Greenhouse gas emissions by total CO<sub>2</sub>-equivalent per person by country in 2008



Source: IEA.

Figure 2.3 Domestic GHG emissions in EU-25 and EU-27 between 1990 and 2008 (%)



Source: IEA.

**A closer look at key sectors of greenhouse gas emissions reveals several trends**

The main sectors of greenhouse gas emissions are the burning of fossil fuels for electricity generation, transport, industry and households – which together account for almost two-thirds of total global emissions. Other sources include deforestation – which contributes about a 10% – agriculture, land filling of waste, and the use of numerous man-made gases. Overall, in the EU, energy consumption – power and heat generation and consumption in industry, transport and households – accounts for nearly 90 % of GHG emissions (\*).

Historic trends of GHG emissions in the EU over the past 20 years are the result of two sets of opposing factors (\*):

On the one hand, emissions have been driven upward by a series of factors, such as:

- increases in the production of electricity and heat by thermal plants, which has increased both as absolute tonnes and as comparison with other sources;
- economic growth in manufacturing industries;
- increasing transport demand for passengers and freight;
- increasing share of road transport compared with other transport modes;
- increasing number of households;
- and demographic changes over the past decades.

On the other hand, emissions have been driven downwards in the same period by factors such as:

- an improved energy strategy, in particular by national and local and the energy industries;
- fuel efficiency improvements in vehicles;
- better waste management and improved water efficiency; the waste sector achieved the highest relative reduction;
- increases in emissions from agriculture by more than 20 % since 1990;
- a shift from coal to less polluting fuels, particularly gas and biomass, for the production of electricity and heat;
- and partly due to the economic restructuring in eastern Member States in the early 1990s.

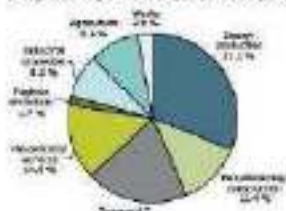
EU GHG emissions levels between 1990 and 2008 were dominated by the two largest emitters, Germany and the United Kingdom, which together were responsible for more than half of the total reduction in the EU. Spanish and Dutch emissions were also reduced by some 15-17 Member States, such as Bulgaria, Czech Republic, Finland and Romania. The overall emissions reduction is mainly due to emissions increases in agriculture, to a lesser extent, Italy, Greece and Portugal (\*).

The overall trends are influenced by the fact that, in many cases, emissions from large point sources have been reduced, while at the same time emissions from the mobile and/or diffuse sources, especially from transport sectors, have increased substantially.

In particular, transport CO<sub>2</sub> emissions in particular are rising quickly. Transport emissions of CO<sub>2</sub> increased by 34 % between 1990 and 2008 in the EU-27, including emissions from international aviation and marine transport (\*). While the freight and marine subsector has declined in most of them, the number of cars in the EU-27 increased by 20 %, or 47 million cars, between 1990 and 2008 (\*).

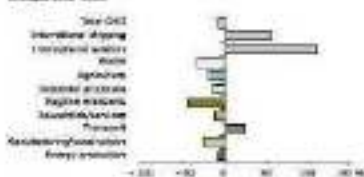
Figure 2.4 Greenhouse gas emissions in the EU-27 by sector in 2005 and changes between 2005 and 2008

Total greenhouse gas emissions by sector in EU-27, 2008



<sup>1</sup> Excludes international aviation and shipping (2.6% of total GHG emissions)

Changes 2005-2008



Note: Greenhouse gas emissions include CO<sub>2</sub>, methane, nitrous oxide, HFCs, PFCs and NF<sub>3</sub>, which are measured in CO<sub>2</sub>-equivalents, see methodology in Annex A. The values in the chart are based on transport mode (2005-2008) 2.6% of total EU-27 GHG emissions in 2008.

Source: EEA.

### Box 2.4 Towards a resource-efficient transport system

The transition to green transport systems in the transport sector – be it rail or across other environments – requires investment – not least in order to meet demand.

The EPRS report Transport and Environment Accounting Indicators (TEAI) report provides for an overview and effectiveness of efforts to improve transport and environmental statistics. For 2005, the report highlights the following trends and findings:

- 1 Freight transport tends to grow slightly faster than the economy, with road and air freight recording the largest increase of the EU-27 (4.4% and 21.5% respectively, between 2007 and 2008). The share of air in volume of airfreight in the EU has long been relatively constant during that period.
- 2 Passenger transport continued to grow but at a slower rate. The share of road increased within the EU, mainly at the national level, increasing 16.5% between 2007 and 2008. Car ownership remained the dominant mode of transport, accounting for 51% of all passenger kilometers in the EU-27.
- 3 Greenhouse gas emissions from transport – including international aviation and shipping – increased by 18% to become 20.7% of EU-27 GHG emissions in 2008. In EU-27, sectoral shares of transport 13% of total emissions.
- 4 In the European Union, only Germany and Sweden are still able to meet their 20% reduction target for motorised road transport, with electricity-related emissions reductions in Greece 40%.
- 5 Despite heavy investments in air pollution abatement, road transport was the largest emitter of nitrogen dioxide and the second largest contributor to carbon dioxide (CO<sub>2</sub>) emissions in 2007 (road and air transport 5%).
- 6 Road traffic remains the most important source of outdoor air pollution levels. The number of motor vehicles in densely populated areas, especially in cities, is expected to increase across all EU countries and cities are developing and implementing air quality management plans and other measures to reduce air pollution.

The report concludes that reducing the most increased modes of transport (air and road) will be a major challenge for the EU transport system. CO<sub>2</sub> emissions in 2050 are expected to be 40% higher than in 2005, with the transport sector accounting for 20% of total emissions.

Source: EEA, EPRS.

### Looking ahead to 2020 and beyond: the EU is making steady progress

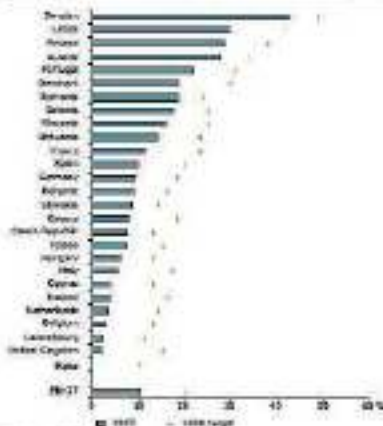
In its climate and energy package (1), the EU has committed to further reduce emissions by (a) 10% by 2010, 20% by 2013, 30% by 2020. Furthermore, the EU will commit to reaching emissions by 50% by 2050, provided that other developed countries commit themselves to comparable emission reductions and developing countries do so equitably according to their responsibilities and respective capabilities. Switzerland and Liechtenstein (with 20 to 25% reduction) as well as Norway (30 to 40%) have made similar commitments.

Current trends show that the EU-27 is making progress towards its 2010 emissions reduction target. Projections by the European Commission indicate that EU emissions could be 14% below 1990 levels by 2010. Taking into account implementation of national legislation in place by early 2009, assuming that climate and energy packages is fully implemented, the EPRS expects to reach the 20% EU-27 emissions target (4). It is worth noting that part of the additional reduction could be achieved through the use of flexible mechanisms both in the trading and non-trading system (5).

Key related efforts include the expansion and strengthening of the EU Emissions Trading System (6), as well as setting legally binding targets for increasing the share of renewable energy to 20% across all energy consumption, including a 10% share in the transport sector, compared to a total share of less than 1% in 2005 (7). Therefore, the share of renewable sources in energy production has been increasing and energy generation using biomass, wind turbines and photovoltaics in particular has grown substantially (8).

Limiting global mean temperature increases to below 2°C in the long-term and reducing peak CO<sub>2</sub> emissions 60% as compared with 1990 by 2050, is generally considered to be beyond what can be achieved with conventional resource technologies. In addition, greater changes in the way we generate and use energy, and how we produce and consume energy, are required in order to be able to meet this target. Further improvements in both energy efficiency and resource-use efficiency need to continue as a key component of GHG emission strategies.

Figure 2.5 Share of renewable energy in final energy consumption in EU-27 in 2007 compared to 2008 targets (5)



Source: EEA, EPRS.

In the EU, significant improvements in energy efficiency occurred in all sectors due to a combination of demand-side, for example, industrial processes, air condition, space heating and electrical appliances, and supply-side measures or a strategy to improve energy efficiency provided for long-term improvements (7). On a larger scale, smart appliances and smart grids can also help improve the overall efficiency of electricity systems, resulting in better generation to be used less frequently through reducing peak loads.

### Box 2.2. Redesigning energy systems: super-grids and smart grids

To enable the transportation of large amounts of electricity generated from renewable energy, we will have to rethink the way we measure energy flow generation to cost.

One of the changes is needed to come from making large generation or demand to occur from the same, and providing flexibility between generation and demand sites. Technologies such as the DC/DC converter (2) are being used to connect offshore wind turbines (3) and the Mediterranean Sea (4) are aimed at reducing the loss, and provide a significant benefit to generation and the grid operator.

Such super-grids would concentrate the capacity of a smart and smart-grid can enable us to move to become more informed about their generation capacity and ensure the best energy activity in changing it. This sort of system also allows the substitution of existing systems, and in the long term, the ability and ability of each (2).

Over the long term, achieving such grids will reduce the investment needed to upgrade Europe's transmission systems.

Source: ITC.

Climate change impacts and vulnerability differ across regions, sectors and communities.

Many key climate indicators are already moving beyond the patterns of natural variability within which contemporary models and assessments have developed and tested.

The main consequences of climate change expected in Europe include an increased risk of extreme sea level rises, drought, loss of biodiversity, threats to human health, and damage to economic activities such as energy, forestry, agriculture, and tourism (2). In some sectors, some special actions may be especially relevant for some time, such as support for agriculture, production and forestry activities in northern Europe. Projections for climate change suggest that the suitability of some regions for tourism – especially in the Mediterranean – may be threatened by the warmer winters, although there may be an increase during other seasons. Similarly, opportunities in expanding tourism in northern Europe may come about. However, over a longer period and with increasing extreme events, adverse effects are likely to dominate in many parts of Europe (4).

The consequences of climate change are expected to vary considerably across Europe, with pronounced impacts expected in the Mediterranean basin, north western Europe, the Arctic and mountainous regions. In the Mediterranean basin, in particular, increasing water temperatures and decreases in water availability are expected to compromise coastal vulnerability to drought, forest fires and loss of water. Mountainous regions in northern Europe, low lying coastal areas face the challenge of sea level rise and an increased risk of elevated storm surges. Very high sea increases are projected to be greater than average in the Arctic, placing particular pressure on very fragile ecosystems. Substantial environmental pressure may result from water scarcity in soil and groundwater, as well as new shipping routes to the east (2).

Mountainous areas face additional challenges including reduced snow cover, potential negative impact on tourism and recreation opportunities. In addition, permafrost degradation in mountain regions may create infrastructural problems, as roads and bridges may not be able to cope. Already today, the replacement of glaciers in the region.

mountains are in retreat... while also affecting water resources susceptible to downstream areas (2). In the Alps, the average glacier length has approximately halved since their retreat since the 1930s (3). Similarly, coastal and river flood-prone areas across Europe are particularly vulnerable to climate change, as a result of sea level rises.

### Map 2.2. Key potential projected impacts and effects of climate change for the main biogeographical regions of Europe



Source: ITC, EC, WCA.

Climate change is projected to have major impacts on ecosystems, water resources and human health.

Climate change is projected to play a significant role in biodiversity loss and paleoecological functions at risk. Changing climate conditions are important, for example, for the observed northward and uphill distribution shifts of many European plant species. There are projections to need, for example, to move several hundred kilometres to the north during the 21st century – when this is not always possible. A combination of the rate of climate change and habitat fragmentation, which results from activities such as roads and other infrastructure, is likely to impede the migration of many plant and animal species, and may also in some circumstances change and a continuing decline in European biodiversity.

The timing of seasonal events, phenology, for plants and the life cycle of several species – likely to be affected and altered – along with climate change (2). Change in seasonal events, flowering date and agricultural growing seasons are observed and projected. Theology shift have also been seen – the length of the growing season of several agricultural crops is now five to ten days in some locations, increasing the risk of crop loss in some species that were not previously suitable. At the same time, there is evidence of a decrease in the growing season of several fish species. Such changes in the cycle of agricultural crops are projected to continue – potentially severely impacting agricultural production (2).

Risingly, climate change can be expected to affect aquatic ecosystems. Warming of surface water can have several effects on water quality, such as thermal stratification. These include a greater likelihood for algal blooms to occur and the emergence of toxic cyanobacteria, as well as changes in productivity. Also, within aquatic ecosystems, climate change is likely to affect the geographic distribution of plankton and fish, the diversity of changed timing of the spring, particularly in fish, putting additional pressure on fish stocks and related ecosystem activities.

A further major potential impact of climate change is on mountain, with loss of glaciers and snow development practices, in the



modification of the hydrological cycle – that is changes in precipitation, precipitation, glaciers and snow cover. In general, snow cover levels are decreasing in the north and decreasing in the south, a trend that is projected to increase with future global warming. Large changes in snowfall are also projected, with lower levels in summer and higher levels in winter. As a consequence, droughts and water stress are expected to increase especially in southern Europe and particularly in summer. Flood events are projected to occur more frequently in many river basins, particularly in winter and spring, although estimates of changes in flood frequency and magnitude remain uncertain.

While information on the impacts of climate change on soil and the various related methods is very limited, changes in the bio-physical nature of soil are likely due to projected rising temperatures, changing precipitation intensity and frequency, and more severe droughts. Soil (compaction) tends to contribute to soil erosion on low slopes – and a substantial increase in CO<sub>2</sub> emissions. Regional seasonal variations in rainfall patterns will, similarly, are likely and will also have some implications for erosion. Projections show significant reductions in snowcover and snowmelt in the Mediterranean region, and increases in north eastern Europe (1). Furthermore, prolonged drought periods due to climate change may contribute to soil degradation and increase the risk of desertification in parts of the Mediterranean and western Europe.

Climate change is also projected to increase health risks due to, for example, heat waves and weather related events (see Chapter 3 for further details). This highlights the need for proactive, awareness-raising and adaptation (2). The affected cities are very dependent on human behaviour and the quality of built urban structure, particularly, a number of socio-technical changes at work in some ways – and lead to more diverse individuals may become more engaged with rising temperatures, and more frequent extreme events (3). In parts of Europe, there may be some benefits to health, and using better health care. This, however, depends in part on the benefits will be outweighed by the negative effects of rising temperature (4).

Dedicated adaptation by Europe is urgently needed to build resilience against climate impacts.

Even if Europe and global action on climate and mitigation efforts over the coming decades prove successful, adaptation measures will still be necessary to deal with the unavoidable impacts of climate change. Adaptation is defined as the adjustment of natural or human systems actual or expected climate change or its effects in order to moderate harm or exploit beneficial opportunities (5).

Adaptation measures include technological solutions (grey measures), market-based adaptation options (green measures) and behavioural, managerial and policy approaches (soft measures). Practical examples of adaptation measures include early warning systems related to heat waves, drought and water scarcity risk management, water demand management, crop diversification, coastal and river flood defence, disaster risk management, tourism development or insurance, land-use management, and enhancing green infrastructure.

There needs to extend the degree to which vulnerability to climate change differs across regions and economic sectors, as well as across social groups – especially the rich and low-income households, both of which are more vulnerable than others. Furthermore, many adaptation efforts will be needed to be undertaken as short-term actions, but extended efforts towards structural and coastal defence measures, including water security, coastal growth and coastal defence strategies.

The costs of adaptation in Europe are potentially large – and may amount to billions of Euro per year in the medium and long term. However, economic assessments of the cost and benefits of adaptation systems have suggested that timely adaptation measures in infrastructure, social and environmental sectors, at the national and regional level, may significantly and pay off many times compared to inaction.

In general, countries are aware of the need to adapt to climate change and EU Member States had adopted a national adaptation strategy for spring 2008 (6), all a European-wide, the EU White Paper on

Table 2.2 People at risk of being affected, damaged and adapted to at EU-27 level – with or without adaptation

Year	People at risk of being affected (Millions <sup>1</sup> )		Adaptation cost (Billion Euro/ year)		Additional damage cost (Billion Euro/ year)		Total cost (Billion Euro/ year)	
	Without adaptation	With adaptation	Without adaptation	With adaptation	Without adaptation	With adaptation	Without adaptation	With adaptation
2020	21	9	0	11	0.8	1.9	4.9	0.8
2050	11	5	0	11	0.8	1.9	2.1	4.2
2100	116	9	0	11	0.8	1.9	10.9	3.8
2020	19	9	0	11	0.7	1.8	2.1	3.1
2050	11	5	0	11	0.7	1.8	1.1	3.8
2100	116	9	0	11	0.7	1.8	11.1	4.8

Note: 1. No persons are affected, even if the effect is not to anyone directly.

Source: IMA, ITC, AIC and Climate Change (7).

Adaptation (8) is a first step towards an adaptation strategy to reduce vulnerability in the context of climate change, and goes along with actions at national, regional and local levels. Integration of adaptation into environmental and national policy requires – such as those related to water, nature and biodiversity, and resource efficiency – to be implemented.

However, the EU White Paper on Adaptation recognises that timely knowledge is a key factor and calls for a strategic knowledge base. In addition related gaps, the creation of a European observatory on climate change impacts, vulnerability and adaptation is essential. This should enable and encourage the sharing of information and good adaptation practices between all stakeholders.

Responding to climate change also affects other environmental challenges.

Climate change is a sector of one of the greater environmental issues the world has seen (9). The issue is closely intertwined with other environmental issues, as well as economic growth and consumer, development. Responding to climate change by mitigating or adapting can and should therefore not be done in isolation – as responses that successfully cover other environmental issues both directly and indirectly (Chapter 4).

Strategies between mitigation and an adaptive measures are possible. For example, in the context of land and water management, land adaptation can help increase resilience against other environmental challenges. Moreover, land adaptation is to be avoided, this takes to ensure that the other (regional, national, and international) level of policy objectives on the long term is to be achieved, some making or an adaptation (or a long-term target) (10).

Many climate change mitigation measures will deliver ancillary environmental benefits including enhanced greenhouse gas emissions, air pollution, land and water conservation. Conversely, reduced air pollution measures related to climate change policies are also expected to lead to a fall in pressure on public health systems and ecosystems, for example through lower levels of pollution or decreased levels of acidification (11).

Climate change policies are already making the overall cost of pollution abatement needed to meet the objectives of the EU. The sectoral strategy on Air Pollution (12) It has been suggested that the reduction of the effects of air pollution on climate change on air quality strategies on air pollution measures provide by reducing particulate matter and ozone precursors in addition to targeting CO<sub>2</sub> and other long-lived GHGs (13).

The implementation of measures to control climate change is likely to involve cooperative activity between air pollution abatement by 2010. This includes lower overall costs of controlling air pollutant emissions at the rate of EUR 19 billion per year and a reduction in



damage to public health and ecosystems (19). Such activities are particularly sensitive to crises of nitrogen ( $\text{NO}_x$ ), sulphur dioxide ( $\text{SO}_2$ ), and airborne particles.

**Techniques** for the reduction of emissions of land, sea and other sources – such as ‘best practice’, carbon avoidance from fossil fuel combustion and ‘learning by business’ – may have substantial benefits both in improving air quality and limiting the related warming effect. Such carbon credits in storage contribute to carbon sequestration and are stored in the Arctic region, which may moderate the melting of the ice caps and associated climate change impacts.

However, in other cases meeting co-benefits between tackling climate change and responding to other environmental challenges may be less straightforward.

There may be, for example, trade-offs between the large-scale deployment of different renewable energy types and the improvement of Europe’s environment. Examples of this include the interplay between hydro-power generation, soil goals of the Water Framework Directive (7), the national land-use levels of bioenergy production which can greatly vary in its climate change benefits (8), and the sensitive placement of wind turbines and harvests in order to reduce impacts on nature and birds life.

Conversely, adaptation and mitigation measures that build on an ecosystem perspective have the potential to lead to win-win situations as they both provide adequate responses to climate change challenges and aim to sustain natural capital and ecosystem services in the long term (Chapters 4 and 5).



### 3 Nature and biodiversity

#### Biodiversity loss, degradation, natural capital and ecosystem services

Nature includes all living organisms found in the atmosphere, on land and in water. All species have a role and provide the fabric of life on which we depend from the smallest bacteria to the seal in the open ocean to the crane (7). The four main building blocks of biodiversity are genetic species, habitats and ecosystems (8). The preservation of biodiversity is fundamental to human well-being and sustainable provisioning of natural resources (9). Furthermore it is closely interlinked with other environmental issues, such as the challenges to climate change or protecting human health.

Europe’s biodiversity is heavily influenced by human activities including agriculture, forestry and fisheries, as well as urbanisation. Roughly half of Europe’s land area is farmed, most forests are exploited, and natural areas are increasingly fragmented by urban areas and infrastructure development. The marine environment is also heavily affected, not just by unsustainable fisheries, but also by other activities such as offshore extraction of oil and gas, wind and geothermal extraction, shipping, and offshore wind farms.

Exploitation of natural resources typically leads to disturbance and changes in the diversity of species and habitats. Concomitant extensive agricultural patterns, as well as Europe’s traditional agricultural landscapes, have contributed to a higher species diversity by a regional area if compared to rural areas to be expected in rural nature systems. Over-exploitation, however, can lead to degradation of natural ecosystems and of diversity in species and habitats. Examples of such ecological breakdowns are the collapse of commercial fish stocks through overfishing, the decline of pollinators due to intensive agriculture and reduced flower resources and increased breeding loss due to the destruction of meadows.

By introducing the concept of ecosystem services, the Millennium Ecosystem Assessment (7) brought this debate on biodiversity by link

upside down. Beyond conventional concerns, biodiversity loss has become an essential part of the debate on human well-being and the sustainability of our lifestyle, including consumption patterns.

Loss of biodiversity can thus lead to degradation of ecosystem services and ultimately human well-being.

Delivered in proving that ecosystem services are under great pressure globally due to the over-exploitation of natural resources in combination with human-induced climate change (7). Ecosystem services are often taken for granted, but are in fact very vulnerable. The soil, for example, as a key component of ecosystems, not supports a rich variety of organisms and provides many regulating and supporting services. Yet it is only, at most, a few meters thick, and often considerably less, and subject to degradation through erosion, pollution, compaction and salinisation (Chapter 4).

Although Europe’s population is expected to remain roughly stable over the next decades, the consequences for biodiversity of increasing global resource demand for food, fibre, energy, and water, and lifestyle changes are expected to continue to increase (memberships) (see Chapter 2). Further land cover conversion and intensification of land use, both in Europe and in the rest of the world, may

#### Box 3.1 Ecosystem services

Ecosystem services is a term to name services that are essential to living Earth’s organisms (including) these include:

- **Provisioning services** – the services that are directly provided by humans, or by animals, plants, letters, sea invertebrates, mushrooms
- **Regulating services** – the services that indirectly allow realisation of natural resources, such as primary production, pollination
- **Supporting services** – the services that underpin food production or other ecosystem services, but are not directly consumable, such as soil formation, food production, etc.
- **Cultural services** – the benefits people gain from the natural environment for recreation, culture and spiritual purposes.

Source: Millennium Ecosystem Assessment (7)

negatively affect biodiversity – directly through, for example, loss of habitats and species depletion, or indirectly through, for example, fragmentation, drainage, eutrophication, acidification and other forms of pollution.

Developments in this area are likely to affect land use patterns and biodiversity around the globe – directly and for related reasons in Europe already in order to own products. The challenge is therefore to reduce Europe's impact on the global environment while maintaining biodiversity at a level where ecosystem services, for a sustainable use of natural resources and to secure well-being are assured.

**Europe's ambition is to halt the loss of biodiversity and maintain ecosystems in good state**

The EU is committed to halting the loss of biodiversity by 2030. The main actions have been placed at selected habitats and species through the Natura 2000 network, biodiversity of the wider countryside, the marine environment, nature-sensitive systems, and adaptation to climate change (1). The EU's 6th and 7th environmental action plans increased the emphasis on the economic valuation of biodiversity loss, resulting in The Economic of Biodiversity and Biodiversity (EEDB) initiative (2) (see Chapter 6).

It has become increasingly clear, however, that despite progress in some areas, the 2030 target will not be met (3) (4).

Recognising the urgent need for increased efforts, the European Council announced the long-term biodiversity vision for 2030 and a corresponding target, adopted by the Environment Council on 12 March 2022, of setting the loss of biodiversity and the degradation of ecosystems across the EU by 2030, and notably where it is not possible while supplying up to 50% more food or ensuring global biodiversity (5). A further number of measures such as targets will be developed using, for example, baseline data for 2020 (6).

Key policy instruments are the EU Habitats and Marine Directives (7), (8) which aim at favourable conservation status for selected species and habitats, some 700 000 hectares land cover.

More than 10% of Europe's total land area, and more than 160 000 square km (9) have not been designated under these directives in order for conservation within the Natura 2000 network. Furthermore, an EU strategy on green infrastructure is in preparation (10) centring on Natura 2000 and building in other environmental initiatives.

The second main strand of policy action is the integration of biodiversity concerns into several policies for transport, energy production, agriculture, forestry and fisheries. This is aimed at reducing the direct impacts of these sectors, as well as their diffuse pressures, such as fragmentation, acidification, eutrophication and pollution.

The Common Agricultural Policy (CAP) is the central framework in the EU with the strongest influence in this respect. The responsibility for land policy lies primarily with the Member States under the national policy principle. The relevant proposals have been made to further integrate environmental aspects into the Common Agricultural Policy. Other policy instruments affecting biodiversity are the EU Taxonomy Strategy under the EU Taxonomy, the Air Quality Directive (11), the National Environment Challenge Directive (12), the Nature Directives (13), the Water Framework Directive (14) and the Marine Strategy Framework Directive (15).

**Biodiversity is still an objective**

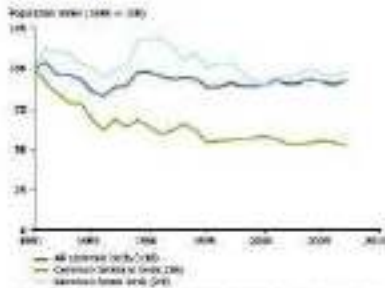
Qualitative data on the status and trends of European biodiversity are sparse, both for conceptual and practical reasons. The spatial scale and level of detail of which ecosystems, habitats and plant communities are observed is to a certain extent arbitrary. There are no consistent measures monitoring stress for ecosystems and habitat quality, and the results of one studies are difficult to compare. Reporting under Article 17 of the Habitats Directive has recently improved the evidence base, but only for the listed habitats (16).

Species monitoring is increasingly more straightforward, but remains uneven and is mostly very selective. Around 1 700 vertebrate species, 80 000 insects and 10 000 vascular plants have been recorded in Europe (17) (18). This figure does not even include the diversity of marine species, or bacteria, viruses and euk.

vertebrates. Macroscopic trend data cover only a very small fraction of the total number of species – they are largely limited to common birds and butterflies. Aquatic and riparian species for which data are more numerous are more abundant in large rivers.

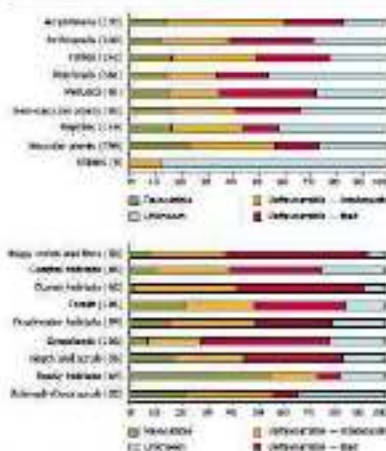
The data on common bird species suggest a gradual rise in bird levels during the last decade. Degradation of forest birds has declined by around 25% since 1990, but from 2000 onwards concerns appear more intense. Increased forest fragmentation decreased the extent, notably due to agricultural intensification. Their populations have remained stable since the mid-1980s, albeit at a low level. General farming trends such as lower agriculture, increased wetlands and areas of organic farming and policy measures such as targeted agri-environmental schemes may have contributed to this (19) (20). Grassland butterfly populations, however, have declined by a further 50% since 1990, indicating the impact of further conversion of agricultural to the rural landscape and increased use of the sites.

**Figure 3.2 Common birds in Europe – population index**



Source: UNEP, Birds Breeding in European Wetlands (21) (22) (23) (24) (25)

**Figure 3.3 Conservation status of species (fish and habitats) (ability of Community to meet its 2020 goal)**



Note: Number of representatives in Natura 2000. Designated average EU species reported in Natura 2000.

Source: IUCN, IUCN Red List of Species (26) (27) (28) (29) (30)

The conservation status of the most threatened species and habitats remains worrying despite the more established Natura 2000 network of protected areas. The situation appears worse for aquatic habitats, coastal zones and riverine zone wetlands, forests, sea anemone, bog, river and fen. In 2005, only 17 % of the legal species under the Natura 2000 network continued to have a favourable conservation status, 53 % an unfavourable status, and the rest of 30 % was unknown.

These aggregated data, however, do not allow conclusions about the effectiveness of the protection regime of the Natura 2000 sites, since base data are not yet available and habitat conditions and species recovery may require more time. Also, no comparison can currently be made between protected and unprotected areas within the special ranges. For the Birds Directive, however, studies indicate that the total conservation measures in Natura 2000 have been effective (7).

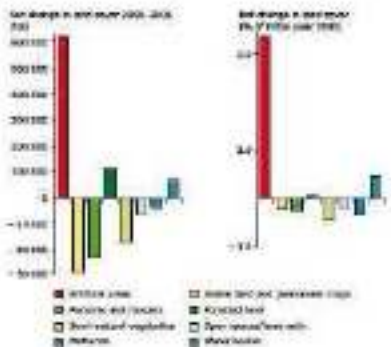
The cumulative number of alien species in Europe has been increasing steadily since the beginning of the 20th century. Out of a total of 19 000 established alien species, 141 000 have been identified as the most serious because they have proved to be highly invasive and damaging to native biodiversity in at least part of their European range (7). While the incentive may be slowing down or levelling off for terrestrial and freshwater species, this is not the case for aquatic and arboreal species.

#### Land conversion drives biodiversity loss and degradation of soil functions

The main land cover types in Europe are forest, 31 %; arable, 34 %; pasture, 17 %; semi-natural vegetation, 6 %; water bodies, 4 %; wetlands, 2 %; and artificial - built-up - areas 3 % (7). The trend of land cover change between 1990 and 2005 is not as drastic as had observed between 1950 and 2000. However, the annual rate of change was lower - 0.1 % in the period 1990 to 2000 compared with 0.3 % in the period 1950 to 2000 (7).

Overall, arable areas have expanded further at the expense of all other land cover categories, with the exception of forests and water bodies. Urban areas, and expanding transport networks are

Figure 3.3 Net land cover changes 1990-2005 in Europe - total area change in hectares and percentage change



Notes: 1990-2005: 0.07 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

ongoing habitat loss reducing populations of animals and plants species vulnerable to local extinctions due to habitat fragmentation and dispersal.

These land-cover changes affect ecosystem services and characteristics such as carbon storage. The loss of forest areas, particularly in the tropics, has led to a significant increase in carbon emissions and a corresponding decrease in carbon storage. This is particularly concerning given the high carbon concentrations in tropical rainforests.

followed by extensively managed grassland and forest and carbon losses from cropland. These losses are concentrated. Loss of these habitats is also associated with decreased water retention capacity, increased flooding and erosion risk and reduced attractiveness for outdoor recreation.

While the slight forest increase is a positive development, the decline of natural and semi-natural habitats - including grassland, bogs, heath and wet, all with a high content of soil organic matter - is a major concern reason.

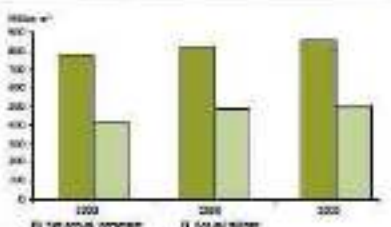
#### Forests are heavily exploited: the share of old-growth stands is critically low

Forests are crucial for biodiversity and ecosystem services delivery. They provide natural habitats for plant and animal life, protection against soil erosion and flooding, carbon sequestration, climate regulation and have great recreational and cultural value. Forest is the predominant natural vegetation in Europe, but the remaining forest in Europe under forest sustainability (7). Most are heavily exploited. Exploited forests typically lack higher amounts of deadwood and older trees in habitats for species, and they often show a high portion of non-native tree species (for example Douglas fir). A share of 10 % of old-growth forest has been recognized as a minimum for maintaining viable populations of the most natural forest species (7).

Only 0.5 % of the European forest area is currently considered to be undisturbed by humans (7). The largest areas of old-growth forests in the EU are found in Bulgaria and Romania (7). Loss of old-growth forest, in combination with increased temperatures of the surrounding stands, primarily explains the concerning poor conservation status of many forest species in European regions. Many such species are listed as near-extinct in the national red data books. But even if, we face an ecological 'bottleneck' - since 1/10 of old-growth forest species have been identified as being at serious risk of extinction in the long term (7).

On the practical side, we need to be aware that forest owners will follow the annual (re-)growth and total forest area increases. This is supported by socio-economic trends and national policy initiatives to improve

Figure 3.4 Intensity of forestry - net annual increment in gross value added and full use of forest available for wood supply - EU 28 member countries, 2000-2005



Notes: 2000-2005: 0.07 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

forest management, coordinated in the framework of Forest Europe, a comprehensive global forest governance level of its countries, including those of the EU (7).

Forest management is not only about safeguarding wood harvest, but also a wide range of forest functions into account, and this means a transition from biodiversity conservation and the maintenance of ecosystem services in forest management, among others, to be addressed. A recent EU Green Paper (7) focuses on the socio-economic benefits of climate change for forest management and provides in Europe and on reducing its impact, including planting and biodiversity-friendly. There are also concerns regarding the balance between wood supply and demand in the EU - EU green the planned increase in forestry production (7).



Map 3.2 Intensity of fertiliser – not harvesting rate in 2000



Source: IRI, 2002 (page 4).

Farmed areas decrease but management intensifies: specific rich grasslands are to decline

The concept of extensive farms is primarily associated with agriculture. The prime objective is food production, but limited means exist: other economic sectors, farmer's facilities, agricultural techniques are a major cultural heritage, affect his view and other outdoor recreation opportunities. Farmland also plays a key role in nutrient and water cycling.

European agriculture is characterised by a dual trend: technological intensification in some regions, and land abandonment in others. Intensification is aimed at yield increase and requires investment in machinery, drainage, fertilisers and pesticides. It is also often associated with simplified crop rotations. Where socio-economic and topological constraints do not allow this, agriculture remains extensive or is given up. These developments have led to calls for a combination of market mechanisms, technological innovation, policy support and international market developments, as well as climate change, demographic trends and lifestyle changes. The concentration and replacement of agricultural production has had major consequences for biodiversity, but become apparent in the decline of farmland birds and butterflies.

Agricultural areas with high biodiversity, such as extensive grasslands, still make up about 21% of Europe's farmland. Although its natural and cultural value is recognised in European environmental and agricultural policies, the internal measures being taken within the framework of the CAP do not suffice to prevent further decline. The next major EU High Nature Value (HNV) farmland, about 10%, is made up of extensive pastures, mostly one- or two-herd units. The remaining 30% is protected under the strict and various measures, mostly one of the six administrative or Community sectors of the EU Habitats Directive, are related to agricultural management, habitat grazing and mowing (7).

The associated reports provided by 10 member states under the Natura 2000 (7) indicate that the characteristics stated in these agricultural habitats is worse than the others. Potentially irreparable losses are feared for rural heritage pastures – the second pillar of the CAP – made up of less than 1% of total CAP expenditure

Map 3.3 Approximate distribution of HNV farmland in EU-27 (7)



Note: Country codes: L = Liechtenstein (LIE); M = Malta (MLT); and additional countries in 2007 with missing data were: Austria (AUT), Belgium (BEL), Bulgaria (BUL), Czechia (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Ireland (IRL), Italy (ITA), Latvia (LAT), Lithuania (LTU), Luxembourg (LUX), Netherlands (NLD), Poland (POL), Portugal (PRT), Romania (ROU), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), and United Kingdom (GBR).

Source: IRI, 2004 (7); IRI, 2002 (page 29).

and appear mostly targeted at HNV farmland conservation. The vast majority of CAP support still benefits the most intensive productive areas and farming systems (7). Decoupling subsidies from production is an temporary compromise with environmental legislation but even agricultural producers do the most toward to avoid what, that is, at least in some respects, the continuing management that is needed to achieve HNV in rural ecosystems.

Intensification in agriculture poses threats not only to biodiversity as measured, but also to biodiversity in its broadest sense. The total weight of mowing systems in the field before a harvest of temperate grass and cereals is lower – as much as a million-fold step down – and often occurs in a more ground-based form. These areas are located in most of the low soil horizons. Soil conservation is therefore a major environmental concern and degradation processes are widespread in the EU (11) (page 64).

Increasing intensity production – for example, in the context of the EU target of increasing the share of renewable energy used in transport to 10% by 2020 (4) – has also increased pressure on agricultural land resources and land uses. The conversion of land to certain types of technical crop products can lead to intensification in its form of fertilisers and pesticide use, increased pollution load and further biodiversity loss. Much depends on where the conversion takes place, and the extent to which the open goal of this contributes to reaching the broader target. The available information suggests that the trend towards concentration of agriculture in the most productive areas, as well as to further intensify and productively increases, is likely to continue (8).

Environmental and freshwater ecosystems are still a major pressure: decoupled and second pillar policies leads

Appear from the shared fields of land conservation and exploitation beyond a certain scale as agriculture, including water production and transport (water quality) and contribute either to the ecosystem – namely through air, soil and water pollution. A wide range of pollutants – including insecticides, pesticides, nutrients, industrial chemicals, metals and pharmaceutical products – end up in the soil, in the ground, and surface water. Atmospheric deposition



of atmospheric and soil-borne substances, including nitrogen oxides (NO<sub>x</sub>), ammonia plus ammonia (NH<sub>3</sub>) and sulphur dioxide (SO<sub>2</sub>), adds to the overall pollution. The direct or indirect loads (except nitrogen) are not measured automatically, neither concentrations due to rainfall or ground, and NO<sub>x</sub> flows caused by natural enrichment, and ground and surface water inputs as caused by pesticides, the total nitrogen and phosphorus flows over the EC for

most time span data regarding the effects of pesticides on groundwater and ecosystems, coastal acidification and acidification (2). One of the success stories of Europe's environmental policy has been the significant reduction in emissions of the acidifying pollutants SO<sub>2</sub> since the 1980s. The area subject to acidification has increased further since 1999. In 2003, 16% of the EEA-25 natural ecosystems are in, however, still subject to acid deposition beyond their critical loads. While major emissions declining, nitrogen emitted by agriculture is now the principal soil-borne component to soil air (2).

Agriculture is also a major source of eutrophication through emissions of excess nitrogen and phosphorus, both used as nutrients. The agricultural nutrient intensity in many EU Member States has increased in recent years, not more than 0.5% of cropland, forests, and freshwater ecosystems areas are still subject to atmospheric nitrogen deposition beyond their critical loads. A gradual nitrogen loads are expected to remain high as changes in their use in the EU is proposed to increase by around 0.5 by 2020 (2).

The phosphorus in freshwater systems stems mostly from use of fertilizers and discharges from municipal wastewater treatment plants. There has been a significant decline of phosphorus concentrations in rivers and lakes, mainly due to progressive implementation of the urban wastewater treatment directives (2) since the early 1990s. Current concentrations, however, often exceed the maximum allowed concentrations in some water bodies, due to lack of sufficient nitrogen removal to be required to achieve good status under the Water Framework Directive (2000).

Quantum to attainment of good status by 2015 and in the 2010 (2) will be a reduction in the excessive nutrient loads from a number of water bodies across Europe, as well as the reduction of river velocity and hydro-morphological conditions. From here:

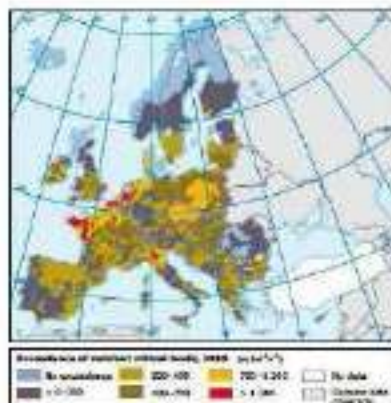
Map 3.3 Exceedance of critical loads for acidification due to the deposition of natural nitrogen in 2002



Note: The results were compiled using the 2002 Critical Load Assessment Model for the European Climate for Effects (CEE) and Data for Europe from the ICP. Values have not been included in the tables due to an insufficient data base for calculating critical loads. For more details see Annex 2.

Source: 2005 EEA/ECM 10/13.

Map 3.4 Exceedance of critical loads for acidification due to the deposit of natural nitrogen in 2002



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Source: 2005 EEA/ECM 10/13.

management plans set up by Member States under the WFD, this is expected by 2015, will have to incorporate a suite of control measures to tackle all sources of natural pollution. This will also need particular provisions regarding the further implementation of water-related aspects like the CAP. Furthermore, full implementation of the WFD will also go hand in hand with the Directive on Habitats Directive as they forming policy spheres in support of the WFD.

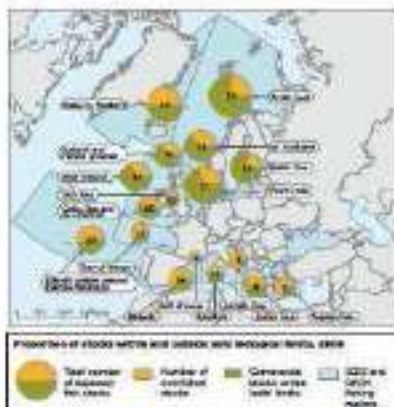
#### The marine environment is heavily affected by pollution and overfishing

Most of the freshwater pollution load, described in the previous section, is ultimately discharged to coastal waters, making agriculture also the main source of nitrogen loads to the marine environment. Although the deposition of nitrogen – ammonia (NH<sub>3</sub>) originating from agriculture and fish, from crop production – is increasing this can be 30% or more of the total nitrogen load to the sea surface.

Increased eutrophication in coastal waters in the marine environment, where it accelerates the growth of phytoplankton. It can change the composition and abundance of marine organisms living in the affected waters and ultimately leads to oxygen depletion. One striking bottom-dwelling organism, Oxygen depletion has resulted in anoxic dead zones the past 20 years, now rising to an almost 50% increased cases in 1991 to almost 1400 in 2002 world wide (2), and it is expected to become more widespread with increasing sea temperatures induced by climate change. In Europe, the problem is particularly visible in the Baltic Sea, where the current writing of status is regarded as particularly poor to bad (2).

The marine environment is also heavily impacted by fisheries. Fish provide the primary source of protein for many coastal communities, but overfishing is threatening the viability of both European and global fish stocks (2). Of the assessed commercial species in the Baltic Sea, 10% are within the biological limits (2), not the case in the North-Atlantic area, the percentage of stock outside safe biological limits vary between 26% in the North-East and 62% in the Bay of

Map 5.8 Proportion of fish stocks within and outside safe biological limits



Source: FAO (2010), 2008 (%); IUCN (2008), 24 (%)

Bycatch in the Mediterranean Sea, the percentage of fish caught outside safe biological limits is about 60%, with four out of six species exceeding 60% (%).

Overfishing not only reduces the total stock of commercial species, but affects the age and size structure within fish populations, as well as the species composition of the marine ecosystem. The average size of the fish caught has decreased, and there has also been a steady increase in the number of large predatory fish species, which occupy the higher trophic levels (%). The consequences of this for the marine ecosystem are still poorly understood, but could be a disaster.

While the Common Fisheries Policy (CFP) system in 2002 stated conservation objectives, it is widely acknowledged that these have not been achieved. An EU Green Paper, announcing the CFP in 2009 called for a complete reform of the way fisheries are managed (%). It also sets long-term fishing effort, catch capacity, licence allocation, fleet reduction measures and a decline in the number of fish caught by European fisheries. This study analysed and why towards implementation of a comprehensive approach that requires business exploitation of stocks in accordance with the sustainable perspective of ecosystem services.

Maintaining biodiversity, also at global level, is crucial for people.

Biodiversity has been suffering from the growing consequences for people through increasing economic activities. Large-scale deforestation and the large-scale natural systems has increased carbon emissions in the air and at the same time reduced carbon and water retention capacity increased in the speed, intensity and increased precipitation as a result of climate change (i.e. nitrogen cycle) that cause and more precipitation cause to contribute to the change of climate resulting.

Biodiversity affects well-being also through providing environmental opportunities and opening landscapes, a sustainable rural landscape is regarded as urban design and spatial planning. Low economic pressure, but equally important, is the relationship between the distribution patterns of species and habitats and water borne

domestic livestock than spend any part of a third in this regard. Their disposal capacity and potential to become disease or, is enhanced by the chlorination of faeces, combined with climate change and the increased resistance of agricultural microorganisms.

Construction also leads to significant impacts of the use of natural resources. The depletion of European fish stocks, for example, has not resulted in domestic food shortages, but has been compensated by an increasing reliance on imports. Whereas the EU was largely self-sufficient until 1990 (when total catches had grown to 4 million tonnes), demand-supply levels had fallen by more 50 % in 2007 (2.5 million tonnes of 2.5 million tonnes consumed) (%).

Large net imports also occur for cereals (around 7.5 million tonnes; fodder included 26 million tonnes) and meat (around 20 million tonnes) (%), again with implications for biodiversity outside Europe (mainly deforestation) (see Chapter 5). Furthermore, the rapidly growing demand for minerals may further increase Europe's global footprint (Chapter 5). Trends such as these increase pressure on global resources (Chapter 7).

Overall, the many contributions of biodiversity to human well-being are becoming more explicit. Increasingly we recognise the food we eat, our clothes and building materials with biodiversity. Extra vital services that need to be managed sustainably and protected with protection, so that we have it protected and the planet at the same time. Europe is currently consuming twice what its land and sea can produce.

The meeting these needs lies at the core of the proposed 2020 SDG vision and 2030 goal (see target, achieving progress requires the active involvement of all citizens – not just socio-economic leaders and actors highlighted throughout this document).





## 4 Natural resources and waste

The overall environmental impact of Europe's economic development has to be taken into account

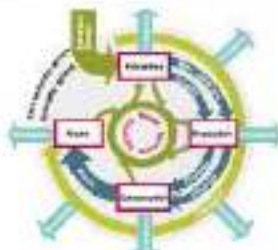
Europe's economic development has to be taken into account. This includes the assessment of the environmental impact of economic activities and the assessment of the environmental impact of the economic activities. The assessment of the environmental impact of the economic activities is the primary objective of the environmental policy. The assessment of the environmental impact of the economic activities is the primary objective of the environmental policy.

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Figure 4.1. EU's environmental policy objectives – waste



Source: EC, 1997, *Waste and Environmental Policy*.

The supply of resources in Europe is being used, and there is potential for future growth (7).

Europe's economic growth has led to environmental degradation

Waste management has been a focus of EU environmental policy since the 1970s. Such policies which have simply required the reduction, reuse and recycling of waste, are insufficient to deal with the long and gradual use throughout the economy, by providing more efficient markets to improve production.

More recently, the EU has been working to improve its waste management policies. This includes the development of a circular economy, which is a system of production and consumption that is designed to be sustainable and to reduce the environmental impact of economic activities.



different phases of the life cycle and from one country to another – using well-defined standards where possible. The cycle of thinking about only one aspect, but also the other side of the coin – by managing the economic and environmental waste, increasing resources, and reducing already developed land.

The EU brings together national environmental policies through the European Strategy on the prevention and recycling of waste (7) and the thematic strategy on the sustainable use of natural resources (7). Furthermore, the EU has set itself a strategic goal of moving towards more sustainable patterns of consumption and production, with a view to decoupling economic growth and resource use from the associated negative environmental impacts and becoming the world's most resource-efficient economy (8) (9) (10).

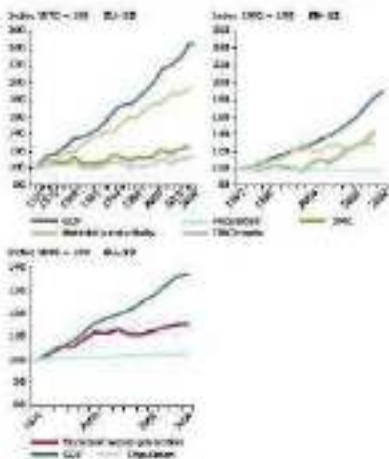
In addition, water is a renewable natural resource created by the water cycle. It is a finite resource, and its availability is limited by the amount of water that can be captured and stored. The amount of water that can be captured and stored is limited by the amount of water that can be captured and stored. The amount of water that can be captured and stored is limited by the amount of water that can be captured and stored.

Waste management continues to shift from disposal to recycling and prevention

Many countries with a history of rapid growth of industry and services have faced the issue of solid waste management, and in Europe, this issue continues to pose considerable concerns.

The EU is committed to reducing waste production, but it is not doing so. This is because the EU is not doing so. This is because the EU is not doing so. This is because the EU is not doing so. This is because the EU is not doing so. This is because the EU is not doing so. This is because the EU is not doing so.

Figure 4.2. Trends in the use of material resources in EU-25 and EU-27 and municipal waste generation in EU-27 compared with GDP and population



Notes: Data for municipal waste generation (MW) are aggregate of materials including water and air that are actually consumed by natural resources. The amount of water and air that are actually consumed by natural resources is the amount of water and air that are actually consumed by natural resources. The amount of water and air that are actually consumed by natural resources is the amount of water and air that are actually consumed by natural resources.





Most likely, municipal waste generation per person stands by a factor of 1.5 to three times, amounting to 304 kg per person in 2006 (average in EU-27 Member States). It has increased between 2001 and 2004 in most of the countries surveyed, however, the growth of municipal waste generation in EU-27 has been slower than that of OECD, thus, according to data concerning the 16 waste streams, the growth in waste volumes was driven mainly by a modest consumption and increasing number of households.

Waste generation from construction and demolition activities has increased, as has packaging waste. There is no time-series data for mobile telephony and electronic equipment, however, current projections show this to be one of the sectors growing waste streams (1). Volume of hazardous waste, which amounted to 3 % of total waste streams in EU-27 in 2004 (2), are also increasing as the EU and remain a key challenge.

Waste-to-energy generation is increasing as well, mainly linked to implementation of the EU's Waste Water Wastes Directive (3). The rate is increasing, albeit at a slower rate, and the effect on steel production volume (apparent final use) is small.

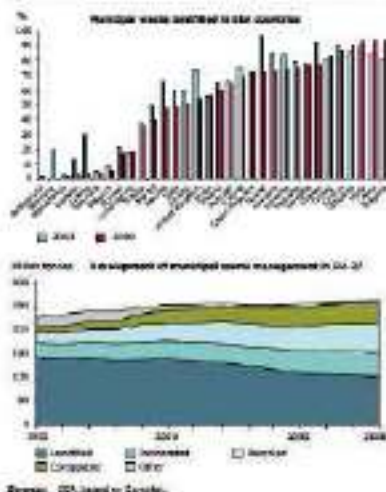
Also, member States (4) are seen to be under pressure for European law (5) (6) – the management of its impacts has been included in the Multi-Strategy Framework Directive (7) and its regional two versions (8).

Furthermore, it is worth noting that there are some specific waste-related challenges to increase skills in countries related to good practices, such as integrated waste management, off-processing, chemical and cement industries, and the consumption of vehicles in the city areas (9).

Moreover, waste management has to proceed in direct at EU Member States, as more waste is being recycled and less landfilled. Nevertheless, with almost half of the 11 million tonnes of total waste generated in the EU-27 in 2004 not recycled, 10 to 15 per cent recycled, and the rest landfilled, it is considered.

Good waste management reduces environmental impacts and offers economic opportunities. It has been estimated that roughly 60 %

Figure 4.3 Percentage of municipal solid waste landfilled in EU countries, 2002 and 2006, and development of municipal waste management in EU-27, 1995 to 2006



of EU GDP corresponds to waste management and recycling (9). The recycling sector has an estimated turnover of EUR 24 billion and employs about half a million persons. Thus, the EU has around 20 % of waste share of its materials and 40 % of the waste and recycling industries (1).

Waste is increasingly shifted across borders, mainly due to recycling, or material and energy recovery. This development is driven by EU policies regarding increasing recycling rates for selected waste streams as well as by economic forces. For years there has been a steady price of raw materials have been high or increasing, making waste materials an increasingly viable alternative. At the same time, export of steel goods (for example, used cars) and their subsequent untreated waste treatment (for example, lead-charge in the recycling industry) can contribute to a sustainable loss of resources (2).

Household and other residential activities also increasingly being stopped, urbanisation, supports increase by almost a third of that between 1997 and 2002. This was especially of the waste is accompanied between EU Member States. Moreover, an increase in the availability of hazardous waste treatment capacities (mainly in different environmental standards between countries) and by different in the Member States, the increase in illegal shipments of waste, for example from electric and electronic equipment, is a trend that needs to be noted.

Overall, the environmental effects of the growing trade in waste need to be examined more closely from a wide range of angles.

**Life-cycle thinking in waste management contributes to reducing environmental impacts and resource use**

European waste management trends, on the example of a waste, mainly, generating waste, on the production, recycling, recovery, and using energy through incineration, and finally disposal. Waste is treated increasingly and seen as a potential resource and a source of energy. However, depending on regional and local conditions, these different waste management activities may have differing environmental impacts.

Although the impacts of waste treatment on the environment have been considerably reduced, there is still potential for further improvement, first by full implementation of existing legislation and then through the extension or setting new requirements to encourage sustainable consumption and production practices including more efficient resource use.

Waste policies can primarily reduce these types of environmental pressures, amongst them, waste treatment alternatives such as methane from landfill, impacts from primary raw materials extraction, and air pollution and greenhouse gas emissions from energy use in production processes. Although recycling processes themselves use less environmental impacts, to meet other overall impacts avoided by recycling and recovery are greater than those incurred in the recycling processes (3).

Waste prevention can help and/or environmental impact during all stages of the life-cycle of resources. Although prevention has the highest potential to reduce environmental pressures, policies to reduce waste generation, such as low growth and other, may be more effective. For example, there has been an increase in recycling, for example, including food waste (3 %) (4) from households. But more might be achieved by addressing the whole food production and consumption chain to prevent waste, thus also contributing to sustainable resource use, protection of soil and mitigating climate change.

Waste recycling (and waste prevention) is closely linked to material use. The average 1.6 tonnes of materials used annually per person in the EU, much of which is either or later turned into waste of the 4.8 tonnes of total waste generated annually per person, amount 31 % is from construction and demolition activities, about 5 % from mining and quarrying, 10 % from manufacturing and 9 % from households. However, stark links between resource use and waste generation are observed in countries with resource-intensive and high technological standards in accounting for them and a lack of long-term strategies data.

The increase in overall resource use and waste generation in Europe are closely linked to economic growth and increasing affluence. In absolute terms, Europe is using more and more resources. For example, resources use increased by 14 % between 2000 and 2007 in







The magnitude of the difference between current points to significant potential for improvement. For example, energy efficiency in EU-15 is only about 4% of that in the EU-10. The rate has changed little over the past two decades, and efficiency improvements in the EU-12 were mostly revealed before 2000.

Indeed, the growth in the productivity of services over the past forty years has been significantly slower than that in the productivity of transport and in some cases of energy. While some of this is a result of the substituting of consumers with a growing share of services, it also reflects the fact that labour has been relatively more costly compared with energy and materials, partly as a result of providing tax regimes.

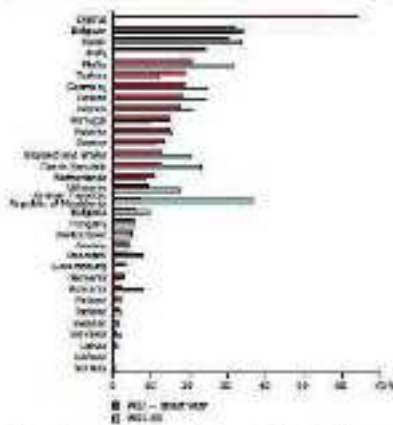
Addressing resource productivity and energy efficiency, substituting non-renewable with renewable resources, and addressing resource efficiency gaps between EU-15 and EU-12 Member States are possible opportunities in the emerging European competitiveness.

**Water resources management is essential for saving water resources within national limits**

Water resource management differs from the management of other resources due to the only water cycle (falls of water as a resource water moves through the hydrological cycle, is dependent on climatic influences, and its availability varies in time and space). While countries differ in regime and other environmental factors, water is the basic resource for many activities (agriculture, transport, energy production, drinking) – but can also have impacts from the associated activities in one region to another. This poses special needs for integration and cross-country cooperation.

Water demand of the water is affected (complicated) with the water needed for maintaining ecological functions. In many locations in Europe, water used by agriculture industries, public water supply and tourism put considerable stress on water resources, and increased their overall local availability – and that is likely to be further exacerbated by climate change impacts.

**Figure 4-10** Water exploitation in the (EU15) – in the EU10 (early 2000s) (WU2-00) average risk to future years a multiple (1999 to 2000 (%))



**Note:** EU15 average water exploitation as a percentage of available long-term resources (1999-2000). For EU10 (early 2000s), water exploitation is available for both a 40% and 20% regime, in the EU10, 40% water exploitation is being taken into full account for EU15.

**Source:** WU, ETC, Water.



Water resources and the demand for water by different economic sectors are unevenly distributed across Europe. Even if water is allocated on a national scale, it may be scarce in individual river basins as they represent more persons or economic activities over basins in the Mediterranean region but abundantly also some northern regions, especially over Scandinavia.

The main reasons for over abstraction include increasing demand for irrigation and tourism, increasing water use in water intensive sectors, public distribution and supply networks prior to a trading economy, then agricultural development in early water scarce regions. In some countries this has led to supply network usage being up to 40 % of the total water supply in others it is below 10 % (1).

A combination of economic and natural factors results in water scarcity in some areas of water use. Water use is also related to changes in technology, European. The decrease is also related to technological changes, technological improvements and the prevalence of water losses in distribution systems, supported by water pricing. Eastern Europe has experienced substantial decrease in water use – for example annual water use in the period 1997 to 2006 was around 40 % lower than in the early 1990s – mainly as a result of the introduction of water meters, higher water prices and the closure of some water intensive industries (2).

In the past, to improve water management has largely focused on increasing supply by drilling new wells, constructing dams and reservoirs, searching to diversify local and large scale water transfer infrastructure. Increasing problems of water scarcity and drought clearly indicate the need for a more holistic management approach. There is a particular need for the model of demand management that increases the efficiency of water use.

Greater water efficiency is possible. For example there are large but currently unutilised potentials for water recycling and the use of wastewater (3). Cases of wastewater have been treated successfully in some remote regions, to be a single-point source of water and one the most effective solutions to water scarcity. In Europe wastewater is viewed mainly to contribute to sewage treatment that the

quality is thoroughly controlled, the benefits can be substantial, including increased availability of water, reduced nutrient discharges, and reduced contaminating units for industry.

Not least, land use practices and development planning could have a major impact on water scarcity. Through prudent, comprehensive evaluation of the use of groundwater and surface water, proactive exploitation of aquifers can give rise to over-exploitation, such as that related to excessive abstraction for irrigation. The resulting short-term increases in productivity and changes in land use largely affect other water-use related developments and can establish a cycle of unsustainable over-exploitation, developments – including lack of power, social distress, energy and food security (4).

Land use practices can also cause significant hydro-morphological alterations with potential adverse ecological consequences. For example, many riparian wetlands, forests and floodplains in large farm areas drained and converted, riparian and channel banks have been constructed to support agricultural activities, energy demand and production from floods. The loss of water quantity and quality in riparian water channels, watercourse conditions, environmental and economic benefits and risk management aspects can be better integrated in the institutional and political systems.

The Water Framework Directive (WFD) provides a framework to address high environmental standards for water quality and use (5) other policies (6). A first look at river basin management plans, which have been set up and reported by Member States during the first round of implementation of the WFD, indicates that a significant number of river basins face a high risk of not achieving good ecological status by 2015. In many cases, this is due to issues related to water management, particularly issues to water quantity and quality, insufficientness of the structure of river banks and river beds, the causes of or causes of water scarcity and poor production systems which have not been addressed by water, pollution-related policies.

The overall challenge under the WFD can help tackle, a fundamental risk is to ensure the maintenance availability of good water quality to both a managing water use that will be less competing uses, such as domestic use, industry, agriculture and the environment (see also Chapter 4).







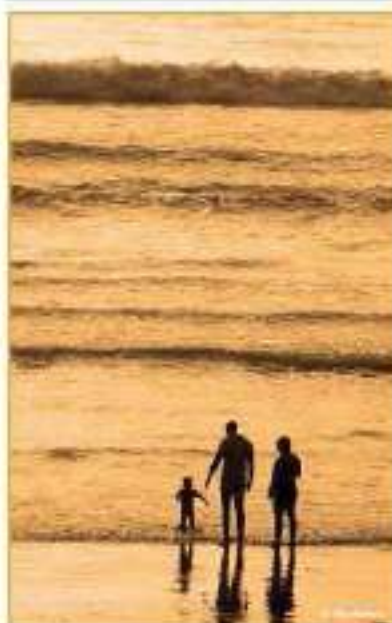
Trade-related environmental impacts may be further aggravated by lower actual and environmental standards in some exporting countries, especially compared to those in the EU. However, governments and trade unions across countries in concert to export economic and jobs revenues. If managed properly, for example by raising technical incentives, the benefits can increase the environmental efficiency of both exports and imports by welcoming green export competitiveness and reducing unbalanced environmental pressures in imports.

**Natural resource management is critical to offset environmental and socio-economic losses**

The direct environmental impacts of resources use include the degradation of fertile land, water shortages, water generation, toxic pollution, and land-use/cover loss on terrestrial and freshwater ecosystems. In addition, indirect environmental impacts, for example related to land-cover changes, may have considerable effects on ecosystems structure and health.

Climate change is expected to increase environmental pressures related to resources use in changing precipitation patterns in the Mediterranean, for example, precipitation patterns on some wetlands and influence land-use changes.

Most environmental pressures assessed in this report are driven – directly or indirectly – by the increasing size of natural resources use production and consumption patterns that serve an environmental footprint in Europe and elsewhere in the world. Furthermore, the related depletion of our stocks of natural capital and its links to other forms of capital in putting at risk the sustainability principle of economy and social cohesion.



## 5 Environment, health and quality of life

**Environment, health, life expectancy and social inequalities are linked**

The environment plays a critical role in people's physical, mental and social well-being. Despite significant improvements, major differences in environmental quality and human health remain between and within European countries. The complex of interlinks between environmental factors and human health, following various multiple pathways and interactions, should be seen in a broader, spatial, socio-economic and cultural context.

In 2016, life expectancy at birth in the EU-27 was among the highest in the world – almost 81 years for men and 83 years for women (1). Most of the gains in life expectancy in recent decades have been due to improved survival of people above the age of 64, while below 64 it was mostly due to a reduction in premature deaths, i.e. deaths before the age of 64. On average, men are expected to live about 11 % of their lives free of disability, and women 73 % (1). There are however, differences between genders, and between Member States.

The degradation of the environment, through air pollution, water, chemicals, poor quality water and loss of natural areas, combined with life-style changes may be contributing to substantial increases in rates of obesity, diabetes, disease of the cardiovascular and musculoskeletal systems and cancer – all of which are major public health problems for European populations (2). Degradation and mental health problems are also on the rise. Airborne allergens (3), and some types of cancer related to environmental pressures are of particular concern in the elderly.

The World Health Organization (WHO) estimates the environmental burden of disease in the non-European region at between 15 and 20 % of total deaths, and 18 to 20 % of disability-adjusted life years (DALYs) (4), with a relatively higher burden in the western part of the region (5). The preliminary results of a study conducted in Belgium, Finland, France, Germany, Italy and the Netherlands, with only half of its

11 % of the total burden of disease could be attributed to nine selected environmental factors, out of which particulate matter, noise, radon, and transmissible bacterial agents were leading. Due to lower burden, the results tend to be congruent with causes of an average ranking of environmental health impacts only (6).

The degree of differences in the quality of the environment across Europe depend on the turning process initiated, for example, by urbanisation, population and natural resource use, topography and associated health risks, as well as the benefits of pollution reduction and of a natural environment, and are not uniformly distributed within populations. Studies show that poor environmental conditions affect vulnerable groups especially (7). The evidence is scant, but it shows

Figure 5.1 – The health gap



Source: Jones and Owen (8)





**Box 5.1. Environmental burden of disease – estimating the impact of environmental factors**

The environmental burden of disease (EBD) measures the proportion of health attributable to exposure to environmental factors. One of the main sources of data on the burden of disease comes from the Global Burden of Disease (GBD) studies, which estimate the burden of disease by age, sex, and geography. The results are then used to estimate the impact of environmental factors on the GBD. The GBD studies are based on data from the World Health Organization (WHO) and other sources. The GBD studies are based on data from the World Health Organization (WHO) and other sources. The GBD studies are based on data from the World Health Organization (WHO) and other sources.

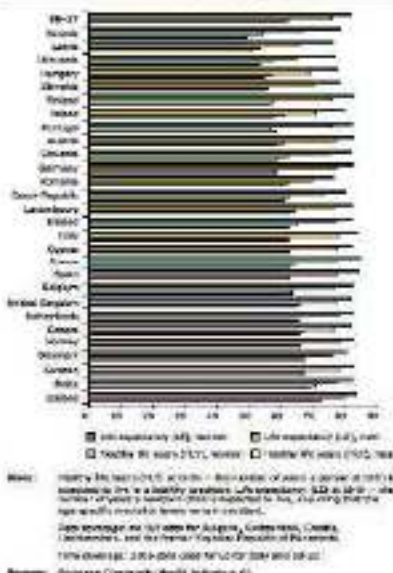
that depressed women are more likely to be affected. For example, in Scotland, mortality rates in people aged under 75 in the 10% most depressed areas were three times higher than those in the 10% least depressed (7).

Better understanding of differences in the social distribution of environmental quality can be helpful for policy development. For example, in Scotland, mortality rates in people aged under 75 in the 10% most depressed areas were three times higher than those in the 10% least depressed (7).

**Europe's ambition is to provide an environmental and growing year to harmful effects on health**

The main European policies aim to provide an environment in which the level of pollution does not give rise to harmful effects on human health and the environment, and vulnerable population groups are protected. These include the Environment Action Programme (EAP) (10), the EU Environment and Health Strategy (11) and Action Plan 2004-2012 (12), and the post-2010 European Environment and Health process (13, 14).

**Figure 5.2. Life expectancy and healthy life years at birth in EU-28, 2010 and 2015, by gender**



Several areas for action have been identified: reducing air and noise pollution, water pollution, chemicals, including harmful substances such as pesticides, and improving the quality of air, especially in urban areas. The environment and action programme, of addressing a better understanding of the environmental factors to human health, reducing the disease burden caused by environmental factors, strengthening EU capacity for policymaking in this area, and stimulating and promoting new environmental health initiatives (1).

While EU policy emphasis is on reducing pollution and the distribution of related services provided by the environment, there is also a growing recognition of the benefits of investment, including green investment, to human health as a well-being (2).

Furthermore, it is worth noting that most health-related pollution policies are targeted to the outdoor environment. A notable exception is air quality in five urban areas in the Netherlands, considering that European citizens spend up to 90% of their time at home (3).

**Box 5.3. Indoor environment and health**

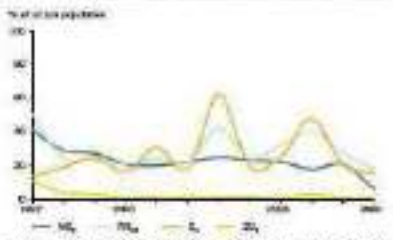
The quality of indoor environment is affected by ambient air quality, building materials and structures, consumer products, heating, ventilation and air conditioning systems, cleaning and maintenance products, occupational hazards, including painting and building maintenance. The quality, energy saving measures, repairs to products, water and electricity, maintenance products, and to products, mould and other biological agents can have direct or indirect effects on health. For example, a 10% increase in indoor air quality can reduce the risk of respiratory and cardiovascular disease (4, 5).

**For some pollutants ambient air quality has improved, but major health threats remain**

In Europe, there has been overall improvement in the levels of sulphur dioxide (SO<sub>2</sub>) and carbon monoxide (CO) in ambient air, as well as a gradual reduction in NO<sub>x</sub>. Also, lead concentrations have declined considerably with the introduction of unleaded petrol. However, exposure to particulate matter (PM) and ozone (O<sub>3</sub>) remains at major concentrations in some countries, linked to a loss of life expectancy and chronic respiratory and cardiovascular effects, impaired lung development in children, and reduced lung growth (6).

Over the past decade, acute concentrations have frequently and widely exceeded health and ecosystem-related target values (7).

**Figure 5.3. Percentage of total population in areas where pollution concentrations are higher than air quality limit values, 2007-2009**



Note: O<sub>3</sub> is the only pollutant where exceeding values is minimal. Ozone is a natural component of air, and is not in the same category as other pollutants. The graph shows the percentage of the population in areas where pollution concentrations are higher than air quality limit values. The graph shows the percentage of the population in areas where pollution concentrations are higher than air quality limit values. The graph shows the percentage of the population in areas where pollution concentrations are higher than air quality limit values.

Clear air for Europe (CAE) programme estimated that at current levels of ground-level ozone exposure to concentrations exceeding the health-related target value (1) is expected with over the next 20 years to increase to 60% annually (7).

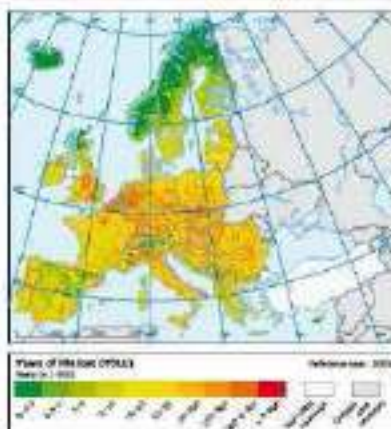
In the period 1997 to 2008, 48 to 62 % of Europe's urban population was periodically exposed to ambient air concentrations of fine and very particulate matter ( $PM_{2.5}$ ) at or above the EU limit value set for the protection of human health (7). However, particulate matter below the threshold concentration, that is below health effects can also occur below the limit value.

The fine particulate matter ( $PM_{2.5}$ ) (7) represents a particular health concern because these can penetrate the respiratory system deeply and be absorbed into the bloodstream. An assessment of the health impacts of exposure to  $PM_{2.5}$  in USA (8) estimates that about 7 to 10 times less life years could be attributed to this pollutant (7). Secondary smoke exposure has recently been shown to bring several of the city goals in the United States of America where the respiratory-increased meet in the region with the largest reductions in  $PM_{2.5}$  over the past 20 years (7).

$PM_{10}$  and  $PM_{2.5}$  concentrations are indicators of complex mixtures of pollutants and are used as proxies for the particulate distribution responsible for the effects. Other indicators, such as  $SO_2$ , ozone, elemental carbon, and the number of particles, might provide a better link to the source of pollution which need stringent measures to specific health effects. This could be benefited by targeted abatement strategies and setting air quality standards (9).

Evidence is increasing that the chemical properties and composition of particles, along with their mass, are important to health impacts (7). For example, hexamethylene diisocyanate (HDI), which is a member of isocyanate polyurethane acetate (IPUA) aerosols, is not that easily from the burning of cigarette material and  $PM_{2.5}$  sources. High levels of HDI occur in some regions, such as the Czech Republic and Poland (7). The increasing urban burning is common in some parts of Europe may become an even more prominent source of such harmful pollutants. Climate change mitigation strategies may also play a role, by stimulating use of wood and biomass as domestic energy sources.

**Fig. 6.1** Estimated years of life lost (YLL) in reference year 2002 attributable to long-term  $PM_{2.5}$  exposure



Source: WHO, WHO Europe Group (7).

The air EAP sets the long-term objective of achieving levels of air quality that do not give rise to unacceptable impacts on, and risks to, human health and the environment. Its subsequent European strategy on air pollution sets common objectives through the improvement of air quality by 2020. The air Quality Directive (7) has set legally binding limits for  $PM_{10}$  and its organic component such as benzene. It has also introduced additional  $PM_{2.5}$  objectives, based on the average exposure indicator (AEI) (7) to determine a weighted percentage reduction to be attained in 2020.

Furthermore, several international bodies are discussing the setting of targets for 2020 in relation to the long-term environmental objectives of European policies and instruments (7, 10).

#### Road traffic is a common source of several health impacts, especially on urban areas

Air quality is worse in urban areas than in rural areas. Most average  $PM_{2.5}$  concentrations in the European urban environment have not changed significantly over the past decade. The main sources are road traffic, industrial activities, and the use of wood, such as for heating and energy production. Motorised traffic is the major source of the  $PM_{2.5}$  fraction responsible for adverse health effects, which also come from non-motorised  $PM_{2.5}$  emissions, for example trails and tyre wear or resuspended particles from pavement materials.

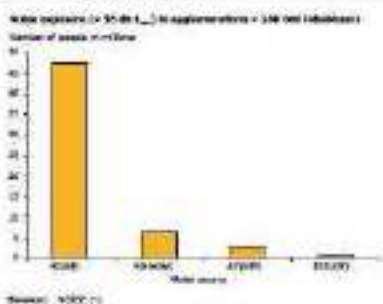
Motorised road traffic agrees, with an estimated more than 1 million accidents in the EU every year, remains an important public health issue. These cause 39 600 deaths in the EU in 2005; 33 % of fatal accidents on highways occur affected people under the age of 25 (7). Transport injuries also account for a substantial proportion of human exposure to cancer, which has negative impacts on human health and well-being (7). This has need to be addressed with the Directive on Road Transport Noise (7) and will also through the Green Urbanisation and International Network for Europe (7).

Approximately 66 % of the population living in the largest cities in the EU-27 may be exposed to long-term average road traffic noise levels (7) exceeding 55 decibels (dB), and at night, almost 2 million people may be exposed to long-term average road noise levels (7) exceeding 60 dB

The WHO might also guidelines for Europe recommend that people should not be exposed to night noise greater than 40 dB. Night-time noise levels of 40 dB observed in an average European public domain, cannot be considered as an indicator for urban areas where the achievement of the pollution limit health (7).

According to a German Environmental Survey for Children, children from families of low socio-economic status are more heavily exposed to noise, and exposed to road traffic noise during the day, as compared with children with higher socio-economic status (7). Urban air quality and noise often share a common source as it may reduce equality. Thus, an example, such as Berlin, of successful integrated approaches to reducing both local air pollution and noise levels (7).

**Fig. 6.2** The reported long-term (yearly average) exposure to air pollution's  $PM_{2.5}$  of more than 250  $\mu g/m^3$  in 2002 with more than 250 000 inhabitants



Source: WHO (7).





### New chemical regulations in my life, but the combined effects of chemicals remain an issue

Water, air, food, consumer products, and even dust can play a role in human exposure to chemicals through ingestion, inhalation, or contact through skin. Of particular concern are pesticides and bioaccumulative compounds, which are among the big chemicals and heavy metals used in plastics, textiles, cosmetics, electrical products, electronic goods, and food packaging (7). Exposure to these chemicals has been associated with chronic diseases such as asthma, neurodegeneration, impaired mental development and neural function, obesity and cancer.

Chemicals in consumer goods may also be of concern when products become waste, as many chemicals are not stable in the environment and can be found in soil, water, air, indoor dust, wastewater and sludge. A relatively new concern is the use of waste electrical and electronic equipment which contains heavy metals, flame retardants and other hazardous chemicals. Recycled plastic, cardboard, pesticides, herbicides, and pest control chemicals are just a few other hazardous wastes of these regulated health chemicals and substances present in the environment and in humans.

Possible combined effects of exposure to a mixture of chemicals found at low levels in the environment or in consumer goods, especially in vulnerable young children, are an emerging public health attention. Furthermore, some adult diseases are linked to early life or even prenatal exposures. The science of understanding of mixture toxicology has recently been advanced significantly not least at a series of EU-funded research (8).

While concerns about chemical engineering, and the chemical movement and their role in the environment, as well as for exposure and associated risks, continue to exist. There remains a need to establish an information system on chemical risks of chemicals in various non-essential compartments and in humans. This approach, and the associated toxicology, offer the scope to do the necessary.

Furthermore, there is increasing recognition that standardised risk assessment is necessary to avoid underestimation of risks that might occur outside the normal paradigm of controlling substances as chemicals in ecosystems (9). The European Commission has been asked to take account of chemical cocktails and to apply the precautionary principle to decreasing risks of chemical combinations when drafting new legislation (7).

Good management poses a crucial role in preventing and reducing exposures. A combination of legal, control-based and information-based interventions to support consumer choices is critical, given public concerns about the possible health risks of exposure to chemicals in consumer products. For example, Germany has prohibited plasticizers on how to reduce children's exposure to chemical cocktails, focusing on phthalates, parabens, and propylparaben byproducts (10). In the EU, right-hand options for non-food diagnostic products, spanning since 2001, of medical risks represented 26 food-related (11) substances in 2005 (9).

The Registration, Evaluation, Authorisation and Restriction of Chemicals regulation (REACH) (12) aims to improve the protection of human health and the environment from the risks of chemicals. Manufacturers and importers are required to gather information on the properties of chemical substances and propose risk management measures for safe production, use and disposal – and to register the substances as a central database. REACH also calls for the progressive substitution of the most dangerous chemicals on a suitable alternative where feasible has been identified. However, the regulation does not address cumulative exposure to multiple chemicals.

The efforts to better protect human health and the environment through safe chemical substances need to be complemented by a systemic approach to chemical assessment. Such assessment should include not only toxicity and ecotoxicity, but also address the climate-related, water, and energy use, financial, status of CO<sub>2</sub> and other emissions, as well as waste generation through the life cycle of different chemicals, such a sustainable chemistry approach requires new, innovative production processes and the development of chemicals that use fewer raw materials and use of high quality, with limited input due to reduce or avoid waste – however, there is no comprehensive legislation on sustainable chemistry in place as yet.

### Climate change and health is an emerging challenge for Europe

Security of the environment and some aspects of climate change (Chapter 2) may ultimately affect human health by such affecting weather patterns, and through changes to water, air and food quality and quantity, ecosystems, agriculture, foodbodies and infrastructure (1). Climate change on multiphase and existing health problems, possible health effects depend largely on population vulnerability and their ability to adapt.

The lead report in Europe in summer 2005, with a death toll exceeding 70 000, highlighted the need for a response to a changing climate (16). The elderly and people with particular diseases are at higher risk, and degraded population groups are more vulnerable (17). In completed urban areas with high soil sealing and low albedo, surfaces, the effects of local waters can be more harmful due to increased urban heat island and poor air exchange (18). For populations in the EU, mortality has been estimated to increase by 1 to 1.4 % for each degree increase of average urban area's daily specific annual peak (19). In the EU, the estimated average annual heat-related mortality resulting from projected climate change could reach of 15 000 per year, mainly in central and southern Europe in spring (20).

An anticipated impact of climate change on the spread of vector-borne and zoonotic (21) diseases in Europe emphasizes the need for action to address vulnerability to public health (22). Through urban patterns of common vector diseases are also influenced by ecological, social and economic factors, such as changing land use patterns, the fading biological diversity of wild areas in human habitat, and outdoor activity, as well as access to health care and population mobility that can be disrupted by the threat to the distribution of food, water of the type disease and food-borne zoonoses. Other in aquatic insects the extended range in Europe of the Asian tiger mosquito, a vector of several viruses, with a potential for further transmission and dispersion under the changing climate conditions (23) (2).

Climate change may also exacerbate existing environmental problems, such as particulate emissions and high ozone concentrations, and pose additional challenges to providing a natural water and sanitation.

concern. Climate related changes in air quality and pollen distribution are expected to affect several respiratory diseases. Systematic assessments of the volume of water supply will be vital to prevent or reduce change and investment in infrastructure water supply plans are needed (24).

### Natural environments provide multiple benefits to health and well-being, especially in urban areas

Nearly 75 % of the European citizens live in urban areas, and this is expected to increase to 88 % by 2025. Under the EU's (25) the 70% strategy on urban environment (26) highlights the consequences for human health of the environmental changes facing cities: the quality of life of urban citizens and the performance of cities. It aims to improve the urban environment, to make it more attractive and healthier to live, work and invest in, while trying to reduce the adverse environment and its impact on the urban environment.

The quality of life and health of urban dwellers depend largely on the quality of the urban environment, functioning as a complex system of interactions with social, economic, and cultural factors (4). Green urban areas play an important role in the creation of multifunctional networks of green urban areas is capable of delivering many with essential social, and economic benefits, job, health maintenance, improved local air quality and recreation, to name a few.

The benefits of streets with sidewalks and access to safe green space for children's play and recreation and for self-development have been shown both in urban and rural settings (27). Health is generally perceived to be better for people living in more natural environments, with greater local, social, greenness in urban green spaces and the area of sidewalks (28) (5). Furthermore, the potential availability of green urban areas has been shown to reduce absenteeism due to stress (29).



Map 5.2 Percentage of green urban areas in cities of the EU



Source: EEA, 2006:100.

**A broader perspective is needed to address ecosystems and health links and emerging challenges**

which progress has been achieved through a more integrated approach to improving the quality of the environment and reducing pollution. In fact, as far as health is concerned, the most significant progress has been made in the biological and ecological dimensions achieved today. Protecting and extending the forested perimeter by the extension of urban health and well-being will require continuous effort to improve the quality of the environment. Furthermore, these efforts need to be complemented by other measures, including significant changes in lifestyle and human behaviour, as well as occupational patterns.

Meanwhile, new challenges are emerging with a wide range of potential, highly uncertain, scientific and human health implications. In this context, technological advancement may provide new lessons – lessons, history and other many aspects of stress health implications new technologies (7).

Nanotechnology, for example, may allow the development of new products and services which are capable of enhancing human health, conserving natural resources or protecting the environment. However, the unique features of nanomaterials also raise concerns about potential environmental, health, occupational and general safety hazards. The understanding of nanotechnology is still evolving, and new methods for assessing and managing the risks inherent in the use of new materials.

Given such knowledge gaps and uncertainties, an approach to responsible development of nanotechnology, such as nanotechnology, could be achieved through proactive governance based on broad stakeholder involvement and early public intervention in research and development (8). The European Commission has, in strategic, scientific aspects and the public regarding the benefits, risks, concerns and perceptions of nanotechnology to support the preparation of a new strategy for nanotechnology (9).



The increasing complexity of such complexity, complexity and uncertainty also means that the EU Treaty principles of prevention and precaution are becoming crucial. In fact, more emphasis on the preventive and precautionary principle is needed, as it is needed to avoid additional costs that outweighing, otherwise, the potential benefit to health, given the price and cost of action (10)(11)(12).

Figure 2.6: Beneficial effects of ecosystem changes on the human health

Beneficial effects of ecosystem changes on human health	Beneficial effects of ecosystem changes on human health
<ul style="list-style-type: none"> <li>Improvement of water and ecosystems health and</li> <li>Climate change</li> <li>Water quality</li> <li>Prevention of air pollution</li> <li>Soil degradation and land use changes</li> <li>Reduction of noise</li> <li>Reduction of air pollution</li> <li>Prevention of disease and other health</li> <li>Prevention of air pollution</li> <li>Prevention of disease and other health</li> </ul>	<ul style="list-style-type: none"> <li>Human health benefits</li> <li>Human health benefits</li> <li>Human health benefits</li> <li>Human health benefits</li> <li>Human health benefits</li> <li>Human health benefits</li> <li>Human health benefits</li> <li>Human health benefits</li> <li>Human health benefits</li> <li>Human health benefits</li> </ul>

Note: For all ecosystem changes we assumed that they can have positive effects, other positions, for example.  
 Source: European Environment Agency (13).



## 6 Links between environmental challenges

Links between environmental challenges are pointed to specific underlying complexity

From the analyses presented in previous chapters, it is clear that the growing demands for nature resources in nature-based services put pressure on the environment and its increasingly complex and wide-ranging ways.

Generally speaking, specific environmental issues often with local effects have in the past been dealt with through targeted policies and single-issue instruments, such as the approaches to waste disposal and species protection. Since the 1980s, however, the recognition of status problems from a current service can lead to an increased focus on the integration of environmental concerns of this kind into policies, for example in transport or agricultural policies.

Today's main environmental challenges are systemic in character and cannot be tackled in isolation. The interconnectedness of environmental policy areas – climate change, nature and biodiversity, use of natural resources and waste, and environment and health – point to a series of direct and indirect links between environmental challenges.

Climate change, for example, impacts all other environmental issues. Changes in temperature and precipitation patterns affect agricultural production as well as plant and animal distribution and physiology, and thus exert additional pressure on biodiversity (Chapter 3). This may lead to species extinction, particularly in arctic, alpine and island areas (Chapter 2). Similarly, changes in climate conditions across Europe are projected to alter existing biodiversity by changing the occurrence of forest types, soil types and water-borne diseases (Chapter 7 and 8).

Nature and biodiversity are the basis for virtually all ecosystem services, including food and fibre production, natural protection and climate regulation – to name, for example, a few key ecosystem services that help absorb greenhouse gas emissions (Chapter 5). These

Table 4.3 Reflecting on environmental challenges

Characterisation of the issue or challenge	Key features	Is the challenge in the spotlight?	Policy approach needed
Local	Local cause-effect relationships, clear local actors and local effects	Highly visible and concrete	Targeted, sectoral and sector-specific policies
Global	Global cause-effect relationships, multiple actors and multiple effects	Highly visible and concrete	Policy targets of global nature-based goods
Systemic	Multiple causes, multiple effects, multiple actors and multiple effects	Highly visible and concrete	Policy objectives and cross-sectoral approaches

Source: IMA.

lead directly from and complicate the problem and only affect climate change and, furthermore, the way we are able to use natural resources. In addition, the role of natural infrastructure has been shown to have various different effects on forests health (Chapter 4).

The use of natural resources and the resulting pollution of air, water and soil put pressure on nature and biodiversity through, for example, eutrophication and acidification (Chapter 2). Ultimately, the use of non-renewable natural resources, such as fossil fuels, is at the heart of the underlying climate change. In addition, waste management is a key sector with regard to greenhouse gas emissions (Chapter 2). How we use natural resources and dispose of wastes also links directly to several health aspects and contributes to the environmental burden of disease (Chapter 3).

Ultimately, environmental pressures that affect them, for example, climate change, indirectly lead, at the use of natural resources, to interact with people's well-being (Chapter 2). It is difficult to think water and air are just essential to our health, but it often is essential for production and creates the conditions for human activities (Chapter 2 and 4). Climate change puts a pressure on air and water quality (Chapter 2). Water biodiversity also may undermine the ability of ecosystems to provide the services, such as purification and other health-related services (Chapter 4).

Table 4.3 Links between environmental challenges

How might it happen (likely future scenario)	Climate change	Water and biodiversity	Use of natural resources	Development and services
<b>Climate change</b>	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise
<b>Nature and biodiversity</b>	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise
<b>Use of natural resources and services</b>	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise	Greenhouse gas emissions increase, leading to global warming and sea level rise

Source: IMA.

many of the links described above and in the previous chapter are likely to change in the state of new environmental issues can become difficult to anticipate and/or to avoid. In addition, examples of indirect interactions with changes in one environmental issue occurring in feedback on another and vice versa.

Local use and feedback changes essentially such indirect links. They can be seen to be both a driver and an impact, not only of climate change, but also of biodiversity loss and the use of natural resources. Thus, any change in land use and land cover resulting, for example, from urbanisation or converting forests to agriculture, affects climate conditions by changing air and water quality, as well as biodiversity by altering ecosystems.

Most of the changes in the state of the environment described here are ultimately driven by considerable consumption and production patterns. These have resulted in unprecedented levels of greenhouse gas emissions and the impact on air resources.

### Box 4.1. Natural capital and ecosystem services

Natural capital and ecosystem services are closely interlinked concepts. As has been defined in the study of natural resources from which products can be derived and the flows of services naturally embedded, the flows and their impact on ecosystem services and functions such as production, use, and sustainability. There are three main types of natural capital which require different approaches to managing them:

- **non-renewable and finite natural resources** – fossil fuels, metals, etc.;
- **renewable but non-storable natural resources** – wind, waves, etc.
- **flows of services** – the flows of functions and services – a product for the services of energy, food and materials, the cycle for water and pollution, the services of climate and water regulation, purification, and the space for living and working.

Using natural capital (when managed well) will ensure flows (services) of all services, the total flow of all ecosystem services (including the flows of the flows) can be managed to ensure that the flows and services (capital) will be able to support the flows of the flows.

Source: IMA.





water management, terrestrial carbon fluxes, land-based natural greenhouse gas production and absorption in nutrient cycles. Thus, we and our economy depend on a multitude of soil functions.

For example, soil microbes play a major role as a beneficial sink of carbon and can contribute to climate change mitigation and adaptation. However, around 40 % of the cropland soils in Europe have low or very low organic matter content (0 to 1 % organic carbon) and do not have a neutral cationic (1 to 6 % organic cations) and soil organic matter in Europe is constantly declining. Several factors are responsible for the decline in soil organic matter and many of them relate to human activities. These factors include conversion of grasslands, forest and natural vegetation to cropland, loss of plant and animal residues through burning, nitrogen fertilizer use, tillage of past soils, crop rotations with reduced proportion of grasses.

#### Sustainable water management requires striking a balance between different uses

Water is an ecological and economic resource, renewable but finite. It is vital to support healthy ecosystems (Chapter 2), while access to clean water is essential for human health (Chapter 3). Furthermore, water is a key natural resource linked with agricultural diversity and industrial production, household consumption, and energy production (Chapter 6).

Environmental pressures on European water systems are closely related to land use patterns and related human activities in the river basins. The main pressures are diffuse pollution, water abstraction, and hydro-morphological changes in connection with hydroelectric generation, drainage and canalisation, loss of wetland areas in the periurban sector, habitat erosion and loss of water retention capacity. Are alternatives to better water storage systems necessary?

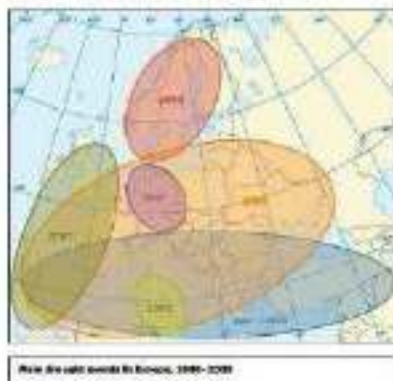
Large areas of Europe are affected by water scarcity and droughts, while other regions are increasingly exposed to excess floods. Over the past few years, Europe has experienced more than 140 major floods, causing deaths, displacement of people and large economic losses. Future climate change is expected to make matters worse.

Map 6.2 Determinants of floods in Europe, 1994–2005



Source: IFA.

Map 6.3 Main drought events in Europe, 1994–2009



Source: IFA, ETC Land Use and Spatial Information.

The Water Framework Directive (WFD) (4) is the key policy approach aimed at tackling these challenges. It sets ecological goals for all water bodies and encourages, furthermore, a change in Member States and regional authorities to take increased measures regarding, for example, agriculture, energy, transport and housing, within the context of rural and urban spatial planning, while also taking biodiversity conservation concerns into account. As noted already (Chapter 2 and 4), a first look at river basin management plans shows that many actions are needed in the coming years to achieve good ecological status by 2015.

For the WFD to be successful, integrated management of water basins is crucial, involving all stakeholders from identifying and implementing spatially differentiated measures that often involve trade-offs between different interests. The management of flood risks, in particular the valuation of cycles and natural retention of flood peaks, requires integrated urban and landscape planning.

Map 6.4 Limited yet competing for use, water-energy-food systems

Water, energy and sustainability in production activities including agriculture and energy production, and as a water-related issue. As a secondary system it is also required to have efficient production and use. The effects of food systems activities in energy, for example agriculture, via its direct use of energy, climate change and water production processes from its activities to contribute to climate change.

At the EU and national levels, there are different national and sub-national policies and measures that may conflict with water management and the objective of reducing a given amount of water. It is essential to assess the impact of policies on energy, water and hydro-energy, the promotion of large agriculture, the development of forests, and expanding forest services (Energy).

The Water Framework Directive provides criteria to assess energy and biomass requirements in water basins. It is essential to strike a balance between water and energy use. For example, related to energy and agricultural production, in reducing greenhouse gas emissions – as well as the benefits of its impacts on the strongest driver of water stress, nitrogen and phosphorus and related.

Source: IFA.

Furthermore, the water energy link illustrates that coordinated water management in the context of energy generation is needed — to enable local development, cooling, and electricity supply without impacting water ecosystems. The sustainability of energy use, its distribution, and wastewater treatment also needs to be evaluated.

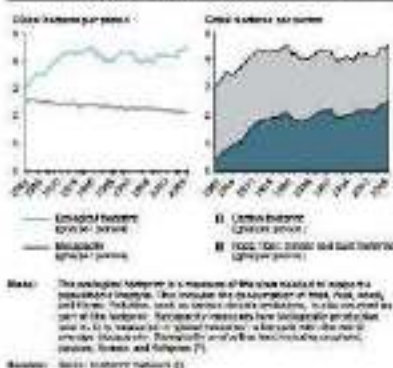
#### [Not] Keeping our environmental footprint within limits

Common to most of the examples given so far is the fact that many environmental problems in Europe cannot be studied or solved in isolation. European and global nature is interconnected. The key question is to what extent Europe will be able to rely on other resources from outside Europe in the light of increasing worldwide demand. Europe's consumption, however, is directly exposed to environmental resource production by approximately a factor of two (4).

There is little doubt that increasing global food demand, the need of population increases and development, is likely to result in less land conversion and increased efficiency of food production (% of land of the global total). There are large and complex systems of agricultural products. The total volume and intensity of European agricultural production thus differs by the production of non-essential resources and ecosystems in Europe and around the globe.

Major progress, technological development and policy interventions have resulted in a complex technology to concentrate agricultural production on the most fertile farmland areas in Europe, while marginal or remote locations are being given up. The associated mechanisation leads to increased environmental pressure on water and soil resources in intensively cultivated areas. In addition, abandonment of extensive farmland leads to a loss of biodiversity in the areas affected. Moreover, more natural vegetation cover can provide other ecosystem services — such as the carbon storage provided by forests.

Figure 4.1 Ecological footprint consisted of 10 biologically capital and different components of the natural capital in 1961 (left) and 2008 (right)



Complexity — and as a global perspective — the coordination of growth and production to agricultural land is one of the most important elements for natural food and greenhouse gas emissions reduction.

There are clear links between the use of land in Europe and global agricultural trends, and both relate to international trade. Trade is associated with increasing demand and environmental

pressure in Europe, and their implications for the ecosystem around the world need to be evaluated. An integrated consideration in this regard is the preservation of critical natural capital — such as fertile soil, landscape and clean water resources, and natural ecosystems. But more sustainable, further growth, diversity and supported food production.

#### How and where we use natural capital and ecosystem services matters

All the things we look to for typical goods: natural capital, including land, water, soil, and freshwater resources, provides a foundation for ecosystem services and other forms of capital that humans rely on: in business, social, institutional and financial capital. This depends very little on where to get another level of complexity for soil, to balance different uses of natural resources within environmental limits because a trade-off exists (5).

In order to maintain natural capital and secure a sustainable flow of ecosystem services, further measures are for efficiency will include on the natural resources will be necessary — combined with changing the underlying consumption and production patterns.

The focus is integrated management approaches for natural capital need to take into account traditional elements. In the context, spatial planning and landscape management can help balance the environmental impacts of economic activities, especially those related to transport, energy, agriculture and manufacturing, across communities, regions and countries.

Dedicated management of natural capital and ecosystem services over time can allow us to manage a range of risks with a range of environmental pressures, and to taking for the many economic activities that have been done. Increasing water efficiency and security, especially in energy, water, food, pharmaceuticals, agriculture and tourism, are essential elements of this region (see Chapter 6).







indicates that air, however, need information on specific resource developments. Global food, energy and water systems appear to be more water rich and might have thought a few years ago, the risks here are more water scarce, increased drought, increased supply inelasticity, over-exploitation, degradation and loss of soils as relevant concerns in this regard (9) (10). With global competition and increased geographic and corporate concentration of supplies to some regions, Europe faces increasing supply risks (1).

In spite of general progress in the area of environmental and health in the region, the global base on all environmental health aspects remains deeply worrying. Unstable water, poor sanitation and hygiene conditions, urban outdoor air pollution, indoor air quality from solid fuels and lead exposure and global climate change account for nearly a tenth of deaths and disease burden globally and around one quarter of deaths and disease burden in children under 5 years of age (11). It is again poor people who are most likely to die and be affected most heavily.

Table 3.1. Deaths and DALYs (disability-adjusted life years) attributable to five air pollutants, by region, 2004

Site	World	Low and middle income	High income
<b>Percentage of deaths</b>			
Isolated from road traffic	2.1	2.8	0.9
Isolated from coal burning	2.1	2.2	0.7
Other outdoor air pollution	2.2	2.2	2.2
Indoor air pollution	2.2	2.3	2.2
Lead exposure	2.2	2.3	2.2
All five sites	8.7	9.8	6.8
<b>Percentage of DALYs</b>			
Isolated from road traffic	2.1	2.8	0.9
Isolated from coal burning	2.4	2.6	0.8
Other outdoor air pollution	2.4	2.4	2.4
Indoor air pollution	2.1	2.2	2.2
Lead exposure	2.2	2.3	2.2
All five sites	9.2	9.3	6.9

Source: World Health Organization (1).

any new, and stable income countries may face a growing burden from new risks to health, with air lighting as one of these with the additional risks to health. The World Health Organization (WHO) estimates that between 2005 and 2020, more than two-thirds of the disease could increase attributable by 17%. The greatest increase is projected in the African region (24 %) followed by the eastern Mediterranean region (19 %) (9). Europe is likely to be faced with the greatest problem of managing its air emissions, not because it has the most serious problem of managing its air emissions or particulates, but because of its ecological destruction (12). It is an increasingly urbanised world, which is highly fed by long-distance transport, the maintenance and distribution of vehicles becomes a major business to take to increase (1).

Links between environmental challenges are particularly apparent in Europe's direct neighbourhood

Europe is directly neighboured – in the Arctic, the Mediterranean and the North Atlantic – by a world with high attention here due to the steep environmental and socio-economic trends and the importance of their respective EU external policy instruments, some of the world's largest economies of national economies are in these regions, which is of immediate relevance to a concrete energy strategy.

These regions are also home to some of the world's richest and yet most fragile natural environments in which are living multiple threats. At the same time, energy needs related to energy have steadily increased the water management and air pollution situation shared between Europe and its neighbours. Some of the main environmental challenges in these regions include:

- The Arctic – European activities, such as those resulting in long-range aviation or air pollution, heavy carbon and greenhouse gas emissions, have a considerable impact in the Arctic. All the same time what happens in the Arctic also influences Europe's environment, because the Arctic plays a key role, for example, in the context of climate change and water resources and sea level rise. Furthermore, multiple processes in Arctic ecosystems have included in biodiversity loss across the region. Such changes have global relevance not because of the loss of key ecosystems

Europe has an ongoing additional challenge as the people living in the Arctic – a changing ocean pattern affecting fishing and land practices (1).

- **Trans-continental – EU neighbours** – On the far side many environmental challenges, affecting human health and ecosystems. The EU's direct environmental impact of Europe's activities (13) encompasses key environmental issues across the pan-European region, including countries in western Europe, the Caucasus and

**Box 3.1. The European Neighbourhood Policy**

The European neighbourhood policy (ENP) aims to strengthen co-operation between the EU and its neighbours. It is a dynamic and evolving process to deepen and widen trade and joint responsibility and working. In recent years, the ENP has been fully developed through dialogues with the ENP's 16 partners, such as the European Council for the Mediterranean. With the ENP, based on EU instruments – the EU Neighbourhood Policy, the Water Partnership Strategy and the European Union Climate Change Instrument – an open, transparent process – in partnership with a regional council – is intended to help sustainable economic and social development. The ENP also aims to help developed and developing countries address environmental issues – such as the UNFCCC Convention on Biological Diversity Convention, covering the EU's water, agriculture, and the environment, the human development, to promote the regional countries in addressing the priority areas of energy and climate, education, transport, trade and investment that aim to reduce poverty of the ENP's partners.

With the ENP, a new level of trust and confidence and cooperation, as well as closer and more regular relations, is sought to achieve for better understanding in the area of the EU's foreign policy – while the ENP has also been seen to increase on several levels, the environmental policy dimension aims to promote several EU policies – such as the EU agricultural policy, foreign policy, and the policy, and to extend and create policy or energy policy – and the ENP is intended to directly and indirectly improve the world's health, environment and social and economic progress. Europe's global health, environment and social and economic progress are interdependent on time and space. Better and more regular information to enhance environmental analysis and assessment is needed.

The ENP – within the framework of the European Neighbourhood Policy – is complementary with the countries and their partners in the region – in implementing a series of initiatives that aim to strengthen bilateral relations and to facilitate data and information management.

Source: ENP.

Central data if Europe as the challenge posed by air and water pollution, climate change, biodiversity loss, pressures on the marine and coastal environment, transportation and production patterns, and several sectors ecosystems that cause environmental change across the region.

The Mediterranean – Located at the crossroad of two continents this is one of the richest sea regions and one of the most vulnerable natural environments in the world. The recent report on the State of the Environment and Development in the Mediterranean (14) presents the major impacts of climate change, the degradation of the natural resources and environmental in the region, and the challenges posed by these circumstances. In particular, some of the main pressures from human activities are identified such as tourism, transport, and industry and their impacts on coastal and marine ecosystems are assessed together with considerations about their environmental sustainability.

While Europe is contributing directly and indirectly to some of the environmental pressures in these regions, it is also in an unique position to contribute to improve these environmental conditions, particularly through technology transfer and helping to build a resilient economy. These dimensions are increasingly reflected in European neighbourhood policy priorities (1).

Environmental challenges are closely connected with global drivers of change

A range of leading trends are shaping the future Europe and global world, and many of these are related to the main EU Europe's direct influence. Critical global megatrends are: climate change, technological, economic, political and civic environmental dimensions. Key drivers include: changing demographic patterns, an increasing urbanisation, new technologies, changing energy sources, increasing water interdependence, developing economic power shifts in the changing world.

In 2002, the world's population was 6 billion. Today it is about 6.5 billion. The United Nations Population Division expects the growth to continue so that the global population will exceed



Figure 3.2 A selection of global drivers of change relevant for the European work context



- Demographic change priority areas**
- Globalisation
  - World age diversity
  - World regional mix
  - Diversity, health and safety of HR

**A selection of global requirements**

- **Reducing costs** (Europe is a costlier region: automation, energy and energy efficiency)
- **Control of risk** (with respect to cost and quality, compliance)
- **Changing patterns of global demand** (wages and the risk of new products)
- **Accounting for change** (being open to the changes)
- **Control of economic growth**
- **Global talent** (HRM, HRD) (a mix of HRD and HRM)
- **Education** (global education for the future)
- **Research and development** (of all and new areas)
- **Increasing diversity of the composition of global plants**
- **Increasing vertical integration** (to reduce costs)
- **Global regulation and governance** (to manage globalisation, globalisation, globalisation)

Source: PwC.

Table 3.3 Population of the world and 8th world region, 1994, 2005, 2050 and 2050 according to different growth scenarios

Region	Population in millions			Population in 2050		
	1994	2005	2050	Low	Medium	High
World	5,574	6,305	7,573	7,000	7,139	7,440
Asia (excl. Australasia)	3,127	3,647	4,337	4,200	4,276	4,470
Latin America	575	624	670	670	670	670
Europe	732	730	720	720	720	720
North America	352	348	340	340	340	340
Oceania	34	38	40	40	40	40
Europe (EU-28)	510	510	507	507	507	507

Note: Europe (EU-28) comprises countries of EU member states (except Turkey) and the associated countries, as well as Iceland, Kosovo and Gibraltar. Excludes Palestine, Ukraine.

Source: United Nations Population Division (2).

Written by 2050, according to the 'medium growth variant' of their population estimate (2). However, uncertainties are apparent, and forecasts depend on several assumptions, including fertility rates. As well as 2050, the world population could thus amount to 6.5 billion or be limited to 5 billion (2). The implications of this uncertainty for global business demand are large.

In contrast to the global trend, European populations are expected to decline and age significantly. In developed areas, population declines in peak relative abundance in 2050 and large parts of Europe will be largely empty. Countries with an increasing birth rate in 2050 are not increasing their population growth. In general, the world region of sub-Saharan Africa and the Middle East has experienced the highest rate of population growth of any region in the world since the post-war years (2).



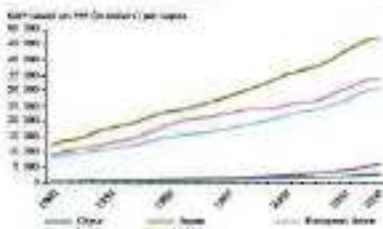
The regional distribution of population growth, the age structure, and migration between regions are also important. Nearly 60 percent of the population growth since 1940 has been in countries classified as new economies (the former east bloc etc.). Moreover, the world is rebounding at an unprecedented rate. By 2050, about 70 % of the global population is likely to live in cities, compared with less than 30 % in 1950. Population growth is even larger in cities than previously concentrated in the developing world, particularly Asia, which is expected to be home to more than 60 % of the global population by 2050 (2).

Global integration of markets, shifts in global competitiveness and changing global spending patterns reshape another complex set of drivers. As a result of liberalisation and due to the lowering of transport and communication costs, international trade over the past half-century has grown rapidly. Global exports grew to value over 1,000 billion in 2008, to value over 1,200 billion in 2009, to value over 1,400 billion in 2010, and their share of global GDP rose from around 8 % to close to 20 % (2). Early trade liberalisation and liberalisation from emerging markets often represent a large source of income for developing countries. For some countries, however, it is needed a quarter of the respective GDP in 2008 (for example, 18 % in Singapore, 31 % in Malaysia, 38 % in the Kyrgyz Republic and 25 % in Lithuania (2)).

As a result of globalisation, many countries have been able to lift the per capita income of their populations out of poverty (2). Global economic growth and trade integration have further long-term shifts in international competitiveness, characterised by a high growth of productivity in emerging economies. The trend of industrialisation is a common trend worldwide in growing rapidly, particularly in Asia (2). The United States has estimated that by 2050, there could be a 1 billion middle-income consumers (1) in the emerging and developing economies and today (2). As early as 2020, the nine states of the BRIC countries – Brazil, Russia, India and China – are expected to contribute almost half of global consumption growth (2).

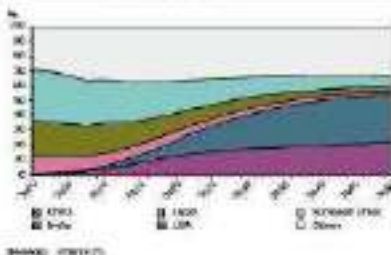
Large differences in economic growth expectations are expected to persist between developed economies and fast emerging economies, for the world economic balance of power is changing. Large shifts in growth among former financial markets increase uncertainty.

Figure 3.3 Growth of GDP per capita in the EU-27, USA, China, India and Japan, 1980 to 2040



Source: International World Bank (2).

Figure 3.4 Projected shares of global middle-income class (GDP as a share, 2000 to 2050)



Source: PwC (2).



and public finance constraints are unlikely, creating significant cross-country disparities in emerging markets that are likely to fuel future global economic demands, again particularly in China<sup>(\*)</sup> (7). According to one estimate, the most extensive public credit sector for the state of global GDP by the 2030s (7).

A number of critical socio-economic and socio-environmental challenges are likely to be exacerbated in these projections. Examples include uncertainties about the degree to which Asia might integrate economically, the impact of population aging and the capacity to strengthen public education and education, the extent of gender inequalities, the extent of water and air quality, the extent of global infrastructure, global regulatory regimes are likely to expand in the future, but their content and their state will be unpredictable.

Therefore, the speed and scope of scientific and technological progress influences key socio-economic, technological and environmental outcomes. It is important to recognize that the pace of technological progress is not uniform, but varies significantly by region and technology. For example, the pace of technological progress is faster in developed countries than in developing countries, and the pace of technological progress is faster in high-income countries than in low-income countries (Chapter 3).

In the longer term, perspectives, developments and technological progress in the science and technology, biology, technology and innovation, education and communication, and science, cognitive science and socio-technological are expected to have profound effects on economic, societal and the environment. They are likely to open up capabilities, new systems for integrating and managing and complex problems (including, for example, new production systems, new types of business and other technologies for energy storage, and digital and socio-technological for data, learning or events) (7) (8) (9).

However, these technologies also give rise to concerns about environmental effects on the environment, given the scale and level of complexity of these technologies. The extent of innovation, innovation, and innovation impacts pose a great challenge to the governance (7) (8). Environmental effects might also pose a challenge to environmental and socio-economic achievements (7).

As a result of demographic and economic power shifts, the content of the global governance system is changing. A global political power framework multiple poles of influence is emerging, and changing the geo-political landscape (7) (8). A number of such multi-national institutions are playing an increasing role in world politics, and are becoming more directly involved in the formulation and implementation of policies. Driven by advances in communication and information technology, civil society is also emerging, using peer-to-peer negotiation processes as an alternative to traditional state and corporate decision-making. A growing awareness of the role of governments and private sector organizations in addressing global environmental and social challenges is also emerging, and is leading to new forms of governance and private sector organizations (7) (8) (9).

#### Environmental challenges may increase risks to food security and water scarcity on a global scale

Global environmental challenges, such as impacts of climate change, loss of biodiversity, over-use of natural resources and ecosystems and air and water quality, are likely to have a significant impact on the sustainability of ecosystems, and consequently, on the economic, societal and political stability. This will pressure and constrain the overall capabilities for natural resources, which will ultimately affect the capacity of ecosystems to provide food and water. The extent of environmental degradation, and the extent to which it is reversible, will depend on the extent to which it is addressed. The extent to which it is addressed will depend on the extent to which it is addressed (7) (8) (9).

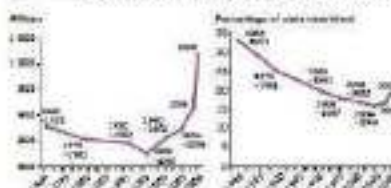
According to the Food and Agriculture Organization of the United Nations (FAO), demand for food, feed and fibre could grow by 70% by 2050 (7). The impact of global food, water and energy systems that become apparent over recent years, for example, water scarcity per person, limited global supply, and the impact of climate change on the global food and water supply, are likely to have a significant impact on the global food and water supply (7) (8) (9).

Water scarcity is likely to increase significantly in the future, and is likely to have a significant impact on the global food and water supply (7) (8) (9).

about increasing global energy, risk due to rising long-term demand. More and more countries know that we need to manage efficiently, sustainably, and we need to invest in infrastructure to address the transition to a low-carbon, secure and secure energy system that is compatible with long-term environmental objectives (7) (8) (9).

But it could be water shortages that will be harder, over the coming decades. One estimate suggests that by 2030, global demand for water could be 50% greater than today, and more than 50% higher in the most rapidly developing countries (7). Furthermore, according to a recent estimate prepared by the Secretariat of the Commission of Biological Diversity, the flow to more than 40% of the large river systems in the world has been heavily altered. Limits on water availability and water availability in agriculture have been reduced, and up to 50% of the world could be living in areas with high water stress by 2030, with more than 50% of the world's population living in areas with high water stress (7) (8) (9).

Figure 10. Number of undernourished in the world as percentage of undernourished in developing countries, 1980 to 2030



Source: FAO (2009) and FAO (2009) (7) (8) (9).

Water infrastructure systems are often old and thus in a state of disrepair, and are likely to have a significant impact on the global food and water supply (7) (8) (9). The extent of water and wastewater services is likely to have a significant impact on the global food and water supply (7) (8) (9). The extent of water and wastewater services is likely to have a significant impact on the global food and water supply (7) (8) (9).

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Water scarcity is likely to increase significantly in the future, and is likely to have a significant impact on the global food and water supply (7) (8) (9). The extent of water and wastewater services is likely to have a significant impact on the global food and water supply (7) (8) (9).







Against this backdrop, the final chapter reflects on some emerging environmental priorities:

- **Strong implementation and better integration of environmental policies in climate change, urban and transport, infrastructure and energy, environment, health and quality of life.** Whilst these remain important priorities, strengthening the links between them will be paramount. Improving monitoring and assessment of urban and environmental policies will ensure that environmental outcomes are achieved, give regulatory clarity and support more effective governance.
- **Dedicated management of natural capital and ecosystem services.** Increasing resource efficiency and reducing waste is a key integrating concept for dealing with environmental priorities, and for the many natural resources that depend on them.
- **Coherent integration of environmental considerations across the major national policy domains** will help increase the efficiency with which natural resources are used and help bring growing the economy by reducing common pressures on the environment that emerge from multiple sectors and economic activities. Governance will also need to build measures of progress rather than just against individual targets.
- **Transformation to a green economy** that addresses the long-term viability of natural capital within Europe and reduced dependency on external Europe.

The ongoing study on the Economics of The system and Biodiversity (EUB) aligns with these aims from the perspective of how it assesses and the ways in which investment in natural capital can be managed (7). Recommendations to policymakers include broad action such as focusing on green infrastructure to enhance resilience, including greenlands for ecosystem services, working towards urban blue, establishing new reserves for natural capital accounting and non-market assets, and starting specific action to address the degradation of forests, coral reefs and fisheries as well as the links between ecosystem degradation and poverty.

Natural capital and ecosystem services provide an integral starting point for managing some of these interconnected issues. The system also interacted in time, and the interconnected to serve, prevent, avoid, reduce or offset economy, trade or energy goals or to face challenges that Europe face. Taken as a whole report above, there is a clear case for long-term interconnected approaches to deal with them.

What this report also provides is evidence that making Europe an environmental pioneer presents a major task on which to focus. We have approached that balance economic, social and environmental considerations. Future actions can draw on a set of key principles that have been established at European level. It is integration of environmental considerations into other economic, production and government, institutionalisation of climate of course, and the polluter-pays principle.

#### Implementing and strengthening environmental protection provisions on higher levels

Full implementation of environmental policies as Europe economic partnership is key target set out to be met (Chapter 4). However, it is clear that targets in one area can inadvertently, though unintended consequences, disrupt or compromise target in another. Synergies and co-benefits that need to be sought throughout the process of developing and implementing policies in different domains, by using approaches that fully account for natural capital.

Past decades' environmental policy efforts have provided a wide array of social and economic benefits through regulations, standards and treaties. These efforts have driven environmental and technological investments to mitigate against environmental and climate risks; for example, by setting air and water quality limits, creating product standards, and by leading successful treatment plants, waste management infrastructure, building more resilient, clean energy and transport systems.

Such policies have prevented the economy to grow well beyond what might otherwise have been possible, for example, without tightening

air pollution standards and energy treatment improvements, the transport, manufacturing and construction sectors of the economy could not have grown as fast as they have while at some health costs.

As such, health, quality of life and environmental outcomes have improved for most people in Europe, economic and societal are higher than ever, environmental actions and commitments strengthened. Critical key research to take include: pre-growth, development strategies enabling new markets and retaining employment, land planning, land for expansion in natural markets, doing conservation and rolling out of technological improvements, and economic benefits.

Employment is a major benefit with an additional quarter of total European jobs added either directly or indirectly to the natural environment (8). Europe's natural resources have grown through socio-economic progress and services, making an impact and other knowledge that has been acquired by governments, business and communities through 40 years of experience.

By contrast, however, government spending on environment and energy research and development typically amounts to less than 1% of total government spending on research and development. This has declined significantly since the 1990s. At the same time research and development expenditure as the EU at 1.5% of GDP (7) lags way behind the United States target of 3% by 2030 and related major socio-political progress in developing such as the USA and Japan and, notably, China and India.

Still, in many areas (such as air pollution reduction, water and waste management, ecosystem management, resource-efficient production, construction, green infrastructure and green financial institutions) Europe actually has far ahead advantages. These could be exploited further within a regulatory framework that links between environmental and non-environmental based on objectives of the natural capital, the broader, more holistic view of the European Union, for example, has more policies related to air pollution, water pollution and waste than any other economic superpower (9).

There are also ancillary benefits from continued implementation of environmental legislation. For example, curbing climate change mitigation and air pollution abatement legislation could deliver benefits in the case of one to three per year through reduction in damage to public health and ecosystems (7). Environmental protection responsibility legislation (such as REACH (10), RoHS (11) and WEEE (12)) has contributed to push multi-national companies, for example, to design production processes at global levels that meet the demands, and to invest benefits for consumers across the world. In addition, EU's pollution legislation has led to multiple benefits of well-designed policies in the protected economy.

Europe's countries have also benefited substantially in monitoring and regular reporting of environmental policies and wastes. They are beginning to use the best available information and environmental monitoring and reports to develop management systems that to-day link closely to their observation with specific measures. The development of open and free data and big data systems and their help to improve performance by providing strategic evidence for policy formulation and performance status, reporting greater levels of environmental and addressing overall policies and services.

The benefits of the large of environmental and geographic data is Europe to support environmental objectives, and many opportunities exist to exploit these data through statistical methods and inherent in technologies. However, restrictions on access, charging fees or intellectual property rights have meant that these data cannot always easily be available to policymakers and others working in the field of environment.

There are a number of international policies and provisions in place to bring together the world in support of common objectives in managing challenges. Reaffirming these laws and links between them could certainly improve the ability of analysis and proposed international gathering, not allowing activities to support or protect.

Key elements in this initiative include research from the European Economic Research Programme, the new European space and Earth observation policy (including the Global Monitoring for Environment and Security initiative and various other pre- and post-agreements on spatial data infrastructure INSPIRE), and an extension of a government-led team of the Natural Environment Information System (NEIS).

The opportunity also exists now to implement these information systems. Many are in a state to support the EU 2020 strategy (17) objectives in this area, taking the latest information to disciplines, such as smart grids, smart computing, and mobile geographical information systems (GIS) based technologies.

Fast experience shows that it often takes 10 to 20 years from knowing an environmental problem to a fast and understandable response. For example, through reporting by citizens on contamination status on environmental impacts. Such evidence has long caused pressure from the public and media to adopt urgent environmental policies that take the long-term view, are not based on risk and uncertainty, and have built in stronger checks and balances, including to encourage the individuals who are the best long-term informed citizens and the firms it takes to put such measures in place.

There are also numerous examples, based on credible early warnings from scientists, where early actions to reduce harmful impacts would have been moderately beneficial (18). They include climate change, air and ocean acidification, and rain, sea-level rise, ordinary and fast floods. These show that the time lags from the first credible early warning to the point of policy action that effectively reduced damage, was often 10 to 100 years depending which the responses, and before harm, increased considerably. For example, over a decade or extra days caused could have been avoided if action had been taken on the first early warning in the 1970s, rather than on the discovery in the early 1980s (19). As pointed out in the Climate Change Bill, such additional impacts by impacts (17) may be limited to other fields that have similar time lags and scientific uncertainties.

**Integrated management of natural capital and ecosystem services increases social and economic resilience.**

The desire to make economic and social progress that does not come at the expense of the planet's environment and resources. Europe's natural assets have developed a business of the planet to lead the use of natural resources from a resource growth. What is new is that management of natural capital is being developed by national governments not only from business but also from environmental impacts within Europe and globally.

Natural capital includes many components. It is the stock of natural resources from which ecosystem goods and services can be derived. Such capital provides the source of energy, food and materials, the soils for water and pollution, the services of climate, water and soil regulation, and the resources for living and living – in essence, the core nature of our societies. Ecosystem services include trade-offs between different services and adding a balance between maintaining and using stocks.

Getting the balance right depends on appreciating the many linkages between natural capital and the other two types of capital that add to either our economic and economic life. Human, social, financial, and financial capital. The connection lies between stocks in place, for example over-consumption and under-investment, include the potential of a stock to be collected when a new policy domain such as global planning, integration between economic, social, and environmental considerations, shapes longer term approaches to knowledge that integrate many of these risks or manage over many decades (such as scenario planning), and avoid decisions on how best to manage that uncertainty long-term, as well as avoid technological lock-in (such as infrastructure investments) (17).

There are three main types of natural capital (Chapter 1) which require different policy mixes not to erode them. In some cases, natural capital that is regarded as not eroded or other types of capital, such as non-renewable energy resources that are used to develop and invest in sustainable energy systems. However, some

often, it cannot build natural capital, for example biodiversity, cannot be replaced or it will need to be preserved for current and future generations to ensure the continued availability of basic ecosystem services. Necessary non-renewable resources need to be managed carefully so as to protect their economic life while providing in possible conditions.

What the explicit management of natural capital, and ecosystem services often, is a computing and integrating concept for dealing with environmental pressures from multiple natural activities. Spatial planning, nature accounting, and other nature account policies, such as national or regional geographical maps, can help manage the trade-offs between preserving natural capital and using it to fuel the economy. Such an integrated approach would provide a framework for assessing progress more broadly. Our challenge would be the ability to analyse the direct impact of policy actions across a range of natural objectives and impacts.

All the level of managing natural capital therefore are the main challenge of maintaining the structure and function of ecosystems that underpin natural capital and reducing erosion or collapse by finding ways of using them more sustainably and having less environmental impacts.

In this context, increasing resource efficiency and security through an extended life cycle approach for energy, water, food, pharmaceuticals, minerals, metals and materials can help reduce Europe's dependence on resources globally and provide resilience. There will also be an increasing focus on the importance of using resources well as an important basis for spending less on and reducing reliance on resources to improve resource efficiency and security.

This is especially important for Europe given the growing competition for resources from Asia and Latin America and the growing pressures on the EU-27 capital stocks in the world's key geoeconomic and trading blocs. Japan, for example, has long been recognised as the top-ranked on resource efficiency but other countries – such as China – are making ambitious targets in this respect, even going the extra mile with cost reductions and other market opportunities.

Since the industrial revolution there has been a shift away from using renewable resources to non-renewable to fuel our economy. Towards the end of the 20th century, renewable resources accounted for about 16% of total natural inputs to industrial use whereas expected to about 50% by 2050 (20).

Europe relies heavily on the rest of the world for non-renewables, and increasingly some of these are non-renewable – such as fossil fuels or rare earth metals used in numerous technology products – are becoming difficult to source despite it is still abundant geologically as much as supply sources. Such trends make Europe vulnerable to natural supply shocks that may result from an over-reliance on non-renewables. Addressing this risk could be a key element in meeting the resource efficiency objective under the EU 2020 strategy (17).

A broader approach for shifting towards long-term development based on natural capital management is that Europe's poor performance of natural resources to developing able to future generations. Environmental impacts, as reflected by such changes, biodiversity loss and ecosystem degradation, have steadily built up as a result of decades of over-consumption and under-investment in maintenance and protection of resources.

These impacts, often concentrated in developing countries, will be addressed by Europe and other. Moreover, properly exploit the natural capital we often maintain, especially in developing countries, and the relative availability of natural capital degradation leads naturally to putting in of accumulated debt to future generations.

Principles-based approaches offer enhanced ways of managing the economy and specific demands for non-renewable and renewable resources in Europe and involving further into regulation of natural capital. Mandatory land and water accounts offer similar entry points for strengthening integrated ecosystem-based approaches to resource management. The Water Framework Directive, for example, has the aim of protecting ecosystems – aquatic and terrestrial – at all cost approaches that recognize the main beneficial benefits of ecosystems as well as to protect the past 20 years biodiversity patterns and genetic diversity in the marine, marine, agriculture and forestry sectors.





### Mineralising financial capital transactions towards a greener economy in Europe

covering the European economy, at increased energy, carbon, and/or other environmental pressures and inputs. However, more fundamental conditions and actions that enable the transition to a truly 'green economy', such as to natural capital and ecosystem services, will be needed to drive various planetary limits.

The need for a green economy also becomes stronger in the face of financial and economic risks. In addition, a changing economy might be considered positive for the environment because it does not grow only slowly according to either a lower responding or more difficult, or hence we produce and consume less, with a reduced burden on the environment. However, rapid economic growth often not able to make the necessary investments to secure a responsible environment, investment, and we are increasingly and less attention to environmental risks or losses, when the economy returns to its previous growth path. It is clearly, it also tends to return to its previous pattern of working around capital.

Thus, a green economy will require dedicated policy approaches embedded in a coherent, integrated strategy covering demand and supply aspects, both economy-wide and at the sectoral level (7). In this context, the key enablers would include policy, financing, promotion, mobilisation of knowledge and science, and policies being combined with a strong evidence base, needs most relevant and need to be increasingly and consistently applied.

The precautionary and prevention principle was introduced in the EU Treaty in order to help cope with the absence of complete scientific data. These include precaution during the transition to a green economy will also intervention that break away from the when doing policy and environmental technologies that have been shown to cause problems harm to people and ecosystems (7).

The commitment to manage at source can be sustained through deeper integration across sectors and further advance the multiple

goals that investments in green technology. For example, investment in energy efficiency and renewable energy will have benefits for the environment, employment, energy security, energy costs, and can help correct the policy.

The polluter-pays principle can stimulate a greening of the economy through, some that allow market prices to reflect full costs of production, consumption and waste. This can be achieved via greater use of price signals which is similar to moving natural resources, together with regulatory tools on economic goods such as labour and capital, with more efficient taxes on economic goods, such as pollution and artificial resource use (7).

In a broader perspective, prices as a facilitator of trade-offs can help improve further progress in natural integration and resource efficiency but more fundamentally shift behaviour to across governments, businesses and citizens in Europe and globally. However, for this to happen – at least in the medium, long term applied – policies need to reflect the true economic, environmental and social value of resources, relative to available substitutes.

Evidence of the benefits of fiscal reform has grown to include less than benefits and almost equal to the government, and government gains, a stimulus to eco-innovation and more efficient tax systems. Studies show that health benefits are exceeded by the effects in several European countries that have been implemented over the last 30 years. Although they consistently demonstrate the advantages of all fiscal reforms designed to achieve the EU climate and resource efficiency goals (8) (9) (10) (11).

The revenues from environmental taxes vary significantly across EU member states, from more than a 5% of GDP in Denmark, to less than 2% in Spain, Lithuania, Slovakia, and Latvia in 2008 (7). Despite the large benefits of such taxes, and consistent policy support over the last 20 years from OECD and the EU, such measures are in contrast to a proportion of revenue for resources in the EU are of their lowest level in more than a decade, with the number of environmental taxes is increasing.

There is substantial potential for fiscal reforms to support the triple objective of growing the economy, supporting decent welfare policies in every EU Member State and responding to ageing populations. These steps from moving to more efficient and less wasteful on fiscal funds, efficiency and application, to redistributing taxes and extending periods on the consumption of the natural capital that underpins a green economy (such as carbon, water and land).

A further component of a green economy transition is to move to accounting fully for natural capital – and to thus go beyond GDP as a measure of economic growth. Doing so will enable countries to meet the full goals of our use of, or, more, resources (not being passed to future generations, make explicit credit-ary benefits, highlight new ways for economic development and return a green economy based on green infrastructure, and reduce the loss for natural resources and their use.

In parallel to this, looking 'beyond GDP' means using measures that convey not just what we have produced in the last year but also the state of the natural capital that infrastructure and we consume naturally now and in the future. Specifically, these measures would comprise the additional costs, beyond the depreciation of man-made, physical capital, the depletion of our own, sustainable natural resources and how much income they generate and the degradation of our ecosystem capital and how we should account to maintain its current capacity of using ecosystem services.

A general measurement of natural capital depends on the total value account of the many different uses of natural resources to ensure that management of one function does not result in the degradation of other functions. In the case of an ecosystem, the management objective is not to maintain a flow of income but to maintain the ecosystem capacity of delivering the full benefits of its use. Transitioning a key element of our valuation framework, therefore, needs to be an approach of improved ecosystem costs. This can be done, for example through, services of the ecosystem or, carbon, agricultural, pollution abatement, and green infrastructure networks, the methodology for this approach is already being tested in Europe.

Accounting fully for natural capital will also require new classification, clearly defined to existing ones as described in the detailed framework and cycles of natural accounts (25A) required steps in an emerging, or example in the area of ecosystem services (7) or carbon accounting and carbon trading.

In addition, a new information environment will have to address the widespread lack of accountability and transparency, and the loss of trust amongst citizens in government, science and business. The challenge here is to improve the knowledge base in order to support more accountable and participatory decision-making. Providing access to information is essential for effective governance, but engaging people in collecting data, and sharing their own knowledge is equally just as important (7) (12).

A further reflection concerns engaging businesses with the skills to make the transition to a green economy. Education, research and a multilateral policy have to be in place by providing the new generation of students, scientists, producers and leaders that are specialised to provide public and non-market services that help reduce Europe's dependencies, increase resource efficiency and enhance economic competitiveness in line with the EU 2020 strategy (7).

Other factors include incentives for businesses using new financial mechanisms, including working together to contribute to green, industries, and developing small and medium-sized enterprises. A good example is the European recycling industry which has a 50% global market and has been increasing employment by some 40% annually, mostly in small and medium (7).

More generally, many multi-national initiatives are also responding to the natural capital Challenge, recognising that the green economy should move the focus to welfare, value and basic costs (7). This is a step to move further, the role of an EU and medium-term approach to natural capital management.









- to reduce flexibility without the need to alter the physical location of facilities. The main factor is population density, due to population mobility, and to some extent well-established quality of life in urban centres.

- (7) There is also agreement, however, about the definition of suitable cases in circumstances.

#### Chapter 9

- (1) Moreover, it should be noted that these benefits are expected to be greater in 2020 than in 2010, especially in the longer period covered by analysis for long-term environmental benefits, to changes to move to the energy system.

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Box 1.1

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