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B Core set of indicators

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Core set of indicators

Setting the scene

Part B of the report presents a four-page summary of each of the 37 indicators in the EEA core set based on data available mid-2005. For each indicator we give the key policy question, the key message and an assessment. This is followed by information on the indicator definition, the rationale behind the indicator, the policy context and a section on uncertainty.

On top of being an important source of information in its own right, the core set underpins the integrated assessment in Part A and also the country analysis in Part C. References to the indicators and how they have been used can be found in those parts.

The complete indicator specifications, technical explanations, caveats and assessments are available at EEA's website (currently at www.eea.eu.int/coreset). The assessments will be updated on a regular basis as new data becomes available.

The EEA identified a core set of indicators in order to:

- provide a manageable and stable basis for indicator-based assessments of progress against environmental policy priorities;
- prioritise improvements in the quality and coverage of data flows, which will enhance comparability and certainty of information and assessments;
- streamline contributions to other indicator initiatives in Europe and beyond.

The establishment and development of the EEA core set of indicators was guided by the need to identify a small number of policy-relevant indicators that are stable, but not static, and that give answers to selected priority policy questions. They should, however, be considered alongside other information if they are to be fully effective in environmental reporting.

The core set covers six environmental themes (air pollution and ozone depletion, climate change, waste, water, biodiversity and terrestrial environment) and four sectors (agriculture, energy, transport and fisheries).

The indicators in the core set were selected from a much larger set on the basis of criteria widely used elsewhere in Europe and by the OECD. Particular attention was given to relevance to policy priorities, objectives and targets; the availability of high-quality data over both time and space, and the application of well-founded methods for indicator calculation.

The core set, and particularly its assessments and key messages, is targeted mainly at policy makers at the EU and national level who can use the outcomes to inform progress with their policies. EU and national institutions can also use the core set to support streamlining of data flows at the EU level.

Environmental experts can use it as a tool for their own work by using the underlying data and methodologies to do their own analysis. They can also look at the set critically, give feedback and so contribute to future EEA core set developments.

General users will be able to access the core set on the web in an easily understandable way, and use available tools and data to do their own analyses and presentations.

01 Emissions of acidifying substances

Key policy question

What progress is being made in reducing emissions of acidifying pollutants across Europe?

Key message

Emissions of acidifying gases have decreased significantly in most EEA member countries. Between 1990 and 2002, emissions decreased by 43 % in the EU-15 and by 58 % in the EU-10, despite increased economic activity (GDP). For all EEA member countries, excluding Malta, emissions decreased by 44 %.

Indicator assessment

Emissions of acidifying gases have decreased significantly in most EEA member countries. In the EU-15, emissions decreased by 43 % between 1990 and 2002, mainly as a result of reductions in sulphur dioxide emissions, which contributed 77 % of the total reduction. Emissions from the energy, industry and transport sectors have all been significantly reduced, and contributed 52 %, 16 % and 13 % respectively of the total reduction in weighted acidifying gas emissions. This reduction is due mainly to fuel switches to natural gas, economic restructuring of the new Länder in Germany and the introduction of flue gas desulphurisation in some power plants. So far, the reductions have resulted in the EU-15 being on track to reaching the overall target for reducing acidifying emissions in 2010.

Emissions of acidifying gases have also decreased significantly in the EU-10 and candidate countries (CC-4). Emissions in the EU-10 Member States decreased by 58 % between 1990 and 2002, also mainly as a result of the large reduction in sulphur dioxide emissions, as in the EU-15 countries.

The reduction in emissions of nitrogen oxides is due to abatement measures in road transport and large combustion plants.

Indicator definition

The indicator tracks trends since 1990 in anthropogenic emissions of acidifying substances: nitrogen oxides, ammonia, and sulphur dioxide, each weighted by their acidifying potential. The indicator also provides information on changes in emissions by the main source sectors.

Indicator rationale

Emissions of acidifying substances cause damage to human health, ecosystems, buildings and materials (corrosion). The effects associated with each pollutant depend on its potential to acidify and the properties of the ecosystems and materials. The deposition of acidifying substances still often exceeds the critical loads of ecosystems across Europe.

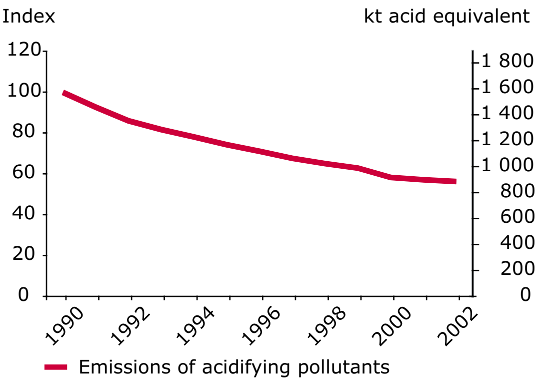
The indicator supports assessment of progress towards implementation of the Gothenburg Protocol under the 1979 Convention on Long-range Transboundary Air Pollution (CLRTAP) and the EU Directive on National Emissions Ceilings (NECD) (2001/81/EC).

Policy context

Emission ceiling targets for NO_x, SO_2 and NH_3 are specified in both the EU National Emission Ceilings Directive (NECD) and the Gothenburg Protocol under the United Nations Convention on Long-range Transboundary Air Pollution (CLRTAP). Emission reduction targets under NECD for the EU-10 have been specified in the treaty of accession to the European Union 2003.

The NECD generally involves slightly stricter emission reduction targets for 2010 than the Gothenburg Protocol for the EU-15 countries.

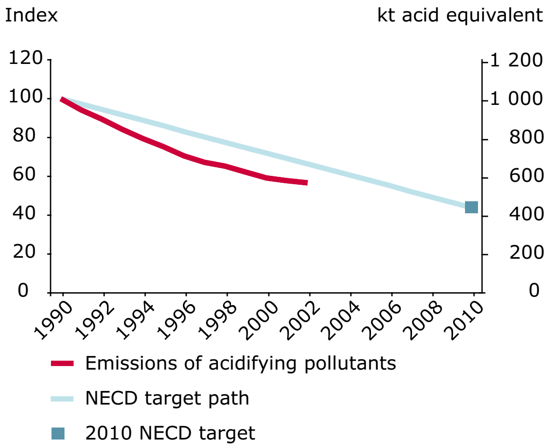
Figure 1 **Emission trends of acidifying pollutants (EEA member countries), 1990–2002**



Note: Data not available for Malta.

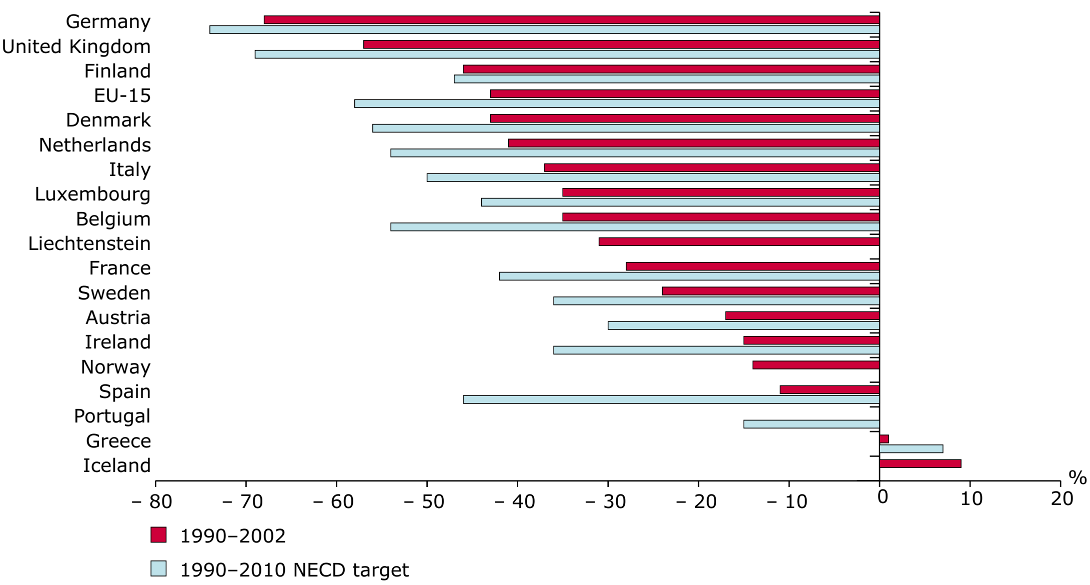
Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution.

Figure 2 **Emission trends of acidifying pollutants (EU-15), 1990–2002**



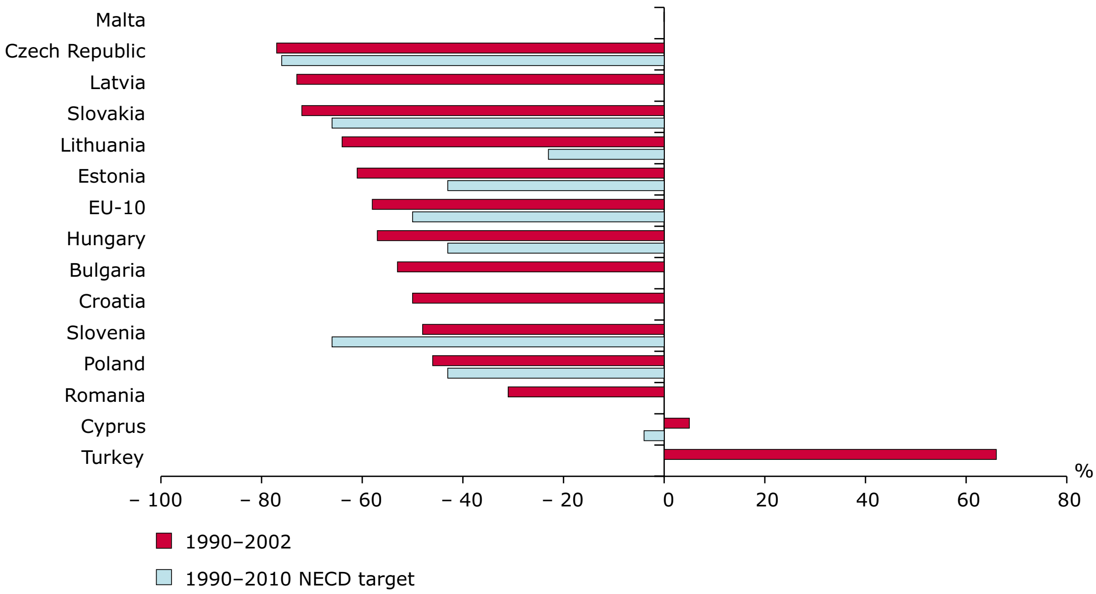
Note: Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution.

Figure 3 **Change in emission of acidifying substances (EFTA-3 and EU-15) compared with 2010 NECD targets (EU-15 only), 1990–2002**



Note: Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution (Ref: www.eea.eu.int/coreset).

Figure 4 **Change in emission of acidifying substances (CC-4 and EU-10) compared with 2010 NECD targets (EU-10 only), 1990–2002**



Note: Data not available for Malta.

Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution (Ref: www.eea.eu.int/coreset).

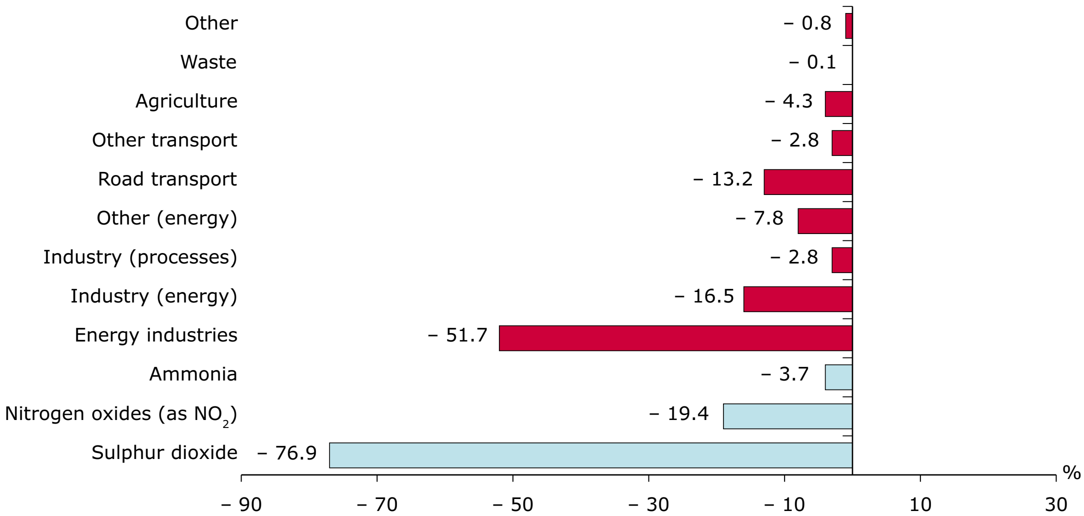
Indicator uncertainty

The use of acidifying potential factors leads to some uncertainty. The factors are assumed to be representative of Europe as a whole; different factors might be estimated on the local scale.

The EEA uses data officially submitted by EU Member States and other EEA member countries which follow common guidelines on the calculation and reporting of emissions for air pollutants.

NO_x, SO_2 and NH_3 estimates in Europe are thought to have an uncertainty of about ± 30 %, 10 % and 50 % respectively.

Figure 5 **Contribution to total change in acidifying pollutant emissions for each sector and pollutant (EU-15), 2002**



Note: 'Contribution to change' plots show the contribution to the total emission change between 1990–2002 made by a specified sector/pollutant.

Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution (Ref: www.eea.eu.int/coreset).

02 Emissions of ozone precursors

Key policy question

What progress is being made in reducing emissions of ozone precursors across Europe?

Key message

Emissions of ozone-forming gases (ground-level ozone precursors) were reduced by 33 % across the EEA member countries between 1990 and 2002, mainly as a result of the introduction of catalysts in new cars.

Indicator assessment

Total emissions of ozone precursors were reduced by 33 % across the EEA member countries between 1990 and 2002. For the EU-15 countries, emissions were reduced by 35 %.

Emission reductions in the EU-15 since 1990 are due mainly to the further introduction of catalytic converters for cars and increased penetration of diesel, but also as a result of the implementation of the solvents directive in industrial processes. Emissions from the energy and transport sectors have both been significantly reduced, and contributed 10 % and 65 % respectively of the total reduction in weighted ozone precursor emissions. Emission reductions of the ozone precursors covered by the national emission ceilings directive (non-methane volatile organic compounds, NMVOCs, and nitrogen oxides, NO_X) have resulted in the EU-15 being on track towards reaching the overall target for reducing these emissions in 2010.

Emissions of non-methane volatile organic compounds (38 % of total weighted emissions) and nitrogen oxides (48 % of total weighted emissions) contributed the most to the formation of tropospheric ozone in 2002. Carbon monoxide and methane contributed 13 % and 1 % respectively. The emissions of NO_x and NMVOC were reduced significantly between 1990 and 2002, contributing 37 % and 44 % respectively of the total reduction in precursor emissions.

In the EU-10 ([1]), total ozone precursor emissions were reduced by 42 % between 1990 and 2002. Emissions of non-methane volatile organic compounds (32 % of the total) and nitrogen oxides (51 % of the total) were the most significant pollutants contributing to the formation of tropospheric ozone in EU-10 countries in 2002.

Indicator definition

This indicator tracks trends since 1990 in anthropogenic emissions of ozone precursors: nitrogen oxides, carbon monoxide, methane and non-methane volatile organic compounds, each weighted by their tropospheric ozone-forming potential. The indicator also provides information on changes in emissions by the main source sectors.

Indicator rationale

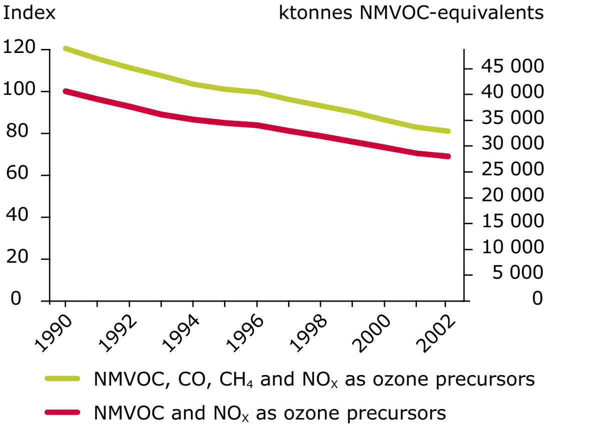
Ozone is a powerful oxidant and tropospheric ozone can have adverse effects on human health and ecosystems. The relative contributions of ozone precursors can be assessed on the basis of their tropospheric ozone-forming potential (TOFP).

Policy context

Emission ceiling targets for NO_x and NMVOCs are specified in both the EU National Emission Ceilings Directive (NECD) and the Gothenburg Protocol under the United Nations Convention on Long-range Transboundary Air Pollution (CLRTAP). Emission reduction targets for the EU-10 under NECD have been specified in the treaty of accession to the European

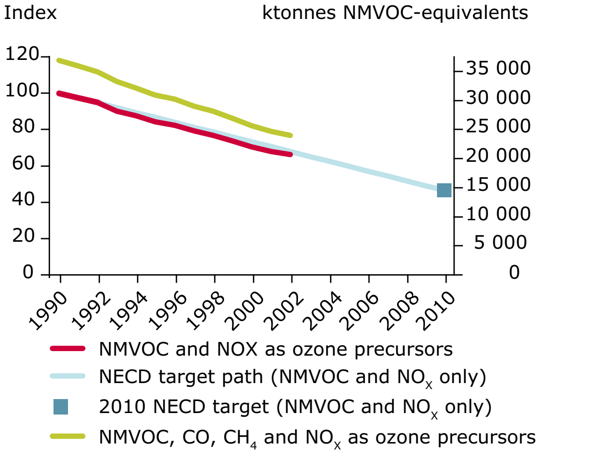
([1]) Data from Malta not available.

Figure 1 **Emission trends of ozone precursors (ktonnes NMVOC-equivalent) for EEA member countries, 1990–2002**



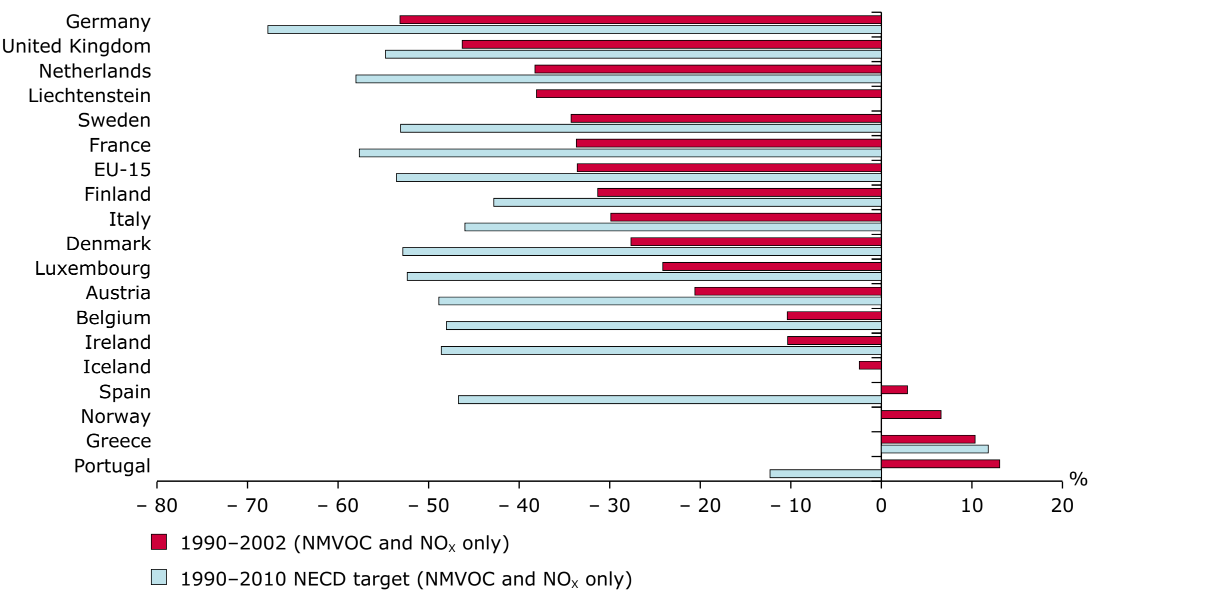
Note: Data from Malta not available.
Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution and the UNFCCC.

Figure 2 **Emission trends of ozone precursors (ktonnes NMVOC-equivalent) for EU-15, 1990–2002**



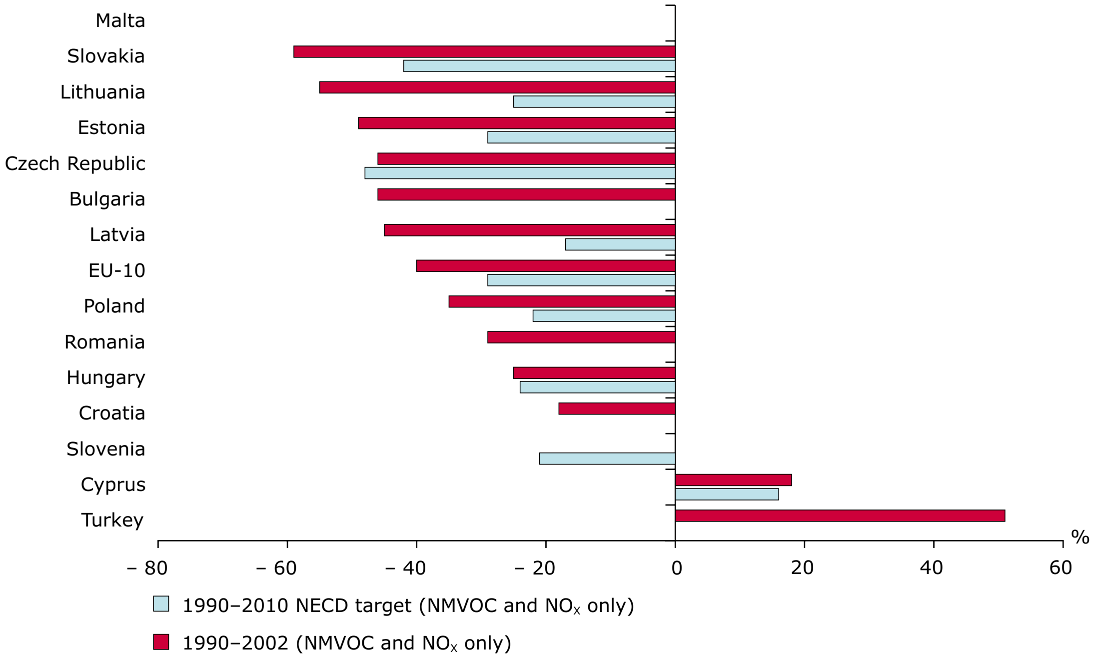
Note: Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution and the UNFCCC.

Figure 3 **Change in emission of ozone precursors (EFTA-3 and EU-15) compared with 2010 NECD targets (EU-15 only), 1990–2002**



Note: Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution and the UNFCCC (Ref: www.eea.eu.int/coreset).

Figure 4 **Change in emission of ozone precursors (CC-4 and EU-10) compared with 2010 NECD targets (EU-10 only), 1990–2002**



Note: Data from Malta not available.

Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution and the UNFCCC (Ref: www.eea.eu.int/coreset).

Union 2003. There are no specific EU emission targets set for carbon monoxide (CO) or methane (CH_4).

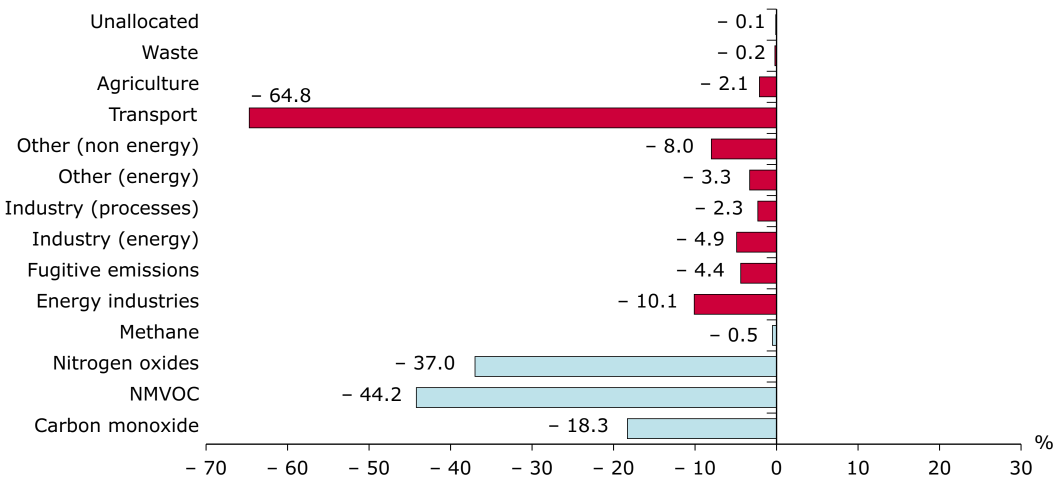
The NECD generally involves slightly stricter emission reduction targets than the Gothenburg Protocol.

Indicator uncertainty

The EEA uses data officially submitted by EU Member States and other EEA member countries which follow common guidelines on the calculation and reporting of emissions for the air pollutants NO_x, NMVOC and CO, and IPCC for the greenhouse gas CH_4.

NO_x, NMVOC, CO and CH_4 emission estimates in Europe are thought to have an uncertainty of about ± 30 %, 50 %, 30 % and 20 % respectively. The use of ozone formation potential factors leads to some uncertainty. The factors are assumed to be representative for Europe as a whole; uncertainties are larger and other factors are more relevant on the local scale. Incomplete reporting and resulting intrapolation and extrapolation may obscure some trends.

Figure 5 **Contribution to change in ozone precursors emissions for each sector and pollutant (EU-15), 1990–2002**



Note: Data not available for Malta.

Data source: Data from 2004 officially reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution and the UNFCCC (Ref: www.eea.eu.int/coreset).

03 Emissions of primary particles and secondary particulate precursors

Key policy question

What progress is being made in reducing emissions of fine particles (PM_{10}) and their precursors across the EU-15?

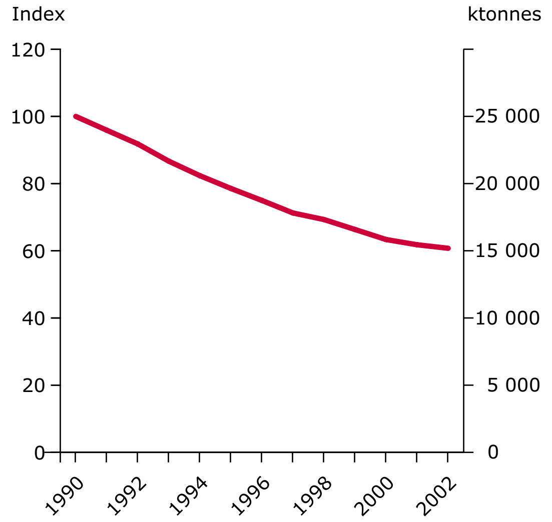
Key message

Total EU-15 emissions of fine particles were reduced by 39 % between 1990 and 2002. This was due mainly to reductions in emissions of the secondary particulate precursors, but also to reductions in primary PM_{10} emissions from energy industries.

Indicator assessment

EU emissions of fine particles were reduced by 39 % between 1990 and 2002. Emissions of NO_X (55 %) and SO_2 (20 %) were the most important contributing pollutants to particulate formation in the EU-15 in 2002. The reductions in total emissions between 1990 to 2002 were due mainly to the introduction or improvements of abatement measures in the energy, road transport, and industry sectors. These three sectors contributed 46 %, 22 % and 16 % respectively to the total reduction.

Figure 1 **Emissions of primary and secondary fine particles (EU-15), 1990–2002**



Note: Data source: Data from 2004 officially-reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution. Where emissions of primary PM_{10} were not reported by countries, estimates have been obtained from the RAINS model (IIASA) (Ref: www.eea.eu.int/coreset).

Indicator definition

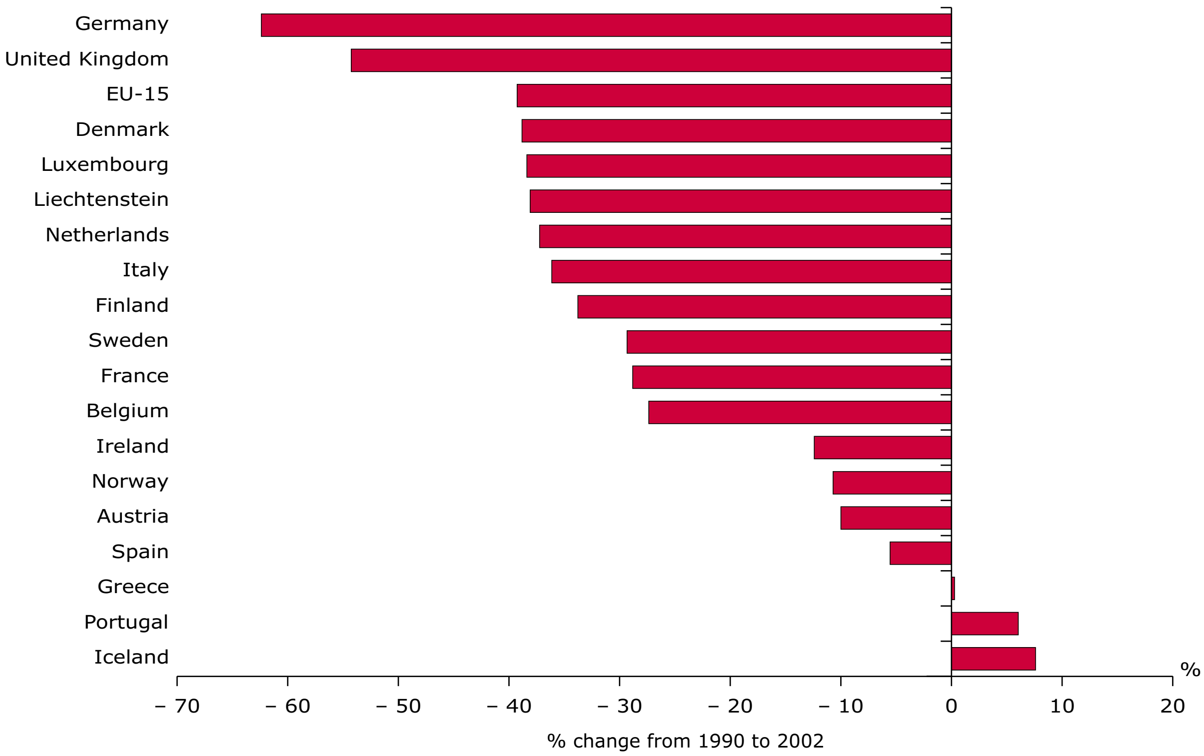
This indicator tracks trends in emissions of primary particulate matter less than 10 µm (PM_{10}) and secondary precursors, aggregated according to the particulate formation potential of each precursor considered.

The indicator also provides information on changes in emissions from the main source sectors.

Indicator rationale

In recent years scientific evidence has been strengthened by many epidemiological studies that indicate an association between long- and short-term exposure to fine particulate matter and various serious health impacts. Fine particles have adverse effects on human health and can be responsible for and/or contribute to a number of respiratory problems. Fine particles in this context refer to the sum of primary PM_{10} emissions and the weighted emissions of secondary PM_{10} precursors. Primary PM_{10} refers to fine particles (defined as having an aerodynamic diameter of 10 µm or less) emitted directly to the atmosphere. Secondary PM_{10} precursors are pollutants that are partly transformed into particles by photo-chemical reactions in the atmosphere. A large fraction of the urban population is exposed to levels of fine particulate

Figure 2 **Changes in emissions of primary and secondary fine particles (EFTA-3 and EU-15), 1990–2002**



Note: Data source: Data from 2004 officially-reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution. Where emissions of primary PM_{10} were not reported by countries, estimates have been obtained from the RAINS model (IIASA) (Ref: www.eea.eu.int/coreset).

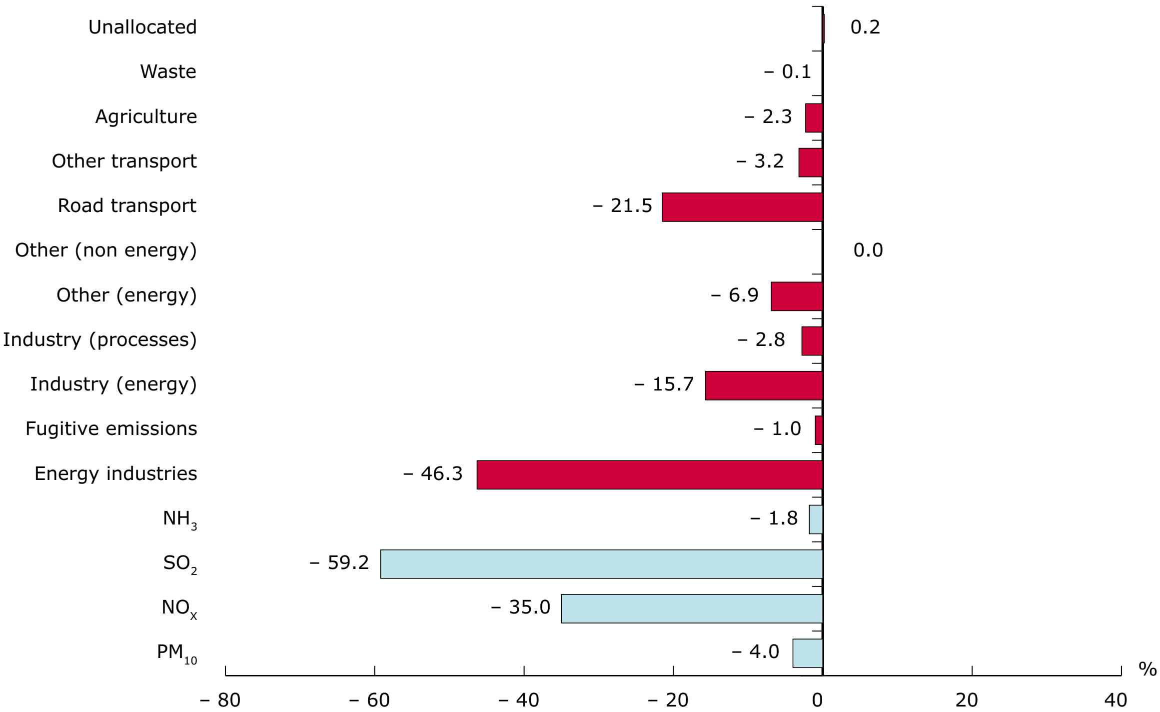
matter in excess of limit values set for the protection of human health. There have been a number of recent policy initiatives that aim to control particulate concentrations and thus protect human health.

Policy context

There are no specific EU emission targets set for primary PM_{10}. Measures are currently focused on controlling emissions of the secondary PM_{10} precursors. However, there are several directives and protocols that affect emissions of primary PM_{10}, including air quality standards for PM_{10}, in the first daughter directive to the framework directive on ambient air quality and emission standards for specific mobile and stationary sources for primary PM_{10} and secondary PM_{10} precursors.

For the particulate precursors, emission ceiling targets for NO_X, SO_2 and NH_3 are specified in both the EU National Emission Ceilings Directive (NECD) and the Gothenburg Protocol under the United Nations Convention on Long-range Transboundary Air Pollution (CLRTAP). Emission reduction targets for the EU-10 have been specified in the Treaty of Accession to

Figure 3 **Contributions to the changes in emission of primary and secondary fine particles (PM_{10}), per sector and per pollutant (EU-15), 2002**



Note: 'Contribution to change' plots show the contribution to the total emission change between 1990–2002 made by a specified sector/pollutant.

Data source: Data from 2004 officially-reported national total and sectoral emissions to UNECE/EMEP Convention on Long-range Transboundary Air Pollution. Where emissions of primary PM_{10} were not reported by countries, estimates have been obtained from the RAINS model (IIASA) (Ref: www.eea.eu.int/coreset).

the European Union 2003 in order that they can comply with the NECD. In addition, the treaty of accession also includes emission targets for the EU-25 region as a whole.

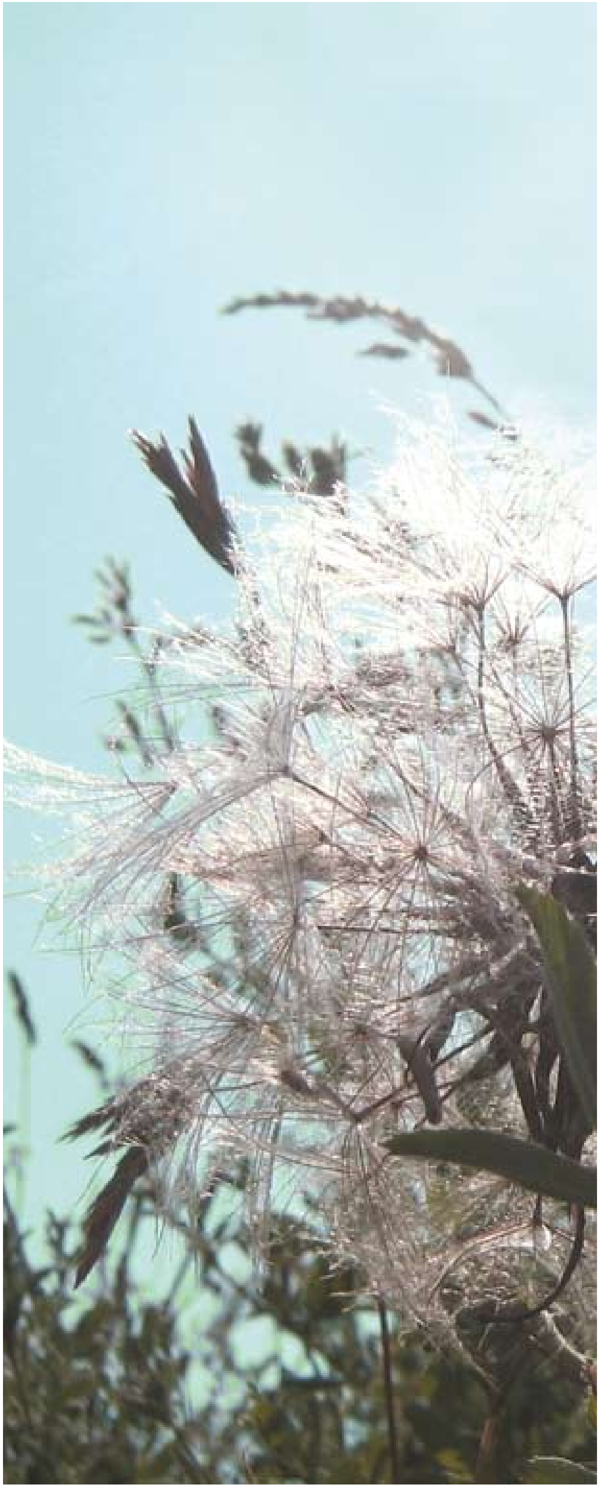
Indicator uncertainty

The EEA uses data officially submitted by EU Member States and other EEA countries which follow common guidelines on the calculation and reporting of emissions for air pollutants.

NO_X, SO_2 and NH_3 estimates in Europe are thought to have an uncertainty of about 30 %, 10 % and 50 % respectively.

The primary PM_{10} emission data are generally more uncertain than the emissions on secondary PM_{10} precursors.

The use of generic particulate formation factors leads to some uncertainty. The factors are assumed to be representative of Europe as a whole; different factors may be estimated at the local scale.



04 Exceedance of air quality limit values in urban areas

Key policy question

What progress is being made in reducing concentrations of air pollutants in urban areas to below the limit values (for SO_2, NO_2 and PM_{10}) or the target values (for ozone) defined in the air quality framework directive and its daughter directives?

Key message

Large fractions of the urban population are exposed to concentrations of air pollutants in excess of the health-related limit or target values defined in the air quality directives. Exposure to SO_2 shows a strong downward trend but no clear downward trend is observed for the other pollutants.

PM_{10} is a pan-European air quality issue. The limit values are exceeded at urban measuring stations for background concentrations in nearly all countries.

Ozone is also a widespread problem, although the health-related target values are less frequently exceeded in north-western than in southern, central and eastern Europe.

NO_2 limit values are exceeded in the densely populated areas of north-western Europe and in large agglomerations in southern, central and eastern Europe.

Exceedances of SO_2 limit values are observed only in a few eastern European countries.

Indicator assessment

PM_{10} particles in the atmosphere result from direct emissions (primary PM_{10}) or emissions of particulate precursors (nitrogen oxides, sulphur dioxide, ammonia and organic compounds) which are partly transformed into particles (secondary PM) by chemical reactions in the atmosphere.

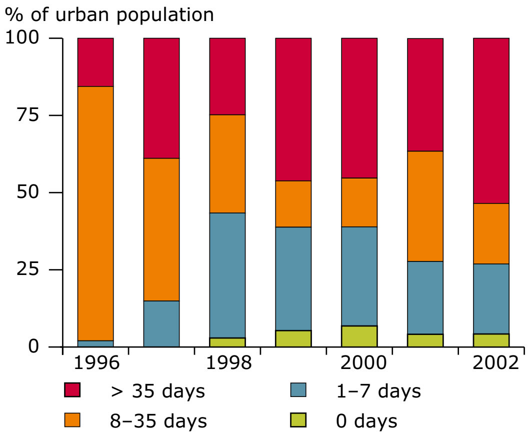
Although monitoring of PM_{10} is limited, it is clear that a significant proportion of the urban population (25–55 %) is exposed to concentrations of particulate matter in excess of the EU limit values set for the protection of human health (Figure 1).

Figure 2 shows a downward trend in the highest daily mean PM_{10} values until 2001.

Although reductions in emissions of ozone precursors appear to have led to lower peak concentrations of **ozone** in the troposphere, the health-related target value for ozone is exceeded over a wide area and by a large margin. About 30 % of the urban population was exposed to concentrations above the 120 µg O_3/m³ level during more than 25 days in 2002 (Figure 3).

Data from a consistent set of stations over the period 1996–2002 show hardly any significant variation for the 26th highest maximum daily 8-hour mean (Figure 4).

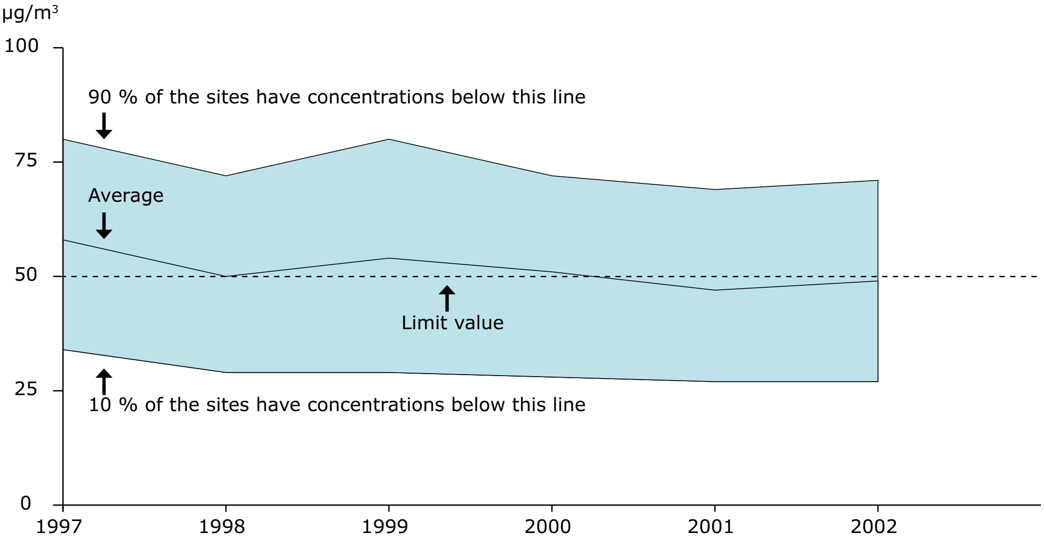
Figure 1 **Exceedance of air quality limit value of PM_{10} in urban areas (EEA member countries), 1996–2002**



Note: Representative monitoring data were not available before 1997. Over the period 1997–2002 the total population for which exposure estimates are made increased from 34 to 106 million as a result of an increasing number of monitoring station reporting air quality data. Year-to-year variations in exposure classes might be caused partly by meteorological variability and partly by the changes in spatial coverage.

Data source: Airbase (Ref: www.eea.eu.int/coreset).

Figure 2 **Highest daily PM_{10} concentration (36th highest daily 24h-mean) observed at urban stations (EEA member countries), 1997–2002**



Note: Data source: Airbase (Ref: www.eea.eu.int/coreset).

About 30 % of the urban population live in cities with urban background concentrations in excess of the annual limit value of 40 µg/m^3 of nitrogen dioxide. However, limit values are probably also exceeded in cities where the urban background concentration is below the limit value, in particular at hot spots in locations with a high traffic density.

The main source of emissions of nitrogen oxides (NO_x) to the air is the use of fuels: road transport, power plants and industrial boilers account for more than 95 % of European emissions. Enforcement of current EU legislation (large combustion plants and IPPC directive, auto-oil programme, NEC directive) and CLRTAP protocols have resulted in a reduction in emissions. This reduction is not yet reflected in the annual average concentrations observed at the urban monitoring stations measuring background concentrations.

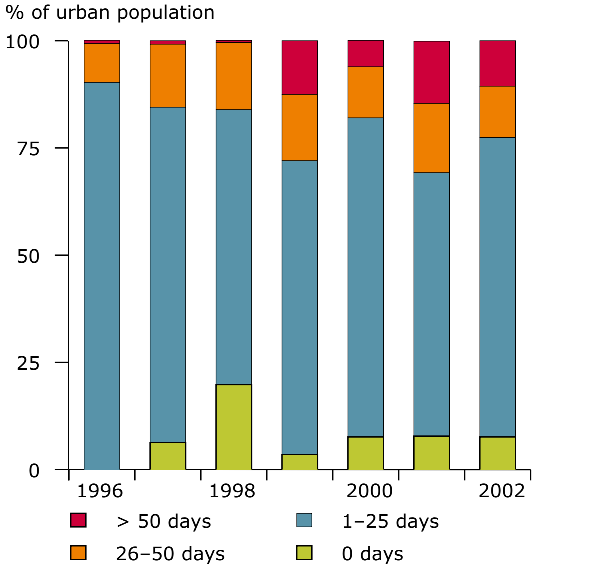
Sulphur in coal, oil and mineral ores is the main source of emissions of sulphur dioxide to the atmosphere. Since the 1960s, the combustion of sulphur-containing fuels has largely been removed from urban and other populated areas, first in western Europe and now also increasingly in most central and eastern European countries. Large point sources (power plants and industries) remain the predominant source of sulphur dioxide emissions. As a result of the significant reductions in emissions achieved in the past decade, the percentage of the urban population exposed to concentrations above the EU limit value has been reduced to less than 1 %.

Indicator definition

The indicator presents the percentage of the urban population in Europe potentially exposed to ambient air concentrations (in µg/m^3) of sulphur dioxide, PM_{10}, nitrogen dioxide and ozone in excess of the EU limit or target value set for the protection of human health. Where there are multiple limit values (see section on policy context) the indicator presents the most stringent case.

The urban population considered is the total number of people living in cities with at least one monitoring station.

Figure 3 **Exceedance of air quality target values for ozone in urban areas (EEA member countries), 1996–2002**



Note: Over the period 1996–2002 the total population for which exposure estimates are made increased from 50 to 110 million as a result of an increasing number of monitoring station reporting under the EoI Decision. Data prior to 1996 with coverage of less than 50 million people are not representative of the European situation. Year-to-year variations in exposure classes might be caused partly by meteorological variability and partly by the changes in spatial coverage.

Data source: Airbase (Ref: www.eea.eu.int/coreset).

Indicator rationale

Epidemiological studies have reported statistically significant associations between short-term, and especially long-term, exposure to increased ambient PM concentrations and increased morbidity and (premature) mortality. PM levels that may be relevant to human health are commonly expressed in terms of the mass concentration of inhalable particles with an equivalent aerodynamic diameter equal to or less than 10 µm (PM_{10}). Health effect associations for the fine fraction ($PM_{2.5}$) are even more clearly evident. Although the body of evidence concerning the health effects of PM is increasing rapidly, it is not possible to identify a concentration threshold below which health effects are not detectable. There is therefore no recommended WHO air quality guideline for PM, but the EU has set a limit value.

Exposure to high ozone concentrations for periods of a few days can have adverse health effects, in particular inflammatory responses and reduction in lung function. Exposure to moderate ozone concentrations for longer periods may lead to a reduction in lung function in young children.

Short-term exposure to nitrogen dioxide may result in airway and lung damage, decline in lung function, and increased responsiveness to allergens following acute exposure. Toxicology studies show that long-term exposure to nitrogen dioxide can induce irreversible changes in lung structure and function.

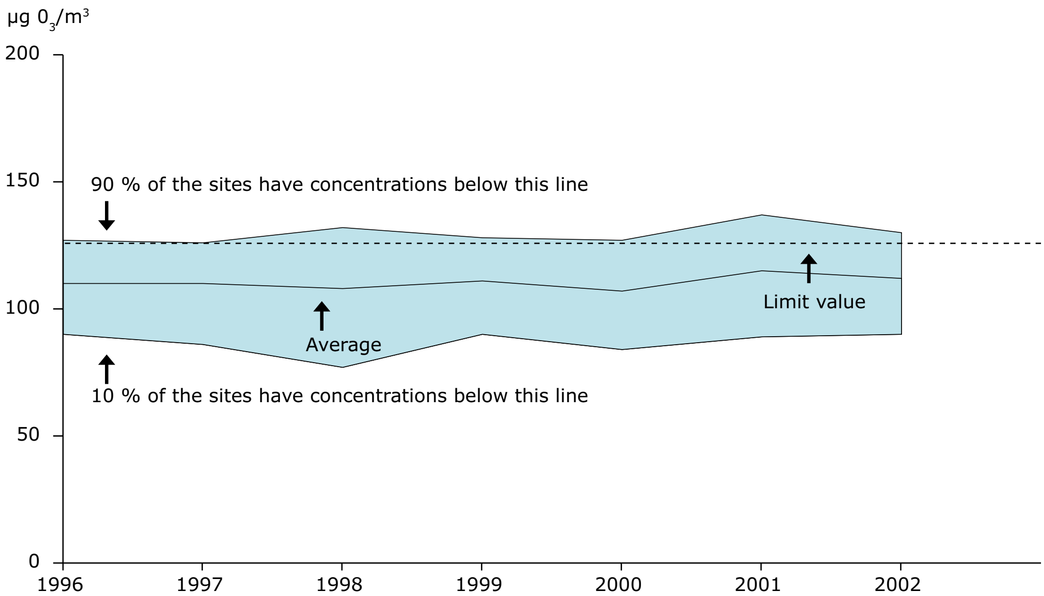
Sulphur dioxide is directly toxic to humans, its main action being on the respiratory functions. Indirectly, it can affect human health as it is converted to sulphuric acid and sulphate in the form of fine particulate matter.

Policy context

This indicator is relevant information for the Clean Air for Europe (CAFE) programme. The Air Quality Framework Directive (96/62/EC) defines basic criteria and strategies for air quality management and assessment for a set of health-relevant pollutants. In four 'daughter' directives, it establishes the framework under which the EU has set limit values for SO_2, NO_2, PM_{10}, lead, CO and benzene and target levels for ozone, heavy metals and polyaromatic hydrocarbons to protect human health.

Emission reduction targets for national emissions have been set in the Gothenburg Protocol by the CLRTAP, and by the EU National Emission Ceiling Directive (NECD; 2001/81/EC). This is intended to address, simultaneously, pollutant-specific ambient air quality problems affecting human health, as well as ground

Figure 4 **Peak ozone concentration (26th highest maximum daily 8h-mean) observed at urban background stations (EEA member countries), 1996–2002**



Note: Data source: Airbase (Ref: www.eea.eu.int/coreset).

level ozone, acidification and eutrophication affecting ecosystems.

The targets used for these indicators are the limit values set by Council Directive 1999/30/EC for sulphur dioxide, nitrogen dioxide, particulate matter and lead in ambient air and the target value and long term objective for ozone for the protection of human health set by Council Directive 2002/3/EC.

Indicator uncertainty

It is assumed that the air quality data submitted officially to the European Commission under the exchange-of-information decision have been validated by the national data supplier. Station characteristics and representativeness is often insufficiently documented. The data are generally not representative of the total urban population in a country. In a sensitivity analysis, the indicator has been based on the most exposed station in a city. In this worst-case calculation, the highest number of exceedance days observed at any of the operational stations (classified as urban, street, other or not defined) is assumed to be representative of the whole city. Locally, the indicator is subject to year-to-year variations due to meteorological variability.

PM_{10} data have been considered from monitoring stations using the reference method (gravimetry) and other methods. Documentation is incomplete whether countries have applied correction factors for non-reference methods, and if they have, which ones. Uncertainties associated with this lack of knowledge may result in a systematic error of up to 30 %. The number of data series available varies considerably from year to year and is insufficient for the period before 1997.

05 Exposure of ecosystems to acidification, eutrophication and ozone

Key policy question

What progress is being made towards the targets for reducing the exposure of ecosystems to acidification, eutrophication and ozone?

Key message

There have been clear reductions in the acidification of Europe's environment since 1980, but with some tailing off in improvement since 2000. Continued attention and further action is needed to ensure that the targets set for 2010 are achieved.

Eutrophication has declined slightly since 1980. However, only limited further improvement is expected by 2010 with current plans.

Most agricultural crops are exposed to ozone levels that exceed the EU long-term objective set for their protection, and a significant fraction are exposed to levels above the target value to be attained by 2010.

Indicator assessment

There have been substantial reductions in the area subjected to **deposition of excess acidity** since 1980 (see Figure 1) ([1]).

Data on a country basis indicate that already by 2000 all but six countries had less than 50 % of their ecosystem areas in exceedance of critical loads of acidity. Further substantial progress is anticipated for virtually all countries in the period 2000–2010.

Eutrophication of ecosystems shows less progress (Figure 1). There have been limited improvements at the European level since 1980, and very little further improvement is expected in individual countries between 2000 and 2010. The broader European continent continues to have a lesser problem than the countries of the EU-25.

The target value for **ozone** is exceeded in a substantial fraction of the arable area of the EEA-31: in 2002, about 38 % of the total area of 133 million ha (Figure 2 and Map 1). The long-term objective is met in less than 9 % of the total arable area, mainly in the United Kingdom, Ireland and the northern part of Scandinavia.

Indicator definition

The indicator (Figures 1 and 2) shows the ecosystem or crop areas which are subject to deposition or ambient concentrations of air pollutants in excess of the so- called 'critical load' or level for the particular ecosystem or crop.

'The critical load or level is defined as the estimated quantity of pollutant deposited or ambient concentration below which exposures to the pollutant are such that significant harmful effects do not occur according to present knowledge.'

Thus the critical load is an indication on how large a burden an ecosystem, or crop, can withstand in the long term without suffering from harmful effects.

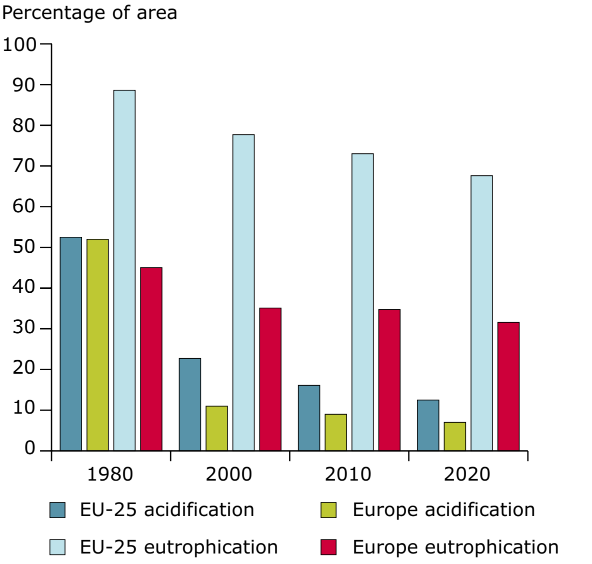
The percentage of the area of ecosystem, or crop, exceeded indicates the extent of possible significant harmful effects in the long term. The magnitude of exceedance is thus an indication of the significance of future harmful effects.

The critical load of acidity is expressed in acidifying equivalents (H^+) per hectare per year (eq $H^+.ha^{-1}.a^{-1}$).

Ozone exposure, critical level, EU target value and the long-term objective are expressed as accumulated exposure to concentrations of over 40 ppb (about 80 µg/m^3) of ozone (AOT40) in the following unit: (mg/m^3)h.

([1]) It is difficult to assess the quantitative improvements since 1990 as acidification status in this base year (1990) remains to be reassessed using the latest critical loads and deposition calculation methodology.

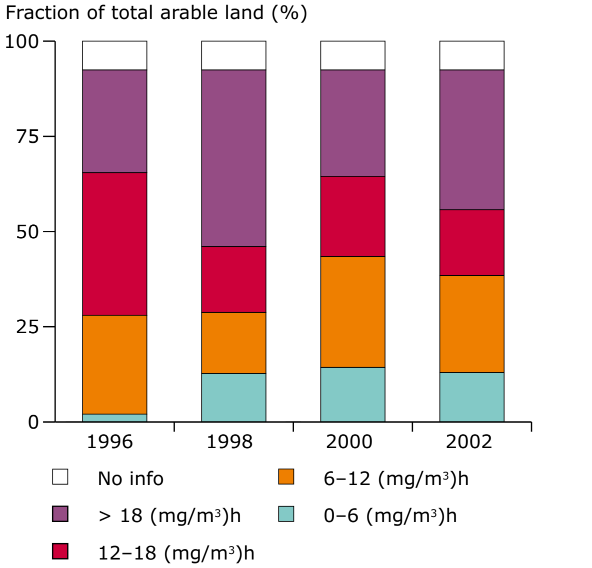
Figure 1 **EU-25 and Europe-wide ecosystem damage area (average accumulated exceedance of critical loads), 1980–2020**



Note: Data source for deposition data used to calculate exceedances: EMEP/MSC-W.

Data source: UNECE — Coordination Center for Effects (Ref: www.eea.eu.int/coreset).

Figure 2 **Exposure of crops to ozone (exposure expressed as AOT40 in (mg/m³)h in EEA member countries, 1996–2002** (2)



Note: The target value for the protection of vegetation is 18 (mg/m³)h while the long-term objective is set at 6 (mg/m³)h.

The fraction labelled 'no information' refers to areas in Greece, Iceland, Norway, Sweden, Estonia, Lithuania, Latvia, Malta, Romania, and Slovenia for which either no ozone data from rural background stations or no detailed land cover data are available. Bulgaria, Cyprus, and Turkey are not included.

Data source: Airbase (Ref: www.eea.eu.int/coreset).

Indicator rationale

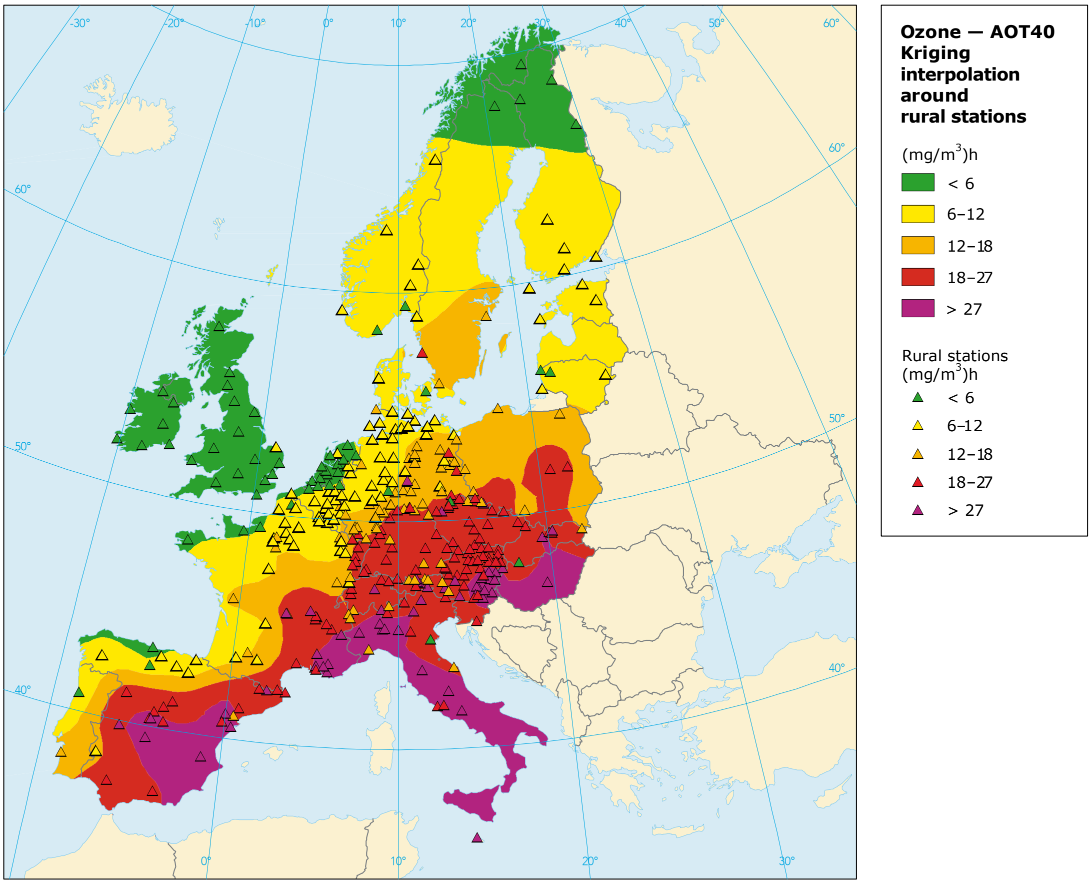
Deposition of sulphur and nitrogen compounds contributes to acidification of soils and surface waters, leaching of plant nutrients and damage to flora and fauna. Deposition of nitrogen compounds can lead to eutrophication, disturbance of natural ecosystems, excessive algal blooms in coastal waters and increased concentrations of nitrate in groundwater.

The estimated capacity of a location to receive depositions of acidifying or eutrophying pollutants without harm ('critical load') may be thought of as the threshold total quantity of air polluting compounds deposited, which should not be exceeded if ecosystems are to be protected from risk of damage, according to present knowledge.

Ground-level ozone is seen as one of the most prominent air pollution problems in Europe, mainly because of its effects on human health, natural ecosystems and crops. Threshold levels set by the EU for the protection of human health and vegetation, and critical levels agreed under the LRTAP Convention

(2) The sum of the differences between hourly ozone concentration and 40 ppb for each hour when the concentration exceeds 40 ppb during a relevant growing season, e.g. for forest and crops.

Map 1 **Exposure above AOT40 target values for vegetation around rural ozone stations (EEA member countries), 2002**



Note: Reference period: May–July 2002 (Kriging interpolation around rural stations).

Data source: Airbase (Ref: www.eea.eu.int/coreset).

for the same purpose, are exceeded widely and by substantial amounts.

Policy context

This indicator is relevant information for the Clean Air for Europe (CAFE) programme. A combined ozone and acidification abatement strategy has been developed by the Commission, resulting in an Ozone Daughter Directive (2002/3/EC) and a National Emission Ceiling Directive (2001/81/EC). In this legislation, target values have been set for ozone levels and precursor emissions for 2010. The long-term objectives of the EU are largely consistent with the long-term objectives of no exceedances of critical loads and levels as defined in the UN-ECE CLRTAP protocols to abate acidification, eutrophication and ground-level ozone.

Negotiation of emission reduction agreements has been based on model calculations, and the reporting of emission reductions in accordance with these agreements would indicate the improvement in environmental quality required by the policy objectives:

National Emission Ceilings Directive 2001/81/EC, Article 5
Acidification: Reduction in areas exceeding critical loads for acidification by 50 % (in each 150 km resolution grid square) between 1990 and 2010.

Vegetation-related ground-level ozone exposure: By 2010 the ground-level ozone load above the critical level for crops and semi-natural vegetation (AOT40 = 3 ppm.h) shall be reduced by one-third in all grid cells compared with the 1990 situation. In addition, the ground-level ozone concentrations shall not exceed an absolute limit of 10 ppm.h expressed as an exceedance of the critical level in any grid cell.

UNECE CLRTAP Gothenburg Protocol (1999)
The protocol sets emission limits with target dates to abate acidification, eutrophication and ground-level ozone. While environmental quality objectives are not specified, full attainment of emission targets is intended to result in an improvement in the state of the environment.

EU Ozone Daughter Directive (2002/3/EC)
The ozone directive defines the target value for the protection of vegetation as an AOT40-value (calculated from hourly values from May to July) of 18 (mg/m^3)h, averaged over five years. This target value should be attained in 2010 (Article 2, indent 9). It also defines a long-term objective of 6 (mg/m^3)h as AOT40.

Indicator uncertainty

The exceedance of deposition of critical loads for acidification and eutrophication presented in this indicator is itself a calculation derived from reported air emissions. Model estimates of pollutant depositions are used rather than observed depositions on account of their larger spatial coverage. Computer modelling uses officially reported national pollutant emission totals and their geographical distributions using documented procedures. Temporal and spatial coverage is imperfect, however, as a number of annual national totals and geographical distributions are not reported according to time schedules. The resolution of the computer estimates has improved recently to 50 km grid averages. Local pollutant sources or geographical features below this scale will not be well resolved. The meteorological parameters used for modelling pollutant supply are mainly computations, with some adjustment towards observed conditions.

The critical load estimates are reported by official national sources, but face difficulties of geographical coverage and comparability. The latest reporting round in 2004 supplied estimates for 16 of the 38 EEA participating countries. For a further nine countries, earlier submissions were reported as being still valid. Those reporting did so for a variety of ecosystem classes, although reported ecosystems typically covered less than 50 % of their total country area. For other countries the most recently submitted critical loads data are used.

Methodology uncertainty in the indicator for **ozone** is due to uncertainty in mapping AOT40 based on interpolation of point measurements at background stations. The different definitions of AOT40 values (accumulation during 8.00 to 20.00 CET following the Ozone Directive or accumulation during daylight hours following the definition in NECD) is expected to introduce minor inconsistencies in the data set.

At the data level it is assumed that the air quality data officially submitted to the Commission under the exchange of information decision and to EMEP under the UNECE CLRTAP have been validated by the national data supplier. Station characteristics and representativeness are often not well documented and coverage of territory and i time is incomplete. Yearly changes in monitoring density will influence the total monitored area. The indicator is subject to year-to-year fluctuations as it is sensitive mainly to episodic conditions, and these depend on particular meteorological situations, the occurrence of which varies from year to year.

06 Production and consumption of ozone depleting substances

Key policy question

Are ozone depleting substances being phased out according to the agreed schedule?

Key message

The total production and consumption of ozone depleting substances in the EEA-31 decreased significantly until 1996 and has since stabilised.

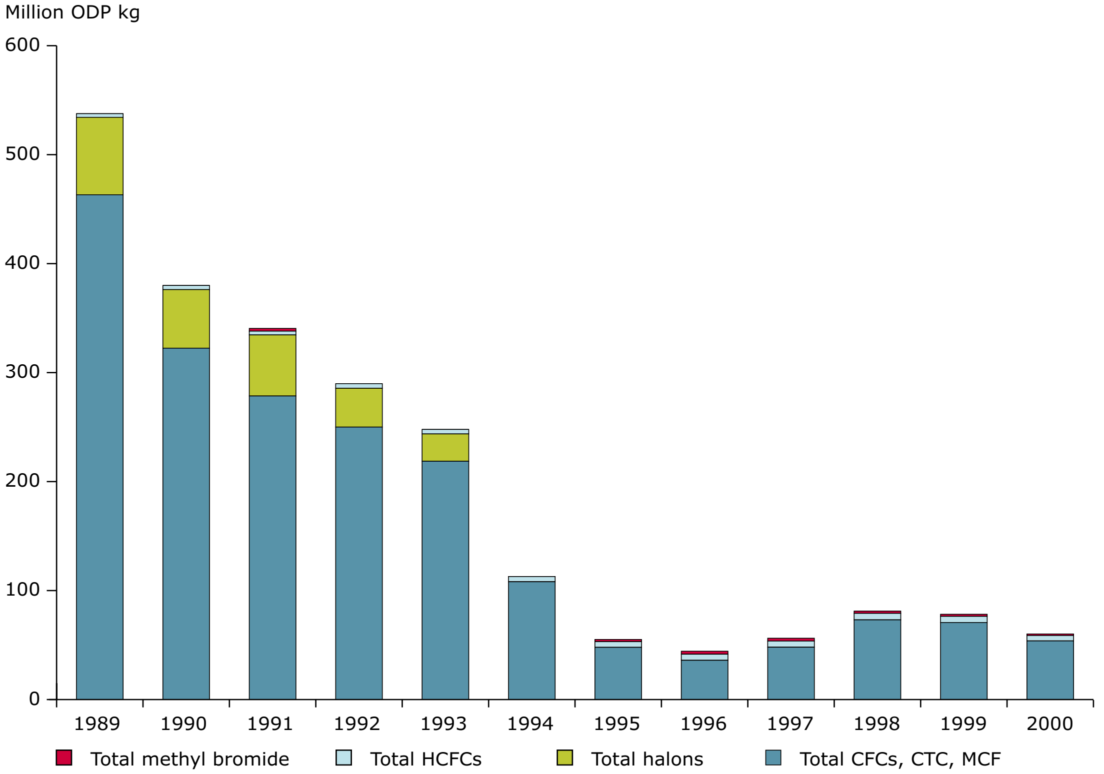
Indicator assessment

The production and consumption of ozone depleting substances (ODS) has decreased significantly since the 1980s (Figures 1 and 2). This is a direct result of international policies (the Montreal Protocol and its amendments and adjustments) to phaseout the production and consumption of these substances. Production and consumption in the EEA-31 is dominated by the EU-15 countries, which account for 80–100 % of total ODS production and consumption. The overall decline is in accordance with the international regulations and the agreed schedule.

Indicator definition

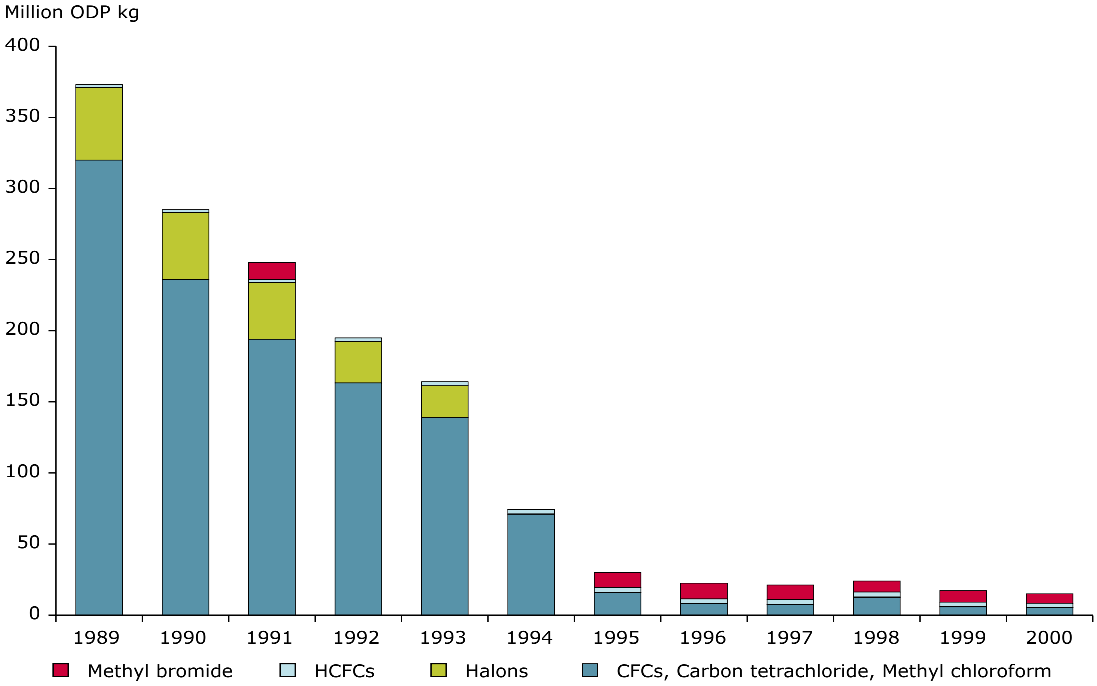
This indicator tracks the annual production and consumption of ozone depleting substances (ODS) in Europe. ODS are long-lived chemicals that contain chlorine or/and bromine and that destroy the stratospheric ozone layer.

Figure 1 **Production of ozone depleting substances (EEA-31), 1989–2000**



Note: Data source: UNEP (Ref: www.eea.eu.int/coreset).

Figure 2 Consumption of ozone depleting substances (EEA-31), 1989–2000



Note: Data source: UNEP (Ref: www.eea.eu.int/coreset).

Developed countries have not been allowed to produce or consume halons since 1994, and CFCs, carbon tetrachloride and methyl chloroform since 1995. A limited production of ODS is still allowed for designated essential uses (e.g. metered dose inhalers) and for developing countries to meet their basic domestic needs.

The indicator is presented as million kg of ODS weighted by their ozone depletion potential (ODP).

Indicator rationale

Policy measures to limit or phaseout the production and consumption of ozone depleting substances (ODS) have been taken since the mid 1980s in order to protect the stratospheric ozone layer from depletion. This indicator tracks progress towards this limiting or phasing-out of production and consumption.

Policies focus on the production and consumption rather than emissions of ODS. This is because emissions

Table 1 Article 5(1) and Non-article 5(1) countries of the Montreal Protocol

Montreal Protocol	EEA member countries
Article 5(1)	Cyprus, Malta, Romania and Turkey
Non-article 5(1)	All other EEA member countries

Table 2 Summary of phaseout schedule for Non-article 5(1) countries, including Beijing adjustments

Group	Phaseout schedule for Non-article 5(1) countries	Remark
Annex-A, group 1: CFCs (CFC-11, CFC-12, CFC-113, CFC-114, CFC-115)	Base level: 1986 100 % reduction by 01.01.1996 (with possible essential use exemptions)	Applicable to production and consumption
Annex A, group 2: Halons (halon 1211, halon 1301, halon 2402)	Base level: 1986 100 % reduction by 01.01.1994 (with possible essential use exemptions)	Applicable to production and consumption
Annex B, group 1: Other fully halogenated CFCs (CFC-13, CFC-111, CFC-112, CFC-211, CFC-212, CFC-213, CFC-214, CFC-215, CFC-216, CFC-217)	Base level: 1989 100 % reduction by 01.01.1996 (with possible essential use exemptions)	Applicable to production and consumption
Annex B, group 2: Carbon tetrachloride (CCl_4)	Base level: 1989 100 % reduction by 01.01.1996 (with possible essential use exemptions)	Applicable to production and consumption
Annex B, group 3: 1,1,1-trichloroethane (CH_3CCl_3) (= methyl chloroform)	Base level: 1989 100 % reduction by 01.01.1996 (with possible essential use exemptions)	Applicable to production and consumption
Annex C, group 1: HCFCs (HydroChloroFluoroCarbons)	Base level: 1989 HCFC consumption + 2.8 % of 1989 CFC consumption Freeze: 1996 35 % reduction by 01.01.2004 65 % reduction by 01.01.2010 90 % reduction by 01.01.2015 99.5 % reduction by 01.01.2020, and thereafter consumption restricted to the servicing of refrigeration and air-conditioning equipment existing at that date. 100 % reduction by 01.01.2030	Applicable to consumption
	Base level: Average of 1989 HCFC production + 2.8 % of 1989 CFC production and 1989 HCFC consumption + 2.8 % of 1989 CFC consumption Freeze: 01.01.2004, at the base level for production	Applicable to production
Annex C, group 2: HBFCs (HydroBromoFluoroCarbons)	Base level: year not specified. 100 % reduction by 01.01.1996 (with possible essential use exemptions)	Applicable to production and consumption
Annex C, group 3: Bromochloromethane (CH_2BrCl)	Base level: year not specified. 100 % reduction by 01.01.2002 (with possible essential use exemptions)	Applicable to production and consumption
Annex E, group 1: Methyl bromide (CH_3Br)	Base level: 1991 Freeze: 01.01.1995 25 % reduction by 01.01.1999 50 % reduction by 01.01.2001 75 % reduction by 01.01.2003 100 % reduction by 01.01.2005 (with possible essential use exemptions)	Applicable to production and consumption

from multiple small sources are much more difficult to monitor accurately than from industrial production and consumption. Consumption is the driver of industrial production. Production and consumption can precede emissions by many years, as emissions generally occur after the disposal of products in which ODS are used (fire-extinguishers, refrigerators, etc.).

Release of ODS to the atmosphere leads to depletion of the stratospheric ozone layer which protects humans and the environment from harmful ultra-violet (UV) radiation emitted by the sun. Ozone is destroyed by chlorine and bromine atoms which are released in the stratosphere from man-made chemicals — CFCs, halons, methyl chloroform, carbon tetrachloride, HCFCs (all completely anthropogenic) and methyl chloride and methyl bromide. Depletion of stratospheric ozone leads to increases in ambient ultra-violet radiation at the surface, which has a wide variety of adverse effects on human health, aquatic and terrestrial ecosystems, and food chains.

Policy context

Following the Vienna Convention (1985) and the Montreal Protocol (1987) and their amendments and adjustments, policy measures have been taken to limit or phaseout the production and consumption of ozone depleting substances

The international target under the Ozone Convention and Protocols is the complete phase-out of ODS, according to the schedule below.

Countries falling under Article 5, paragraph 1 of the Montreal Protocol are considered as developing countries under the protocol. Phaseout schedules for Article 5(1) countries are delayed by 10–20 years compared with Non-article 5(1) countries (Table 1).

Indicator uncertainty

Two data sets are used in the fact-sheet: (1) UNEP data, as reported by the countries to the UNEP Ozone Secretariat (data provided for production and consumption), and (2) DG Environment data, as reported by companies to DG Environment (data provided for production, consumption, import and export). Generally, production data are reported only when individual company performance cannot be recognised in the statistics. So if one or two companies within a country or group of countries only produce a substance, data may be missing because of privacy protection of companies.

The uncertainty in the statistics is unknown, as an uncertainty estimate is not reported by the companies. Production figures are generally better known than consumption, because production occurs only in a few factories, while use of ODS (consumption) takes place in many factories.

Emissions are more uncertain than consumption figures, because emissions take place when products in which ODS are used (e.g. fire-extinguishers, refrigerators) are discarded. The time when these products are discarded is unknown, and hence when the corresponding emissions will occur.

The definition of production in the DG Environment and the UNEP data is different. In the DG Environment data, production is real production without subtracting ODS recovered and destroyed or used as feedstock (intermediate products that are used to produce other ODS).

An estimate of the uncertainty for the EU-15 can be obtained by comparing the DG Environment data with the UNEP data.

07 Threatened and protected species

Key policy question

What measures are being taken to conserve or restore biodiversity?

Key message

Identifying and establishing lists of protected species at national and international levels are important first steps in conserving species diversity. European countries have agreed to join efforts to conserve threatened species by listing them for protection in EU directives and/or the Bern Convention. Some, but not all, of the globally endangered species of wild fauna occurring in Europe in 2004 are currently under European protection status. The responsibility of the EU towards the global community for the conservation of these species is high.

Indicator assessment

According to IUCN (2004), 147 vertebrate (mammals, birds, reptiles, amphibians and fish) and 310 invertebrate species (crustaceans, insects and molluscs) that occur in the EU-25 are considered to be globally threatened, since they have been categorised as critically endangered, endangered, and vulnerable.

The overall assessment shows that specific protection status under EU legislation and the Bern Convention exists for all globally threatened bird species, and for a fair percentage of the reptiles and mammals. However, most of the globally threatened amphibians and fish, as well as invertebrate species occurring in the EU-25 are not protected at the European level. Information on whether these receive protection at the national level, where they occur, is not readily available.

All 20 globally threatened bird species occurring in EU-25 are protected either under the EU birds directive (which, while protecting all bird species, lists a number of species in its Annex I for which strict habitat management is needed) or the Bern Convention (Annex II).

Up to 86 % of reptile and mammal species have been protected at the European level so far: 12 out of 14 globally threatened reptile species and 28 out of 35 mammal species have been included in the EU habitats directive (Annexes II and IV), or the Bern Convention (Annex II).

Less than half of the amphibian and fish species have been protected under European legislation so far; 7 out of 15 amphibian species and 24 out of 63 fish species have been included in the legislative lists.

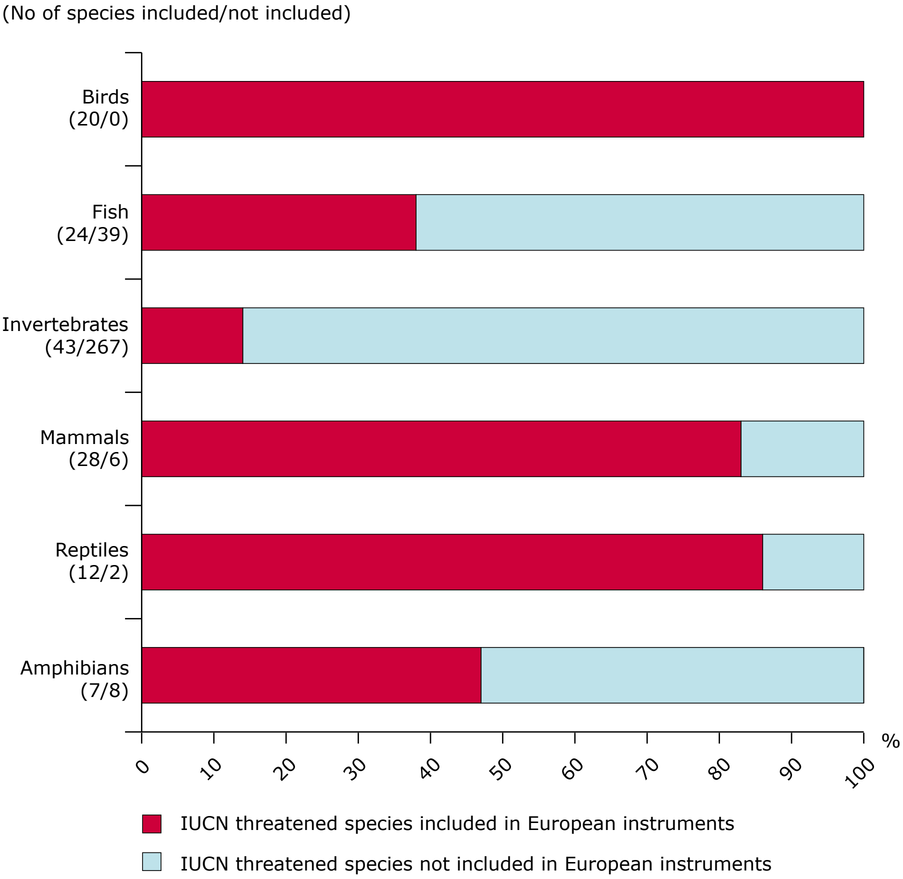
The gap for invertebrate species is vast. Only 43 out of 310 species have been included in the lists.

The indicator in its present form cannot directly assess the effectiveness of EU biodiversity policies. It can only confirm the extent of European responsibility to the global community and show the extent to which global responsibilities are covered by European legislation.

Indicator definition

This indicator depicts the number and percentage of the globally endangered species of wild fauna occurring in the EU-25 in 2004 that are granted European protection status through the EU birds and habitats directives or the Bern Convention. The indicator takes into account modifications to the respective legislative lists of species resulting from EU enlargement.

Figure 1 **Percentage of globally threatened species included in protected species lists of EU directives and the Bern Convention**



Note: Data source: 2004 IUCN list, Annexes of EU birds and habitats directives and Bern Convention (Ref: www.eea.eu.int/coreset).

Indicator rationale

There are a number of ways of assessing progress towards the target of halting the loss of biodiversity in Europe by 2010.

The International Union for Conservation of Nature (IUCN) has been monitoring the extent and rate of biodiversity degradation for several decades by assigning species to red-list categories through detailed assessment of information against a set of objective, standard, quantitative criteria. This assessment is made at the global level and the most recent one was published in 2004.

Globally threatened species are present in and also outside Europe, and some of them may not be classified as threatened at the regional or national levels within the EU. How far European legislation, which is further linked to European policies on nature and biodiversity, takes the EU responsibility to the global community into consideration is shown by the information that the indicator provides on the number of globally threatened species that are protected at the European level.

Indicator uncertainty

The indicator does not currently identify how many species of wild fauna listed as globally endangered are found only in Europe. It also does not consider the protection of species that do not occur in the global red lists but which are endangered in Europe. Finally it does not include data on plants.

Policy context

Halting the loss of biodiversity by 2010 is a target expressed by the 6EAP and the European Council at Gothenburg, and re-enforced by the Environment Council in Brussels in June 2004.

The Council also emphasises 'the importance of monitoring, evaluating and reporting on progress towards the 2010 targets, and that it is absolutely vital to communicate biodiversity issues effectively to the general public and to decision-makers in order to provoke appropriate policy responses'.

Targets

There are no specific quantitative targets for this indicator.

The target to 'halt the loss of biodiversity by 2010' implies not only that species extinction must be stopped but that threatened species must be shifted to a better status.

08 Designated areas

Key policy question

What measures are being taken to ensure the *in situ* conservation of biodiversity components?

Key message

In situ conservation of species, habitats and ecosystems entails the establishment of protected areas. The increase in the cumulative area of sites within the European Ecological Natura 2000 network during the past ten years is a good sign of commitment to the conservation of biodiversity. Some of the Natura 2000 sites include areas that have not already been designated under national laws, thus contributing to a direct increase in the total area designated for *in situ* conservation of biodiversity components in Europe.

Indicator assessment

Worldwide, countries use the designation of protected areas as a means of conserving biodiversity components (genes, species, habitats, ecosystems), each country applying its own selection criteria and objectives. A common EU perspective was defined by the birds and habitats directives. On the basis of these, EU Member States have classified and/or proposed sites for establishing the European Natura 2000 network.

The indicator shows that there has been a steady increase in the cumulative area of sites designated to the Natura 2000 network over the past ten years, from approximately 8 to 29 million ha under the birds directive (as special protection areas) and from 0 to approximately 45 million ha under the habitats directive (as sites of Community importance). Some countries have greater representation of species and habitats listed in the two directives than others. Therefore these countries have designated larger parts of their territory, as is the case with countries of southern Europe as well as the large countries of the north. Spain leads by contributing more than 10 million ha, followed by Sweden with about 5 million ha.

The second part of the indicator demonstrates the extent to which nationally designated sites that already exist are fulfilling the criteria of the European directives. It also provides a snapshot of the significance of the contribution of European legislation to *in situ* conservation in Europe.

Indicator definition

The indicator comprises two parts:

- the cumulative surface area of sites designated over time under the birds and habitats directives by each EU-15 Member State;
- the proportion of the area coverage of the sites designated by a country only under the EC birds and habitats directives, protected only by national instruments, and covered by both.

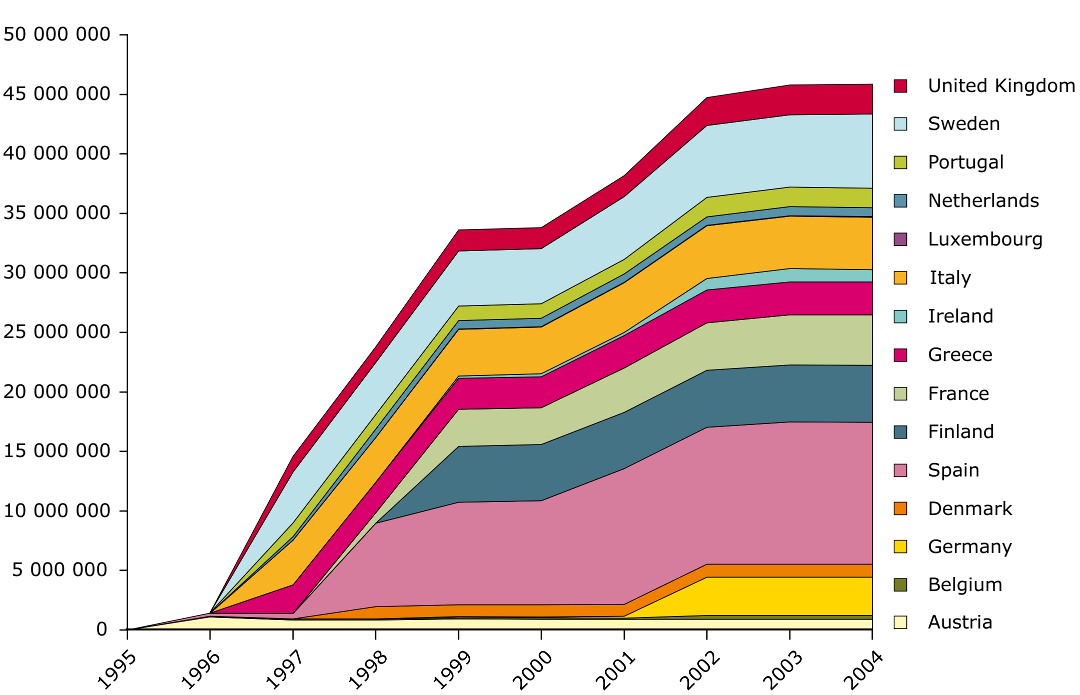
Indicator rationale

There are a number of ways of assessing progress towards the target of halting the loss of biodiversity in Europe by 2010.

The indicator aims to assess progress of *in situ* conservation of biodiversity components, which entails the establishment of protected areas. Progress is shown at the EU level, namely with the establishment of the Natura 2000 network. Quantitative information on the cumulative area comprising the Natura 2000 network over time in the EU-15 is broken down by country in the first part.

The second part of the indicator assesses whether the establishment of the Natura 2000 network is likely to increase the overall surface of protected areas in

Figure 1 **Cumulative surface area of sites designated for the habitats directive over time (sites of Community importance — SCIs)**



Note: Data source: Natura 2000, December 2004 (Ref: www.eea.eu.int/coreset).

Europe, by examining the proportion of the nationally designated areas included in the Natura 2000 network by each Member State, at a given point in time.

Policy context

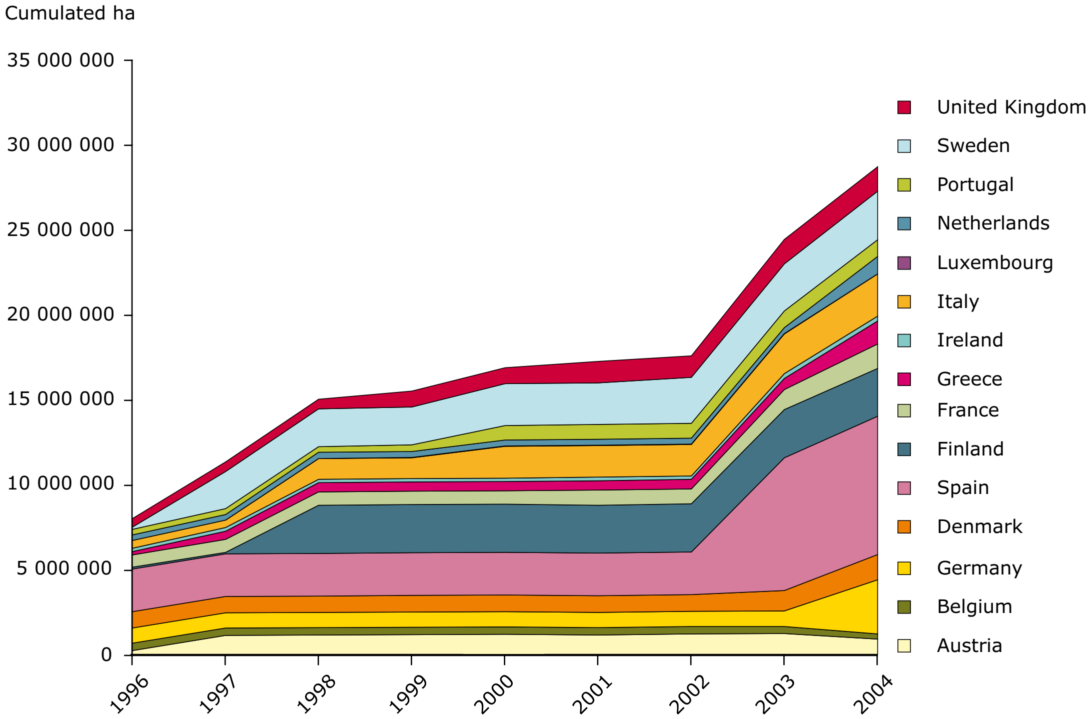
Halting the loss of biodiversity by 2010 is one target expressed by the EU 6th environment action plan and the European Council at Gothenburg (2001). This target was fully endorsed at the Pan-European level in 2003. The European Council has also urged the Commission and Member States to implement the new programme of work on protected areas, adopted in the context of the Convention of Biological Diversity in 2004. This programme includes the need to update information on the status, trends and threats to protected areas.

At the EU level, policy on nature conservation is essentially made up of two pieces of legislation: the birds directive and the habitats directive. Together, they establish a legislative framework for protecting and conserving the EU's wildlife and habitats.

Targets

At the global level, the Convention on Biological Diversity (CBD) has set relevant targets to be achieved by 2010: Target 1.1 is the effective conservation of at least 10 % of each of the world's ecological regions and Target 1.2 is the protection of areas of particular importance to biodiversity.

Figure 2 **Cumulative surface area of sites designated for the birds directive over time (special protection areas — SPAs)**



Note: Data source: Natura 2000 , December 2004 (Ref: www.eea.eu.int/coreset).

At the Pan-European level, the target is full establishment of the Pan-European Ecological Network, of which Natura 2000 is a part, by 2008.

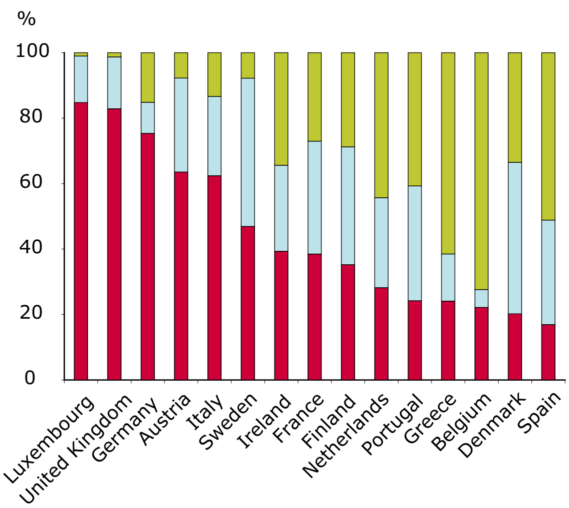
At the EU level, Member States should contribute to the establishment of Natura 2000 in proportion to the representation within their territories of the natural habitat types and the species mentioned in the directives.

With regard to time, the Natura 2000 network should be completed on land by 2005, implemented for marine sites by 2008, and management objectives for all sites should be agreed and instigated by 2010.

Indicator uncertainty

The indicator does not currently address all the targets set, especially sufficiency and evaluation of the management of sites. The EU-10 have not been assessed.

Figure 3 **Proportion of total surface area designated only for the habitats directive, protected only by national instruments, and covered by both (sites of Community importance — SCIs)**



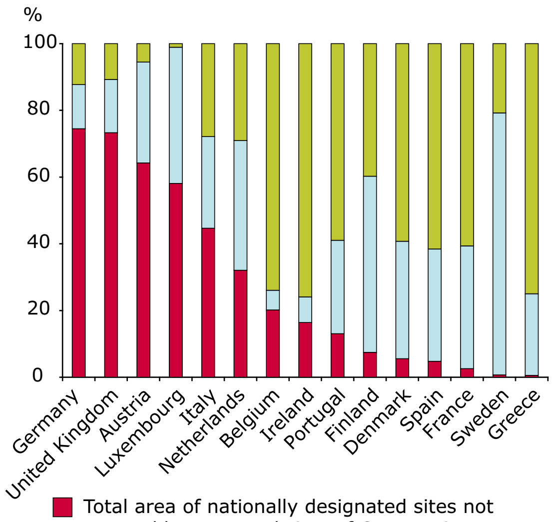
Total area of nationally designated sites not covered by special protection areas (SPAs)

Total area of designated special protection areas (SPAs) covered by national designations

Total area of special protection areas (SPAs) not covered by national designations

Note: Data source: CDDA, October 2004; Proposed sites of Community importance database, December 2004 (Ref: www.eea.eu.int/coreset).

Figure 4 **Proportion of total surface area designated only under the birds directive, protected only by national instruments, and covered by both (special protection areas — SPAs)**



Total area of nationally designated sites not covered by proposed sites of Community importance (pSCIs)

Total area of proposed sites of Community importance (pSCIs) covered by national designations

Total area of proposed sites of Community importance (pSCIs) not covered by national designations

Note: Data source: CDDA, October 2004; Special protection areas database, December 2004 (Ref: www.eea.eu.int/coreset).

09 Species diversity

Key policy question

What is the state and trend of biodiversity in Europe?

Key message

The populations of selected species in Europe are falling. Since the early 1970s, butterfly and bird species linked to different habitat types across Europe show population declines of between 2 % and 37 %. The declines may be linked to similar trends in the land cover of specific habitats between 1990 and 2000, especially certain wetland types as well as heaths and scrubs.

Indicator assessment

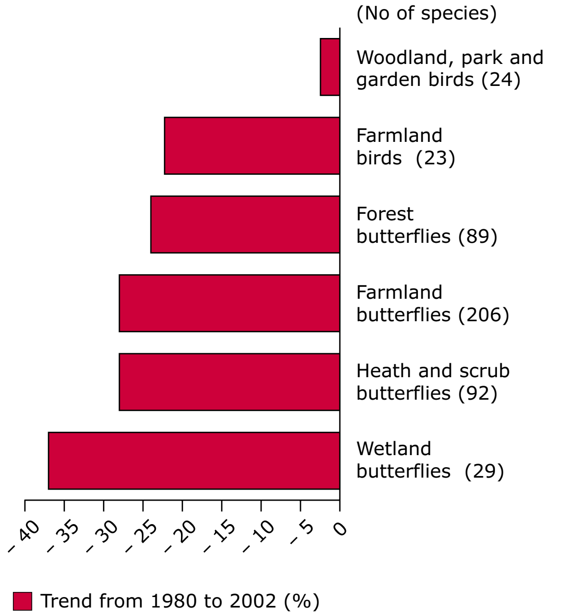
The indicator links population trends of species belonging to two groups (birds and butterflies) to the trends in the extent of different habitat types deriving from land cover change analysis for 1990–2000.

The assessment is based on 295 butterfly species and 47 bird species linked to 5 different habitat types across several European countries. Results vary among species/habitats groups, but it is striking that both birds and butterflies, linked to different habitat types, show a decline in all the habitats examined.

The declines in the populations of wetland bird and butterfly species can be explained by direct habitat loss as well as habitat degradation through fragmentation and isolation. Mires, bogs and fens, which are specific wetland habitats, declined most in area (by 3.4 %) across the EU-25 between 1990–2000, a result based on detecting changes bigger than 25 hectares.

Heaths and scrubs have a particularly high diversity of butterfly species, up to at least 92 species in the habitats surveyed. Direct habitat loss (by 1.6 %) as well as habitat degradation through fragmentation and isolation also play a role in the very substantial decline (28 %) observed among butterfly species.

Figure 1 **Trends in birds and butterfly populations in the EU-25 (% decline)**

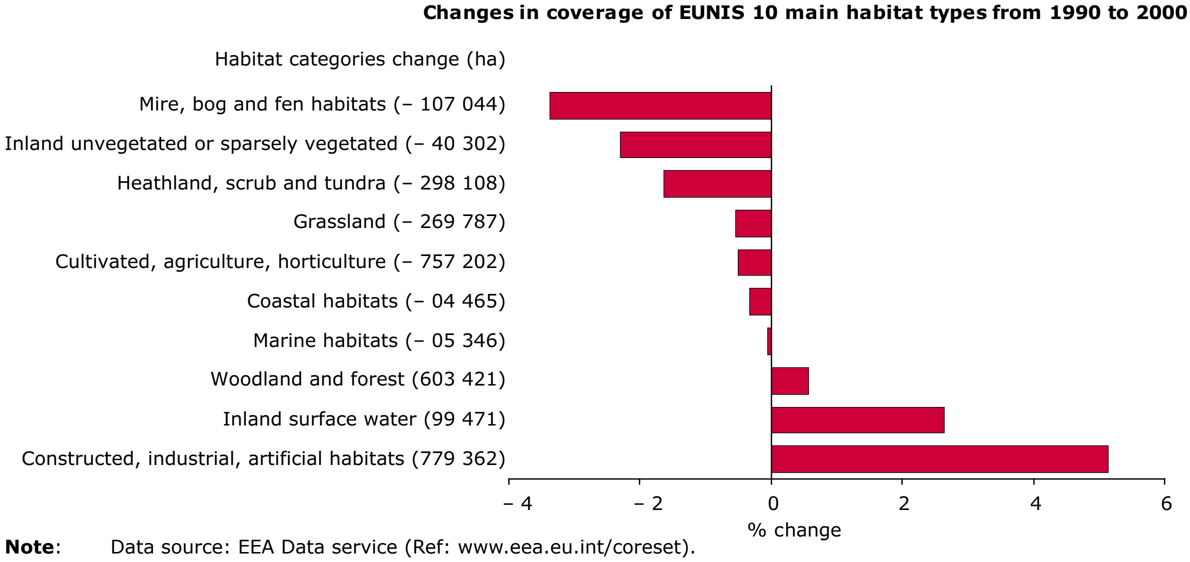


Note: The numbers in brackets show the number of species taken into account for each habitat type. The bird trends reflect the period 1980–2002. The butterfly trends reflect the period 1972/73–1997/98.

Data source: Pan-European Common Bird Monitoring project (EBCC, BirdLife Int, RSPB), Dutch Butterfly Conservation (Ref: www.eea.eu.int/coreset).

The highest number of species assessed, namely 206 butterfly species and 23 bird species, occur in the farmland habitat. These species are typical of open grassy areas such as extensively farmed areas, grasslands, meadows and pastures. The two species groups show very similar trends of decline: 28 % and 22 % respectively. The main pressures related to this decline are loss of extensive farmland with a low or no input of nutrients, herbicides and pesticides, and an increase in agricultural intensification, which leads, among other factors, to loss of marginal habitats and hedgerows and a higher input of fertilisers, herbicides and insecticides.

Figure 2 **Land cover change from 1990 to 2000 expressed as % of the 1990 level, aggregated into EUNIS habitat level 1 categories**



Note: Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

The area of woodland and forest habitats has increased by 0.6 % since 1990, which in absolute terms is about 600 000 hectares. However, the species linked to the woodland and forest habitats have declined. The 89 butterfly species occurring in this habitat show a decline of 24 % and birds occurring in woodland, parks and gardens show a 2 % decline. Nearly all forests in Europe are managed to some extent and the various management schemes surely have an impact on species diversity. For example, the presence of dead wood and old-growth trees are of importance to birds for nesting and feeding, and clearing of forests is an important factor for forest butterflies.

Indicator definition

This indicator comprises two parts:

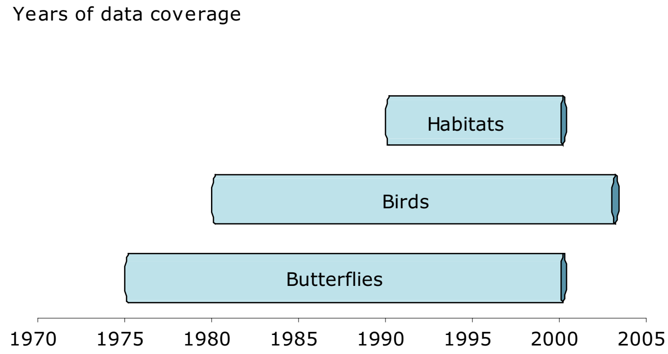
- Population trends of species and species groups. Currently the species groups considered are: birds, namely those species occurring in farmland, woodland, parks and gardens, and invertebrates, namely butterflies. The time reference of the species data sets used is also given.
- Change in area of the 10 main EUNIS habitat types, calculated on the changes in land cover between two points in time.

Indicator rationale

The indicator presents information on the state and trends of biodiversity in Europe, addressing species and their habitats in an interlinked way. In order to approach the issue, the trends of widely distributed taxonomic groups may be assessed through a range of habitats over the whole of Europe. Given the data availability on a European level, birds and butterflies were selected as a proxy for species and habitat biodiversity in general. Species from both groups can be linked to a range of different habitats, and their trends may also be considered as representative of the quality of a habitat with regard to other species.

In the case of birds, the species assessed are all common (numerous and widespread) breeding birds, with large distribution areas over Europe, linked to farmland, woodland, park and garden habitats.

Figure 3 **Temporal coverage for the three data sets**



In the case of butterflies, the species assessed are not necessarily present in all countries, nevertheless each can be related to one of four major EUNIS habitat types, namely farmland, forest, heath, and scrub and wetlands.

An interpretation of the resulting species population trends per habitat type requires the assessment of trends in habitat area. For this indicator, the approach taken is to analyse land cover changes of the different habitat types between 1990 and 2000.

Future development of the indicator will clearly involve extending the concept to other species and species groups, while also defining common criteria for inclusion or deletion of species and by improving the selection of species in relation to habitats.

Policy context

'Halting the loss of biodiversity by 2010' is an objective of the European strategy for sustainable development, adopted in 2001 and further endorsed at the Pan-European level in 2003 by the Kiev resolution on biodiversity. Other relevant European Community policies include the 6th environment action programme and the European Community biodiversity strategy and action plans.

At the global level, the Convention on Biological Diversity (CBD) in 2002 committed the parties to achieving a significant reduction in the current rate of biodiversity loss at the global, regional and national level by 2010.

Targets

The overall target is to halt the loss of biodiversity by 2010.

No specific quantitative target is identified.

Indicator uncertainty

At present the indicator is prone to uncertainty on various levels. The major uncertainty is in the general lack of data from other species groups, and the incomplete geographical and temporal coverage of the data. In addition, the data are based on voluntary work by NGOs, which are dependent on continued funding and resources.

Farmland, woodland, park, and garden birds: since the species selection has been based on expert judgment and not on statistical evidence of the occurrence of each species, it is anticipated that links to habitats may be not as strong. The same list of bird species was used for all countries.

Butterflies: only very few countries have butterfly monitoring (the United Kingdom, the Netherlands, and

Belgium) but the network is building up. The butterfly trends used for this assessment are therefore based on trends in distribution as a proxy for population trends.

Data sets — geographical and time coverage at the EU level

Specifically on farmland, woodland, park, and garden birds: Data are available for 16 of the EU-25 Member States for 1980–2002 (unavailable for Cyprus, Finland, Greece, Lithuania, Luxembourg, Malta, Portugal, Slovenia and Slovakia). Data reflect different monitoring periods among countries.

Specifically on butterflies: monitoring data are not available for all species; distribution data are used.

Data sets — representativeness of data at the national level

Farmland, woodland, park, and garden birds: the representativeness of the data at the EU level is high because the selected species are widely distributed in Europe. At the national level, however, some of the selected species may be less representative, and other species not selected for this indicator may be more representative of the farmland or forest ecosystems of a country.

Butterflies: good representativeness since the data derive from questionnaires filled out by national experts.

Data sets — comparability

Farmland, woodland, park, and garden birds: overall comparability for the EU-25 is good. Data collection is based on a Pan-European monitoring scheme using a standardised methodology across countries.

Butterflies: comparability is good.

10 Greenhouse gas emissions and removals

Key policy question

What progress is being made in reducing greenhouse gas (GHG) emissions in Europe towards the Kyoto Protocol targets?

Key message

Total EU-15 GHG emissions in 2003 were 1.7 % below base-year levels. Increases in carbon dioxide emissions were offset by reductions in nitrous oxide, methane and fluorinated gas emissions. Carbon dioxide emissions from road transport increased whereas emissions from manufacturing industry decreased.

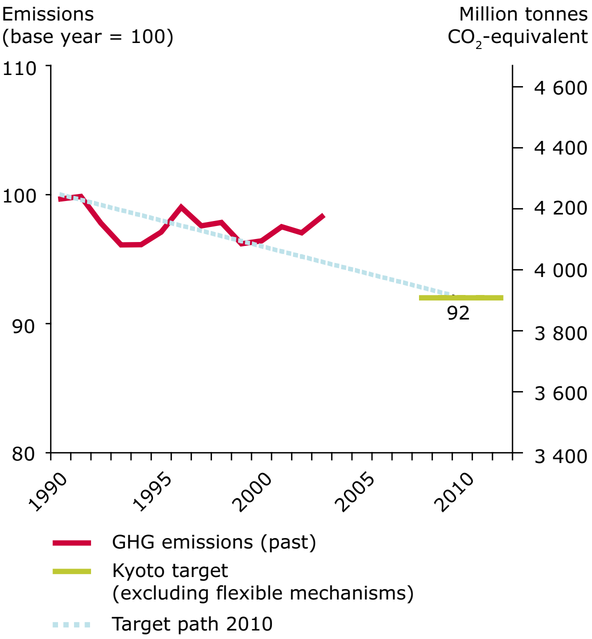
Total EU-15 GHG emissions (including Kyoto Protocol flexible mechanisms) in 2003 were 1.9 index points above the hypothetical linear EU target path. Many EU-15 Member States were not on track to meet their burden-sharing targets. Total GHG emissions in the EU-10 decreased considerably (by 32.2 %) between the aggregate base year and 2003, due mainly to the economic restructuring transition process towards market economies. Most EU-10 Member States are on track to meet their Kyoto targets.

Indicator assessment

Total EU-15 GHG emissions in 2003 were 1.7 % below base-year levels. Four EU-15 Member States (France, Germany, Sweden and the United Kingdom) were below their burden-sharing target paths excluding Kyoto mechanisms. Luxembourg and the Netherlands were below their burden-sharing target paths including Kyoto mechanisms. Nine Member States were above their burden-sharing target paths: Greece and Portugal (excluding Kyoto mechanisms), Austria, Belgium, Denmark, Finland, Ireland, Italy, the Netherlands and Spain (including Kyoto mechanisms). Considerable emissions cuts have occurred in Germany and the United Kingdom, the EU's two biggest emitters, which together account for about 40 % of total EU-15 GHG emissions; the 1990 to 2003 reductions were 18.5 % in Germany and 13.3 % in the United Kingdom. Compared with 2002, EU-15 emissions in 2003 increased by 1.3 %, due mainly to increases from energy industries (by 2.1 %), because of growing thermal power production and a 5 % increase in coal consumption in thermal power stations. From 1990 to 2003, EU-15 transport CO_2 emissions (20 % of total EU-15 GHG emissions) increased by 23 % due to road transport growth in almost all the Member States. CO_2 emissions from energy industries increased by 3.3 % due to increasing fossil fuel consumption in public electricity and heat plants, but Germany and the United Kingdom reduced their emissions by 12 % and 10 %, respectively. In Germany this was due to efficiency improvements in coal-fired power plants and in the United Kingdom to the fuel switch from coal to gas in power production. Reductions were achieved in EU-15 CO_2 emissions from manufacturing industries and construction (by 11 %), due mainly to efficiency improvements and structural change in Germany after reunification. CH_4 emissions from fugitive emissions decreased the most (by 52 %), due mainly to the decline of coal mining, followed by the waste sector (by 34 %), due mainly to reducing the amount of biodegradable waste in landfills and installing landfill gas recovery. Industrial N_2O emissions decreased by 56 %, due mainly to specific measures at adipic acid production plants. N_2O emissions from agricultural soils reduced by 11 %, due to a decline in fertiliser and manure use. HFC, PFC and SF_6 emissions from industrial processes, which account for 1.6 % of GHG emissions, decreased by 4 %. All EU-10 Member States that joined the EU in 2004 have to reach their Kyoto targets individually (Cyprus and Malta have no Kyoto target). Total emissions have declined substantially since 1990 in almost all EU-10, due mainly to the introduction of market economies and the consequent restructuring or closure of heavily polluting and energy-intensive industries. Emissions from transport started to increase in the second half of the 1990s. However, emissions in almost all EU-10 were well below their linear target paths — thus they were on track to meet their Kyoto targets.

Based on their emission trends until 2003, the EU accession countries Romania and Bulgaria, as well as the EEA member country Iceland, were on track to meet their Kyoto targets. Based on their emission trends up

Figure 1 **Development of EU-15 greenhouse gas emissions from base year to 2003 and distance to the (hypothetical) linear EU Kyoto target path (excluding flexible mechanisms)**



Note: Data source: EEA data service (Ref: www.eea.eu.int/coreset).

to 2003, the EEA member countries Liechtenstein and Norway are not on track to achieve their Kyoto targets.

Indicator definition

This indicator illustrates current trends in anthropogenic GHG emissions in relation to the EU and Member State targets. Emissions are presented by type of gas and weighted by their global warming potentials. The indicator also provides information on emissions from sectors: energy industries; road and other transport; industry (processes and energy); other (energy); fugitive emissions; waste; agriculture and other (non-energy). All data are in million tonnes CO_2-equivalent.

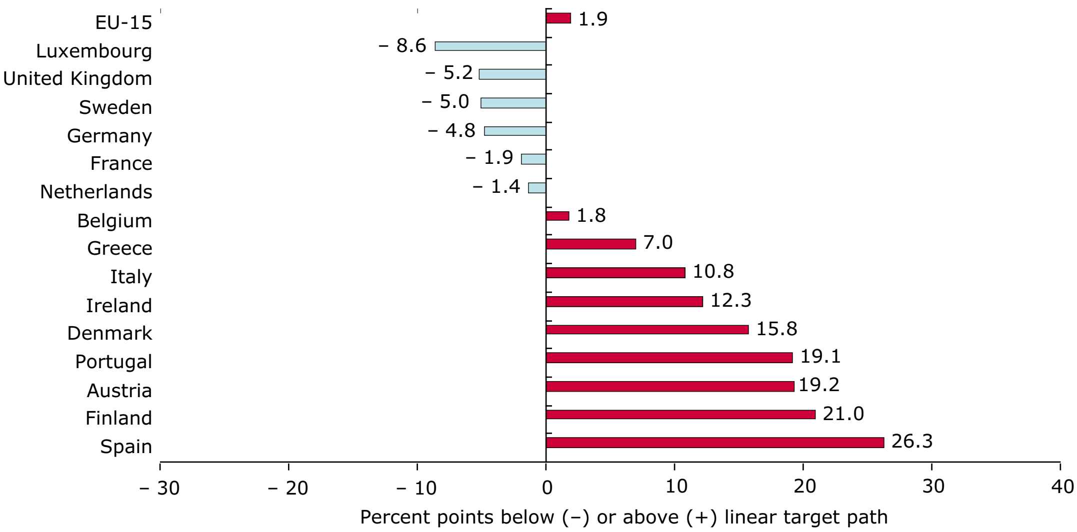
Indicator rationale

There is growing evidence that emissions of greenhouse gases are causing global and European surface air temperatures to increase, resulting in climate change. The potential consequences at the global level include rising sea levels, increased frequency and intensity of floods and droughts, changes in biota and food productivity and increases in diseases. Efforts to reduce or limit the effects of climate change are focused on limiting the emissions of all greenhouse gases covered by the Kyoto Protocol. This indicator supports the Commission's annual assessment of progress in reducing emissions in the EU and the individual Member States to achieve the Kyoto Protocol targets under the EU Greenhouse Gas Monitoring Mechanism (Council Decision 280/2004/EC concerning a mechanism for monitoring Community GHG emissions and for implementing the Kyoto Protocol).

Policy context

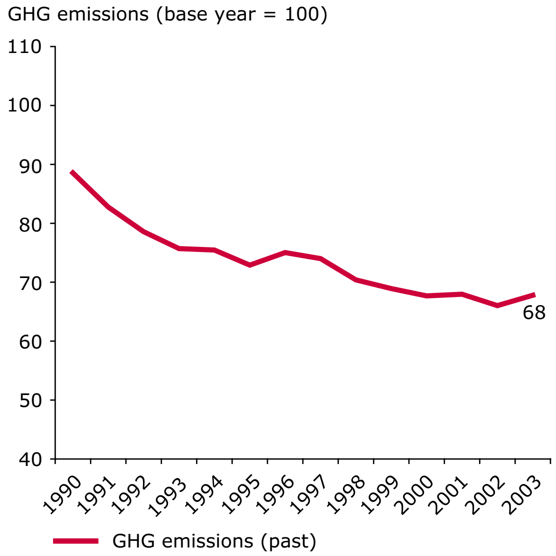
The indicator analyses the trend in total EU GHG emissions from 1990 onwards in relation to the EU and Member State targets. For the EU-15 Member States, the targets are those set out in Council Decision 2002/358EC in which Member States agreed that some countries be allowed to increase their emissions, within limits, provided these are offset by reductions in others. The EU-15 Kyoto Protocol target for 2008–2012 is a reduction of 8 % from 1990 levels for the basket of six greenhouse gases. For the EU-10, accession countries and other EEA member countries, the targets are included in the Kyoto Protocol. For an overview of the national Kyoto targets see the IMS website.

Figure 2 **Distance to target for the EU-15 in 2003 (EU Kyoto Protocol and EU Member State burden-sharing targets)**



Note: Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

Figure 3 **Development of EU-10 greenhouse gas emissions from base year to 2003**



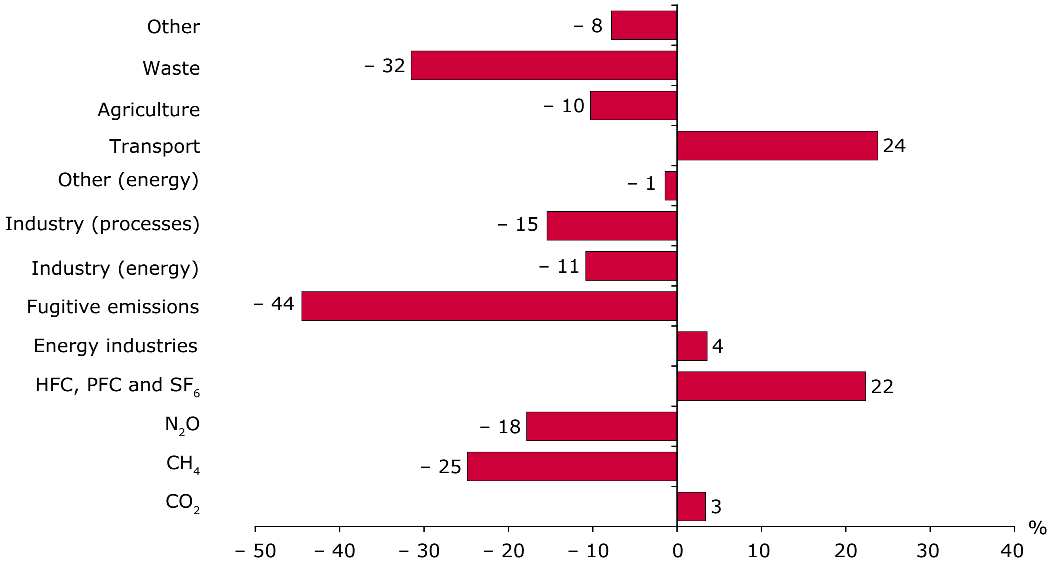
Note: Excluding Malta and Cyprus, which do not have Kyoto Protocol targets.

Indicator uncertainty

The EEA uses data officially submitted by EU Member States and other EEA countries which perform their own assessments of the uncertainty of reported data (good practice guidance and uncertainty management in national GHG inventories: Intergovernmental Panel on Climate Change (IPCC)). The IPCC suggests that the uncertainty in the total GWP-weighted emission estimates, for most European countries, is likely to be less than +/– 20 %. Total GHG emission trends are likely to be more accurate than the absolute emission estimates for individual years. The IPCC suggests that the uncertainty in total GHG emission trends is +/– 4 % to 5 %. This year for the first time uncertainty estimates were calculated for the EU-15. The results suggest that uncertainties at EU-15 level are between +/– 4 % and 8 % for total EU-15 GHG emissions.

For the EU-10 and EU candidate countries, uncertainties are assumed to be higher than for the EU-15 because of data gaps. The GHG emission indicator is an established indicator and is used

Figure 4 **Change in EU-15 emissions of greenhouse gases by sector and gas 1990–2003**



Note: Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

regularly by international organisations and at the national level. Any uncertainties involved in the calculation and the data sets need to be accurately communicated in the assessment, to prevent erroneous messages influencing the political process.

11 Projections of greenhouse gas emissions and removals

Key policy question

What progress is projected towards meeting the Kyoto Protocol targets for Europe for reducing greenhouse gas (GHG) emissions to 2010: with current domestic policies and measures, with additional domestic policies and measures, and with additional use of the Kyoto mechanisms?

Key message

The aggregate projections for the EU-15 for 2010, based on existing domestic policies and measures, show emissions falling to 1.6 % below base-year levels. This leaves a shortfall of 6.4 % to reach the EU's Kyoto commitment of an 8 % reduction in emissions in 2010 compared with base-year levels.

Savings from additional measures being planned would result in emission reductions of 6.8 %, still not sufficient to meet the target. The use of Kyoto mechanisms by various Member States would reduce emissions by a further 2.5 %, leading to total reductions of 9.3 %, sufficient to reach the EU-15 target. This would, however, rely on over-delivery by some Member States. All EU-10 project that existing domestic measures will be sufficient to meet their Kyoto targets in 2010, in one by using carbon sinks. Regarding other EEA countries, Iceland and the EU candidate countries Bulgaria and Romania are on track to achieving their Kyoto targets while Norway and Liechtenstein will, with existing domestic policies and measures, fall short of theirs.

Indicator assessment

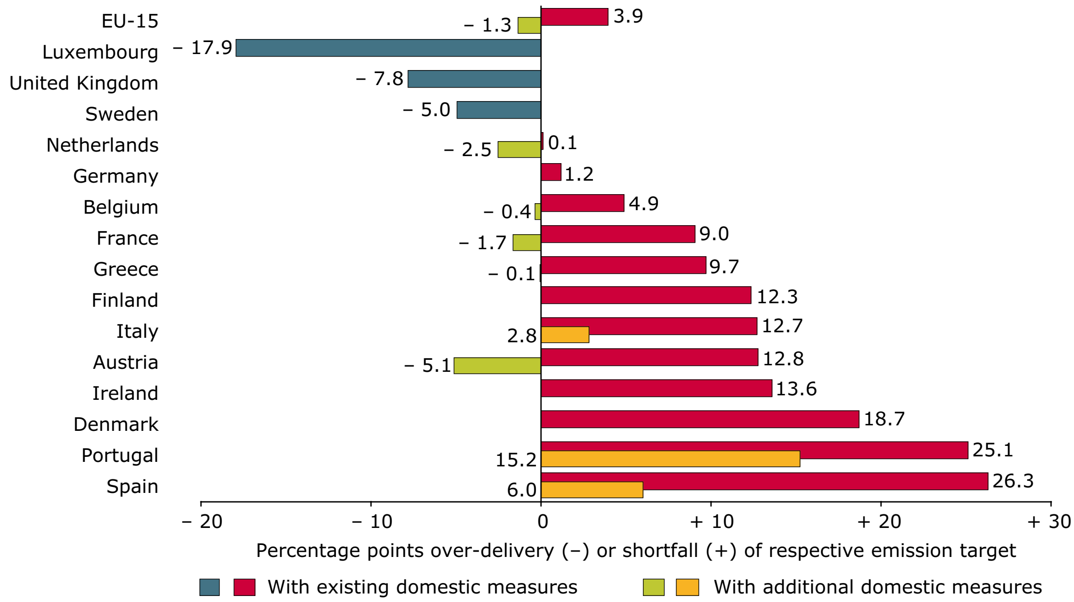
For the EU-15, aggregate projections of total GHG emissions for 2010 based on existing ([1]) domestic policies and measures show a small fall to 1.6 % below base-year levels. This means that the current emission reduction of 1.7 % achieved by 2003 compared with the base-year level is projected to stabilise by 2010. This development, assuming only existing domestic policies and measures, leads to a shortfall of 6.4 % in meeting the EU's Kyoto commitment of an 8 % reduction in emissions in 2010 from base-year levels. The use of Kyoto mechanisms by Austria, Belgium, Denmark, Finland, Ireland, Italy, Luxembourg, the Netherlands and Spain, for which quantitative effects have been approved by the Commission in the EU emission trading scheme, would reduce the EU-15 gap by a further 2.5 %. This would lead to a shortfall of 3.9 % for the EU-15 with the combination of existing domestic measures and the use of Kyoto mechanisms. Sweden and the United Kingdom project that their existing domestic policies and measures will be sufficient to meet their burden-sharing targets. These Member States may even over-deliver on their targets. Emissions in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain are all projected to be significantly above their commitments on the basis of their existing domestic measures. The relative gaps range from more than 30 % for Spain to about 1 % for Germany. By using the Kyoto mechanisms combined with existing domestic measures, Luxembourg would meet its target. Savings from additional policies and measures being planned by Member States would result in total emission reductions of about 6.8 % from 1990, still not sufficient to meet the shortfall for the EU-15 projected on existing domestic policies and measures.

Regarding the EU-10, all those with existing measures, except for Slovenia, have projections resulting in emissions in 2010 being lower than the Kyoto commitments. Slovenia's Kyoto target can be met by accounting for carbon sinks from LULUCF (land use, land use change and forestry).

Regarding other EEA countries, Iceland and the EU candidate countries Bulgaria and Romania will over-achieve their Kyoto targets while Norway and Liechtenstein will fall short with existing domestic policies and measures.

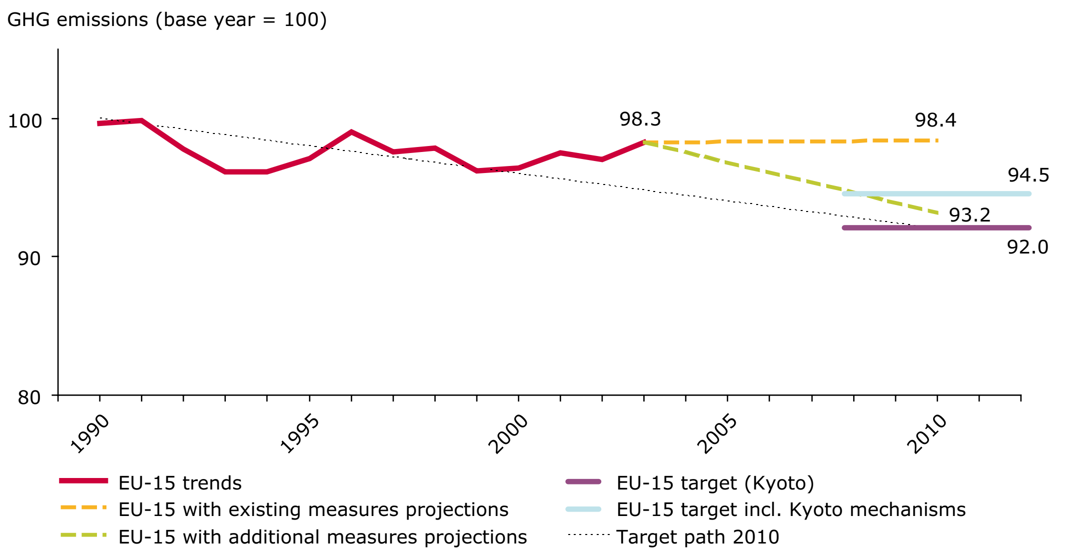
([1]) A 'with existing domestic measures' projection encompasses currently implemented and adopted policies and measures.

Figure 1 **Relative gaps between GHG projections and 2010 targets, based on existing and additional domestic policies and measures, and changes by the use of Kyoto mechanisms**



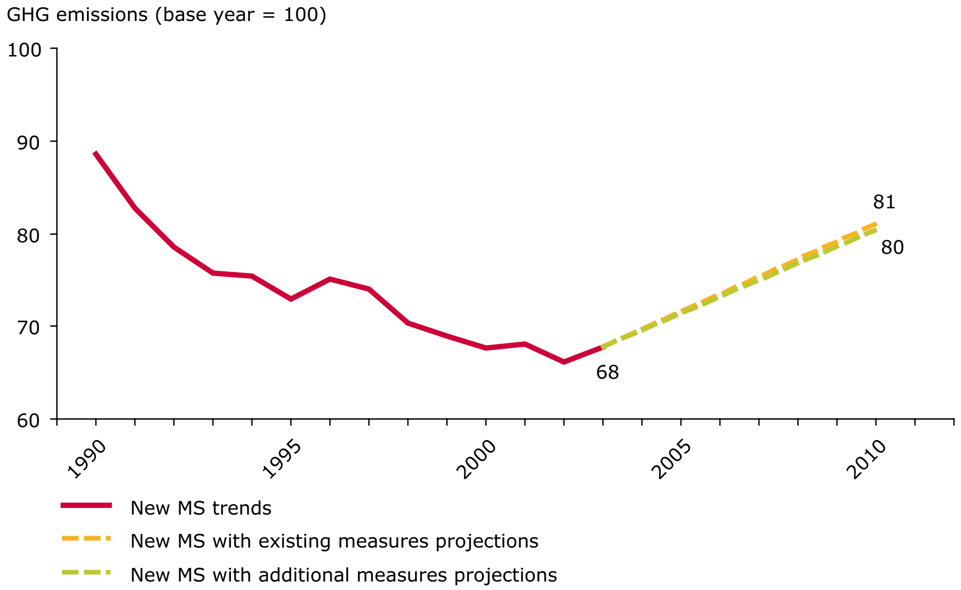
Note: Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

Figure 2 **Actual and projected EU-15 greenhouse gas emissions compared with Kyoto target for 2008–2012**



Note: Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

Figure 3 Actual and projected greenhouse gas emissions aggregated for new Member States



Note: Past GHG emissions and GHG projections include the eight new Member States which have Kyoto targets (not Cyprus and Malta).

Data source: (Ref: www.eea.eu.int/coreset).

Total GHG emissions from the combustion of fossil fuels in power plants and other sectors (e.g. households and services; industry) excluding the transport sector (60 % of total EU-15 GHG emissions) are projected to stabilise at 2003 level (or 3 % below 1990 level) by 2010 with existing measures and to decrease to 9 % below 1990 levels with additional measures.

Total GHG emissions from transport (21 % of total EU-15 GHG emissions) are projected to increase to 31 % above 1990 levels by 2010 with existing measures and to be 22 % above 1990 levels with additional measures.

Total GHG emissions from agriculture (10 % of total EU-15 GHG emissions) are projected to decrease to 13 % below 1990 levels by 2010 with existing measures and 15 % below 1990 levels with additional measures. The main reasons are decreasing cattle numbers and declining fertiliser and manure use.

Total GHG emissions from industrial processes (6 % of total EU-15 GHG emissions) are projected to be 4 % below base-year levels by 2010 with existing measures and 20 % below with additional measures.

GHG emissions from waste management (2 % of total EU-15 GHG emissions) are projected to decrease to 52 % below 1990 levels by 2010 with existing measures. The decline in biodegradable waste being landfilled and the growing share of CH_4 recovery from landfill sites are the main reasons for falling emissions.

Indicator definition

This indicator illustrates the projected trends in anthropogenic greenhouse gas emissions in relation to the EU and Member State targets, using existing policies and measures and/or additional policies and/or use of Kyoto mechanisms. Greenhouse gas emissions are presented by type of gas and weighted by their global warming potentials. The indicator also provides information on emissions by sectors: combustion of fossil fuels in power plants and other sectors (e.g. households and services; industry); transport; industrial processes; waste; agriculture and other (including solvents). All data are in million tonnes CO_2- equivalent.

Indicator rationale

There is growing evidence that emissions of greenhouse gases are causing global and European surface air temperatures to increase, resulting in climate change. The potential consequences at the global level include rising sea levels, increasing frequency and intensity of floods and droughts, changes in biota and food productivity and increases in diseases. Efforts to reduce or limit the effects of climate change are focused on limiting the emissions of all greenhouse gases.

This indicator supports the Commission's annual assessment of progress in reducing emissions in the EU and the individual Member States to achieve the Kyoto Protocol targets under the EU greenhouse gas monitoring mechanism (Council Decision 280/2004/EC concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol).

Policy context

For the EU-15 Member States, the targets are those set out in Council Decision 2002/358EC in which Member States agreed that some countries be allowed to increase their emissions, within limits, provided these are offset by reductions in others. The EU-15 Kyoto Protocol target for 2008–2012 is a reduction of 8 % from 1990 levels for the basket of six greenhouse gases. For the EU-10 and the accession countries and other EEA member countries, the targets are included in the Kyoto Protocol. For an overview of the national Kyoto targets see the IMS website.

Indicator uncertainty

Uncertainties in the projections in GHG emissions have not been assessed. However, several countries carry out sensitivity analyses on their projections.

12 Global and European temperature

Key policy question

Will the increase in global average temperature stay within the EU policy target of not more than 2 °C above pre-industrial levels by 2100, and will the rate of increase in global average temperature stay within the proposed target of not more than 0.2 °C per decade?

Key message

The increase in global mean temperature observed over recent decades is unusual in terms of both magnitude and rate of change. The temperature increase up to 2004 was about 0.7 +/– 0.2 °C compared with pre-industrial levels, which is about one-third of the EU policy target of not more than 2 °C. According to the Intergovernmental Panel on Climate Change (IPCC), global mean temperature is likely to increase by 1.4–5.8 °C between 1990 and 2100, and thus the EU target might be exceeded between 2040 and 2070.

The current global rate of change is about 0.18 +/– 0.05 °C per decade, a value probably exceeding any 100-year average rate of warming during the past 1 000 years.

Indicator assessment

The earth in general and Europe in particular have experienced considerable temperature increases in the past 100 years (Figure 1), especially in the most recent decades.

Globally, the temperature increase up to 2004 was about 0.7 +/– 0.2 °C compared with pre-industrial levels, which means about one-third of the EU policy target for limiting global average warming to not more than 2 °C above pre-industrial levels. These changes are unusual in terms of both magnitude and rate of change (Figure 2). The 1990s was the warmest decade on record, and 1998 was the warmest year, followed by 2003, 2002, and 2004.

Global mean temperature is likely to increase by 1.4–5.8 °C between 1990 and 2100, assuming no climate change policies beyond the Kyoto protocol and taking the uncertainty in climate sensitivity into account. Considering this projected range, the EU target might be exceeded between 2040 and 2070.

The rate of global temperature increase is currently about 0.18 +/– 0.05 °C per decade, which is already close to the indicative target of 0.2 °C per decade. Under the range of scenarios assessed by the IPCC, the indicative proposed target of 0.2 °C per decade is likely to be exceeded in the next few decades.

Europe has warmed more than the global average with an increase of nearly 1 °C since 1900. The warmest year in Europe was 2000 and the next seven warmest years were all in the last 14 years. The temperature increase was larger in winter than in summer.

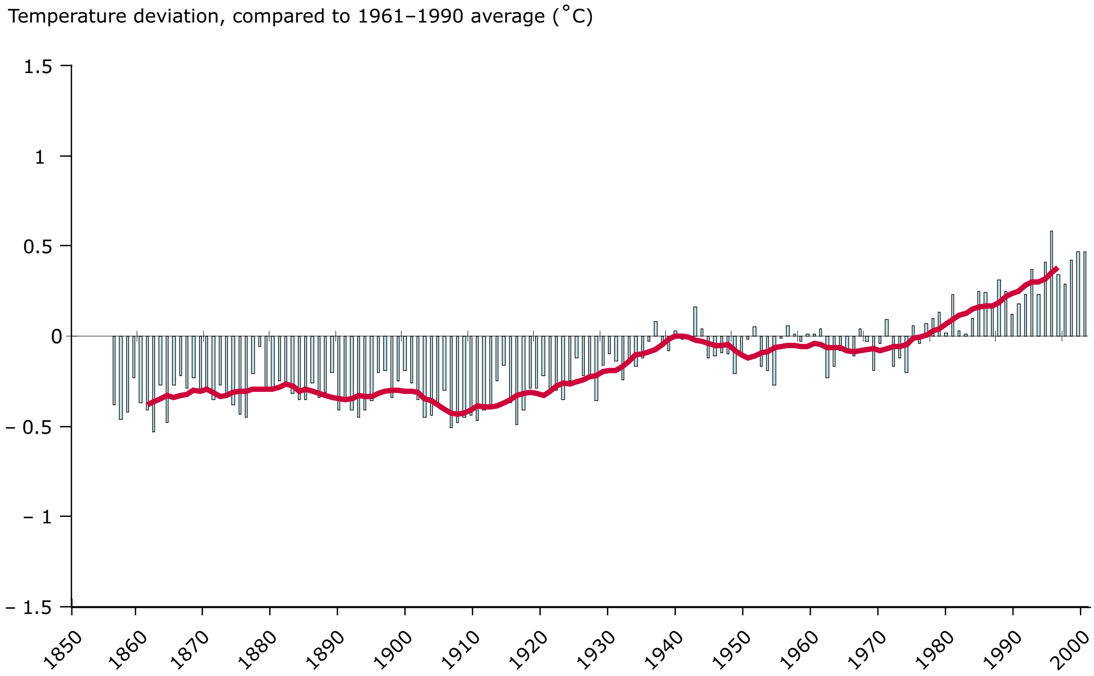
Indicator definition

The indicator shows trends in annual average global and European temperature and European winter/summer temperatures (all compared with the 1961–1990 average). The units are °C and °C per decade.

Indicator rationale

Surface air temperature gives one of the clearest signals of climate change, especially in recent decades. It has been measured for many decades or even centuries. There is mounting evidence that anthropogenic emissions of greenhouse gases are (mostly) responsible for the recently-observed rapid increases in average temperature. Natural factors such as volcanoes and solar activity could to a large extent explain the temperature variability up to middle of the 20th century, but can explain only a small part of the recent warming.

Figure 1 **Global annual average temperature deviations, 1850–2004, compared with the 1961–1990 average (in °C)**



Note: Data source: KNMI, Climate Research Unit (CRU), http://www.cru.uea.ac.uk/cru/data file tavegl.dat (Ref: www.eea.eu.int/coreset).

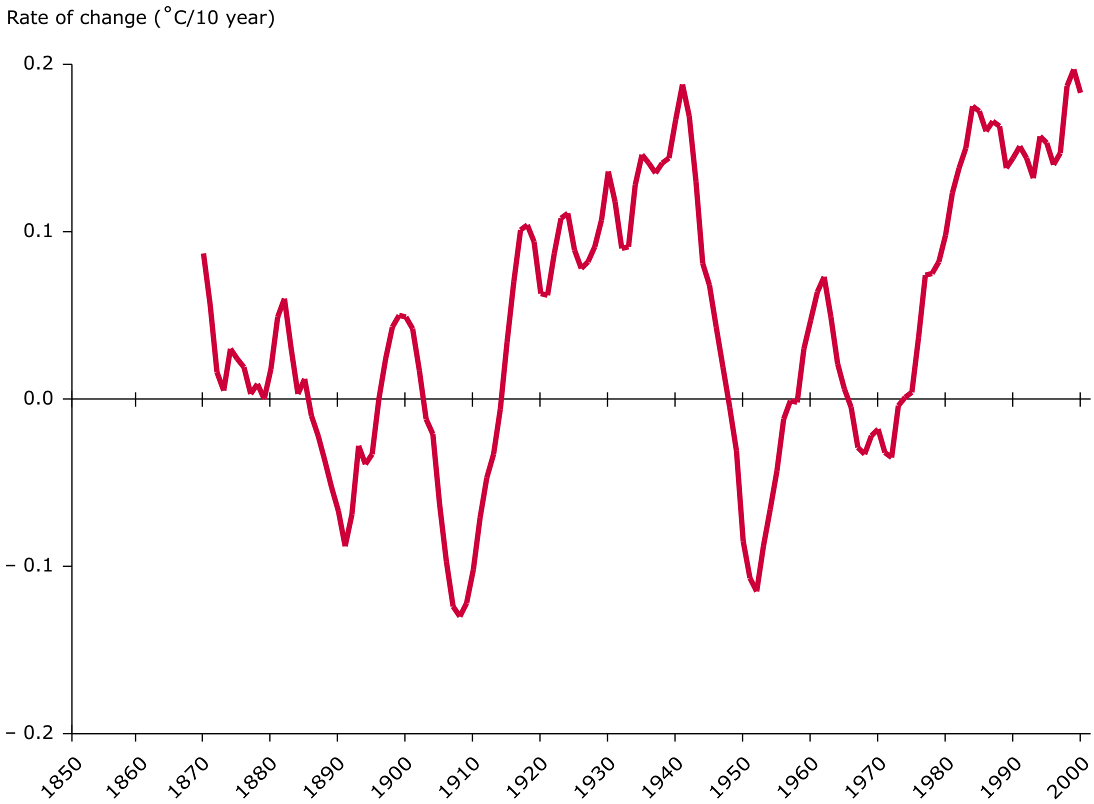
Possible effects of climate change include rising sea levels, increasing frequency and severity of floods and droughts, changes in biota and food productivity and increase of infectious diseases. Trends and projections for the global annual average temperature can be related to indicative EU targets. However, temperature in Europe shows large differences from west (maritime) to east (continental), south (Mediterranean) to north (Arctic), and regional differences; winter/summer temperatures and cold/hot days illustrate temperature variations within a year. The rate and spatial distribution of temperature change is important, for example to determine the possibility of natural ecosystems adapting to climate change.

Policy context

The indicator can answer policy-relevant questions: will the global average temperature increase stay within the EU policy target (2 °C above pre-industrial levels)? Will the rate of global average temperature increase stay within the indicative proposed target of 0.2 °C increase per decade?

To avoid serious climate change impacts, the European Council, in its sixth environment action programme (6EAP, 2002), reaffirmed by the Environment Council and the European Council of March 2005, proposed that the global average temperature increase

Figure 2 **Global average rate of temperature change (in °C per decade)**



Note: Data source: KNMI, Climate Research Unit (CRU), http://www.cru.uea.ac.uk/cru/data file tavegl.dat. (Ref: www.eea.eu.int/coreset).

should be limited to not more than 2 °C above pre-industrial levels (about 1.3 °C above current global mean temperature). In addition, some studies have proposed a 'sustainable' target of limiting the rate of anthropogenic warming to 0.1 to 0.2 °C per decade.

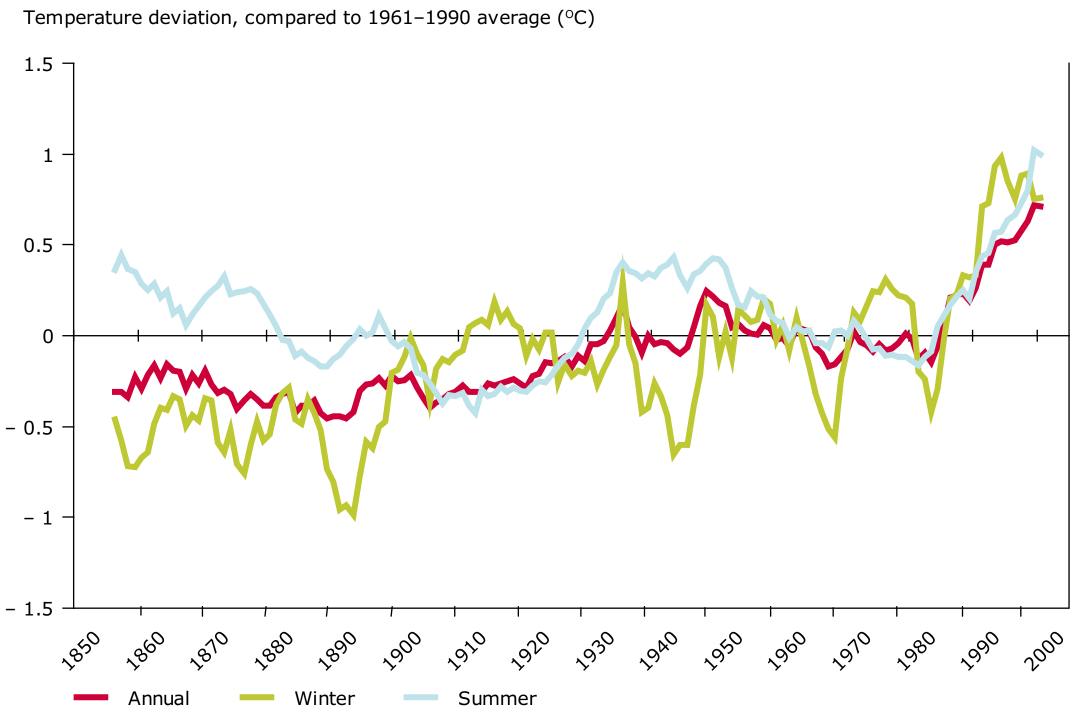
The targets for both absolute temperature change (i.e. 2 °C) and rate of change (i.e. 0.1–0.2 °C per decade) were initially derived from the migration rates of selected plant species and the occurrence of past natural temperature changes. The EU target for global temperature increase (i.e. 2 °C) has recently been confirmed as a suitable target from both a scientific and a political perspective.

Indicator uncertainty

The observed increase in average air temperature, particularly during recent decades, is one of the clearest signals of global climate change.

Temperature has been measured over centuries. There is a generally agreed methodology with low uncertainty. Data sets used for the indicator have been checked and corrected for changing methodologies and location (rural in the past, now more urban). The uncertainty is larger for projected temperature changes, partly resulting from a lack of knowledge of parts of the climate system, including climate sensitivity

Figure 3 **European annual, winter and summer temperature deviations (in °C, expressed as 10 year mean compared with the 1961–1990 average)**



Note: Data source: KNMI, (http://climexp.knmi.nl) based on Climate Research Unit (CRU), file CruTemp2v. (Ref: www.eea.eu.int/coreset).

(temperature increase that results from doubling CO_2-concentrations) and seasonal temperature variability.

Temperature has been measured at many locations in Europe for many decades. The uncertainty has decreased over recent decades due to wider use of agreed methodologies and denser monitoring networks.

Annual values of global and European temperature are accurate to approximately +/– 0.05 °C (two standard errors) for the period since 1951. They were about four times as uncertain during the 1850s, with the accuracy improving gradually between 1860 and 1950 except for temporary deterioration during data-sparse, wartime intervals. New technologies, especially related to the use of remote sensing, will increase the coverage and reduce the uncertainty in temperature.

13 Atmospheric greenhouse gas concentrations

Key policy question

Will greenhouse gas (GHG) concentrations remain below 550 ppm CO_2-equivalent in the long term, the level needed to limit global temperature rise to 2 °C above pre-industrial levels ([1])?

Key message

The atmospheric concentration of carbon dioxide (CO_2), the main GHG, has increased by 34 % compared with pre-industrial levels as a result of human activities, with an accelerated rise since 1950. Other GHG concentrations have also risen as a result of human activities. The present concentrations of CO_2 and CH_4 have not been exceeded during the past 420 000 years and the present N_2O concentration during at least the past 1 000 years.

IPCC baseline projections show that GHG concentrations are likely to exceed the level of 550 ppm CO_2-equivalent in the next few decades (before 2050).

Indicator assessment

The concentration of GHGs in the atmosphere increased during the 20th century as a result of human activities, mostly related to the use of fossil fuels (e.g. for electric power generation), agricultural activities and land-use change (mainly deforestation), and continue to increase. The increase has been particularly rapid since 1950. Compared with the pre-industrial era (before 1750), concentrations of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) have increased by 34 %, 153 %, and 17 %, respectively. The present concentrations of CO_2 (372 parts per million, ppm) and CH_4 (1772 part per billion, ppb) have not been exceeded during the past 420 000 years (for CO_2 probably not even during the past 20 million years); the present N_2O concentration (317 ppb) has not been exceeded during at least the past 1 000 years.

The IPCC showed various projected future GHG concentrations for the 21st century, varying due to a range of scenarios of socio-economic, technological and demographic developments. These scenarios assume no implementation of specific climate-driven policy measures. Under these scenarios, GHG concentrations are estimated to increase to 650–1 350 ppm CO_2-equivalent by 2100. It is very likely that fossil fuel burning will be the major cause of this increase in the 21st century.

The IPCC projections show that global atmospheric GHG concentrations are likely to exceed 550 ppm CO_2-equivalent in the next few decades (before 2050). If this level is exceeded, there is little chance that global temperature rise will stay below the EU target of not more than 2 degrees C above pre-industrial levels. Substantial global emission reductions are therefore necessary to meet this target.

Indicator definition

The indicator shows the measured trends and projections of GHG concentrations. GHGs that fall under the Kyoto Protocol (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) are covered. The effect of GHG concentrations on the enhanced greenhouse effect is presented as CO_2-equivalent concentration. Global annual averages are considered. CO_2-equivalent concentrations are calculated from measured GHG concentrations (parts per million in CO_2-equivalent).

(1) Recent scientific insight shows that in order to have a high chance of meeting the EU policy target of limiting global temperature rise to 2 °C above pre–industrial levels, global GHG concentrations may need to be stabilised at much lower levels, e.g. 450 ppm CO_2-equivalent.

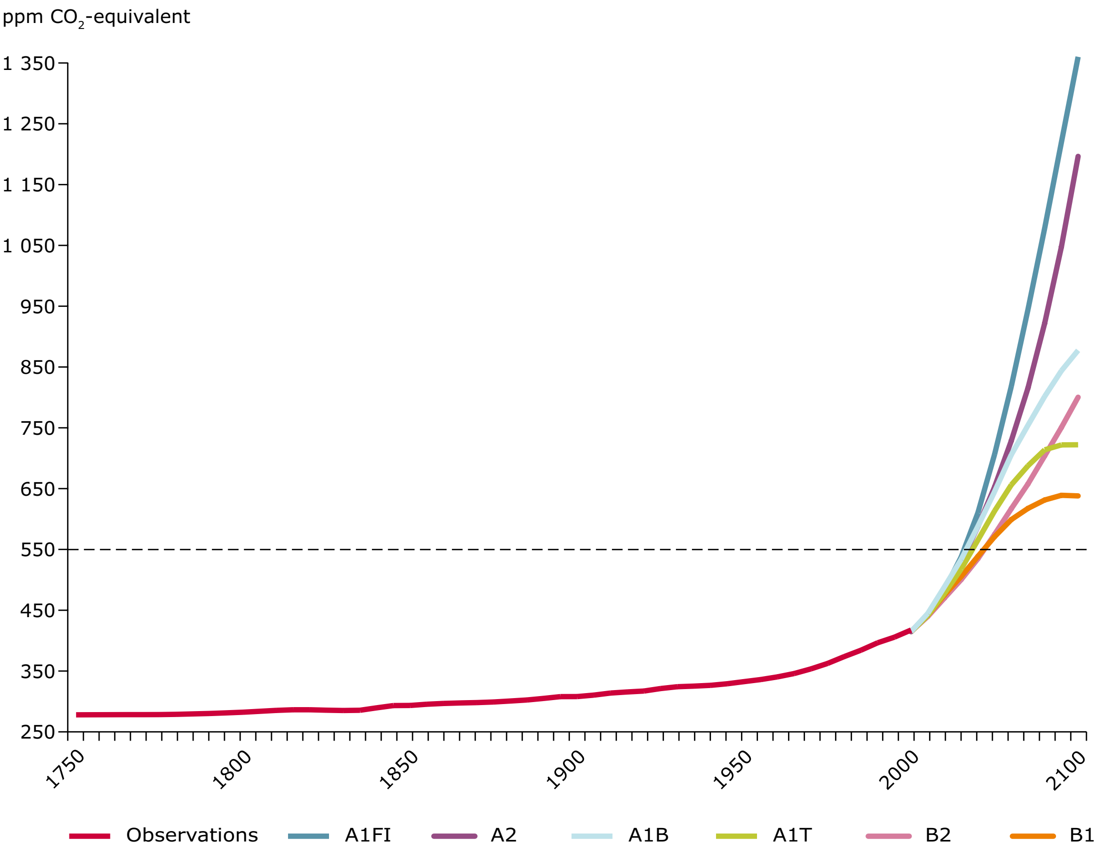
Indicator rationale

The indicator shows the trend in GHG concentrations. It is the key indicator used for international negotiations for future (post-2012) emission reductions. Increase in GHG concentrations is considered to be one of the most important causes of global warming. The increase leads to enhanced radiative forcing and a more intense greenhouse effect, causing the global mean temperature of the earth's surface and lower atmosphere to rise.

Although most of the emissions occur in the northern hemisphere, the use of global average values is justified because the atmospheric lifetime of GHGs is long compared with the timescales of global atmospheric mixing. This leads to a rather uniform mixing around the globe. The indicator also expresses the relative importance of different gases for the enhanced greenhouse effect.

Enhanced GHG concentrations lead to radiative forcing and affect the earth's energy budget and climate system. To express instantaneous disturbance of the earth's radiation budget, both radiative forcing and CO_2-equivalent concentration can be used as an indicator. The CO_2-equivalent concentration is defined as the concentration of CO_2 that would cause the same

Figure 1 Measured and projected concentrations of 'Kyoto' greenhouse gases



Note: Data source: SIO; ALE/GAGE/AGAGE; NOAA/CMDL; IPCC, 2001 (Ref: www.eea.eu.int/coreset).

amount of radiative forcing as the mixture of CO_2 and other GHGs. Here CO_2-equivalent concentrations rather than radiative forcings are presented, because they are more easily understandable by the general public. CO_2-equivalent concentrations can also easily be used to track progress towards the long-term EU climate objective to stabilise GHG concentrations at well below 550 ppm CO_2-equivalent. CFCs and HCFCs are not considered for this indicator, because the EU concentration stabilisation target applies only to the Kyoto GHGs. Increases in GHG concentrations are mostly from emissions from human activities, including the use of fossil fuels for power and heat generation, transport and households, and agriculture and industry.

Policy context

The indicator is aimed at supporting assessment of progress towards the long-term EU target to limit global temperature increase to below 2 °C above pre-industrial levels, and, derived from this, stabilisation of GHG concentrations at well below 550 ppm CO_2-equivalent (Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002, laying down the sixth Community environment action programme, confirmed by the Environment Council conclusions of March 2005).

The ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) is to achieve *stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner*.

To reach the UNFCCC objective, the EU has specified more quantitative targets in its 6th environment action programme (6th EAP) which mentions a long-term EU climate change objective of limiting global temperature rise to a maximum of 2 °C compared with pre-industrial levels. This target was confirmed by the Environment Councils of 20 December 2004 and 22–23 March 2005. According to the Environment Council conclusions of December 2004, stabilisation of concentrations at well below 550 ppm CO_2-equivalent may be needed and global GHG emissions would have to peak within two decades, followed by substantial reductions in the order of at least 15 % and perhaps as much as 50 % by 2050 compared with 1990 levels.

Indicator uncertainty

Global average concentrations since approximately 1980 are determined by averaging measurements from several ground-station networks (SIO, NOAA/CMDL, ALE/GAGE/AGAGE), each consisting of several stations distributed across the globe. The use of global average values is justified because the time-scale at which sources and sinks change is long compared with that of global atmospheric mixing.

Absolute accuracies of global annual average concentrations are in the order of 1 % for CO_2, CH_4 and N_2O, and CFCs; for HFCs, PFCs, and SF_6, absolute accuracies can be up to 10–20 %. However, the year-to-year variations are much more accurate. Radiative forcing calculations have an absolute accuracy of 10 %; trends in radiative forcing are much more accurate.

The dominant sources of error for radiative forcing are the uncertainties in modelling radiative transfer in the earth's atmosphere and in the spectroscopic parameters of the molecules involved. Radiative forcing is calculated using parameterisations that relate the measured concentrations of GHGs to radiative forcing. The overall uncertainty in radiative forcing calculations (all species together) is estimated to be 10 %. Radiative forcing is also expressed as CO_2-equivalent concentration; both have the same uncertainty. The uncertainty in the trend in radiative forcing/CO_2-equivalent concentration is determined by the precision of the method rather than the absolute uncertainty discussed above. The uncertainty in the trend is therefore much less than 10 %, and is determined by the accuracy of concentration measurements (0.1 %).

It is important to note that global warming potentials are not used to calculate radiative forcing. They are used only to compare the time-integrated climate effects of emissions of different GHGs.

Uncertainties in model projections are related to uncertainties in the emission scenarios, the global climate models and the data and assumptions used.

Direct measurements have good comparability. Although methods for calculating radiative forcing and CO_2-equivalent are expected to improve further, any update of these methods will be applied to the complete dataset covering all years, so this will not affect the comparability of the indicator over time.

14 Land take

Key policy question

How much and in what proportions is agricultural, forest and other semi-natural and natural land being taken for urban and other artificial land development?

Key message

Land take by the expansion of artificial areas and related infrastructure is the main cause of the increase in the coverage of land at the European level. Agricultural zones and, to a lesser extent, forests and semi-natural and natural areas, are disappearing in favour of the development of artificial surfaces. This affects biodiversity since it decreases habitats, the living space of a number of species, and fragments the landscapes that support and connect them.

Indicator assessment

The largest land-cover category being taken by urban and other artificial land development (average for 23 European countries) is agriculture land. During 1990–2000, 48 % of all areas that changed to artificial surfaces were arable land or permanent crops. This process is particularly important in Denmark (80 %) and Germany (72 %). Pastures and mixed farmland are, on average, the next category being taken, representing 36 % of the total. However, in several countries or regions, these landscapes are the major source for land take (in a broad sense), for example in Ireland (80 %) and the Netherlands (60 %).

The proportion of forested and natural land taken for artificial development during the period is important in Portugal (35 %), Spain (31 %) and Greece (23 %).

Specific policy question: What are the drivers of uptake for urban and other artificial land development?

At the European level, housing, services and recreation make up half of the overall increase in urban and other artificial areas between 1990 and 2000. But the situation varies from countries with proportions of new land take for housing, services and recreation higher than 70 % (Luxembourg and Ireland) to countries such as Greece (16 %) and Poland (22 %) where urban development is due mainly to industrial/commercial activity.

Industrial/commercial sites is the next sector responsible for land take, with 31 % of the average European new land uptake during the period. However, this sector is taking the largest proportion of new uptake in Belgium (48 %), Greece (43 %) and Hungary (32 %).

Land take for mines, quarries and waste dumpsites was relatively important in countries with low artificial land take from 1990–2000 as well as in Poland (43 %) where mines are a key sector of the economy. At the European level, the percentage of the total new land take for mines, quarries and waste dumpsites is 14 %.

Land take for transport infrastructures (3.2 % of the total new artificial cover) is underestimated in surveys that are based on remote-sensing such as Corine land cover (CLC). Land take by linear features such as roads and railways is not included in the statistics, which focus only on area infrastructures (e.g. airports and harbours). Soil sealing and fragmentation by linear infrastructures therefore need to be observed by different means.

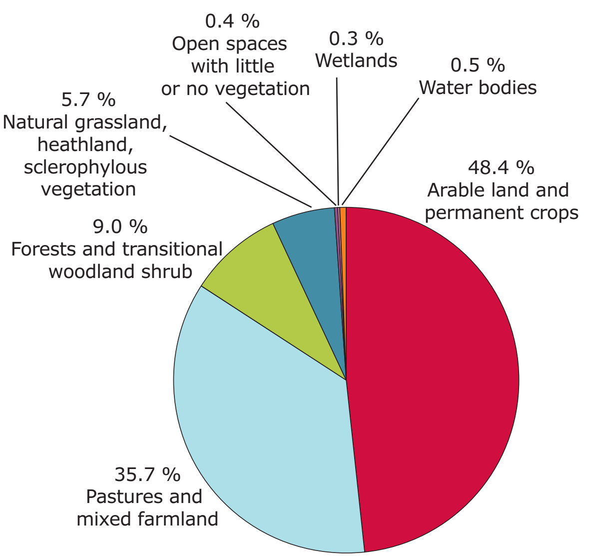
Specific policy question: Where have the more important artificial land uptakes occurred?

Land uptake by urban and other artificial development in the 23 European countries covered by Corine Land Cover 2000 amounted to 917 224 hectares in 10 years. It represents 0.3 % of the total territory of these countries. This may seem low, but spatial differences are very important and urban sprawl in many regions is very intense.

Considering the contribution of each country to new total urban and infrastructure sprawl in Europe, mean annual values range from 22 % (Germany) to 0.02 % (Latvia), with intermediate values in France (15 %), Spain (13.3 %) and Italy (9.1 %). Differences between countries are strongly related to their size and population density (Figure 3).

The pace of land take observed by comparing it with the initial extent of urban and other artificial areas in 1990 gives another picture (Figure 4). From this perspective, the average value in the 23 European countries covered by CLC2000 ranges up to an annual increase of 0.7 %. Urban development is fastest in Ireland (3.1 % increase in urban area per year), Portugal (2.8 %), Spain (1.9 %) and the Netherlands (1.6 %). However, this comparison reflects different initial conditions. For example, Ireland had a very small amount of urban area in 1990 and the Netherlands one of the largest in Europe. Urban sprawl in EU-10 is generally lower than in the EU-15 countries, in absolute and relative terms.

Figure 1 **Relative contribution of land-cover categories to uptake by urban and other artificial land development**



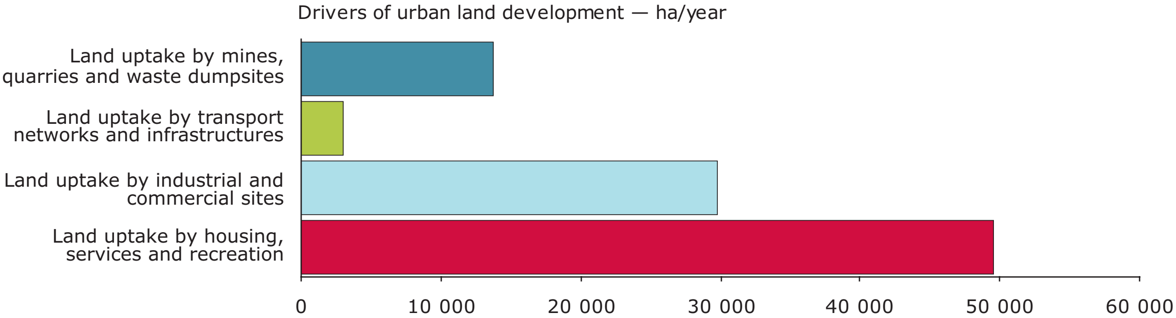
Note: Data source: Land and ecosystems accounts, based on Corine land cover database (Ref: www.eea.eu.int/coreset).

Indicator definition

Increase in the amount of agriculture, forest and other semi-natural and natural land taken by urban and other artificial land development. It includes areas sealed by construction and urban infrastructure as well as urban green areas and sport and leisure facilities. The main drivers of land take are grouped in processes resulting in the extension of:

- housing, services and recreation,
- industrial and commercial sites,
- transport networks and infrastructures, and
- mines, quarries and waste dumpsites.

Figure 2 **Land take by several types of human activity per year in 23 European countries, 1990–2000**

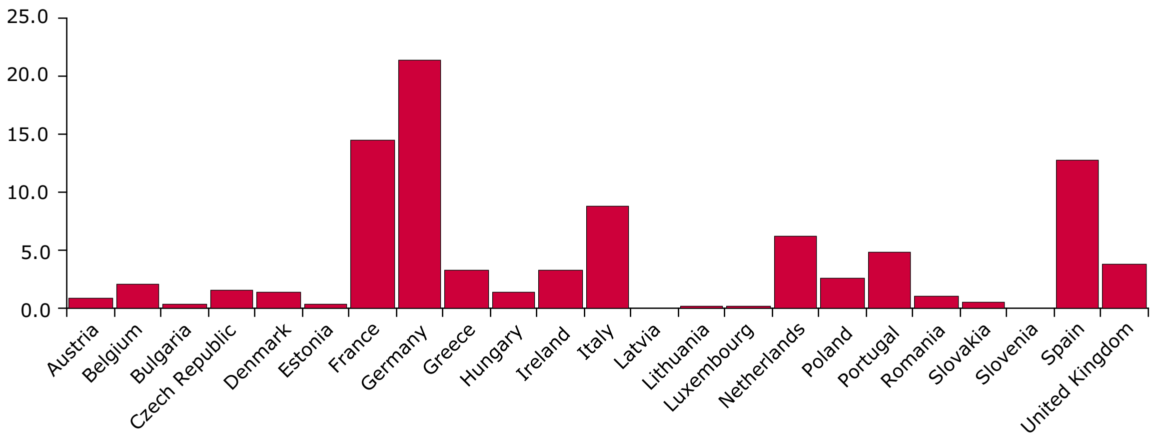


Note: Data source: Land and ecosystems accounts, based on Corine land cover database (Ref: www.eea.eu.int/coreset).

Indicator rationale

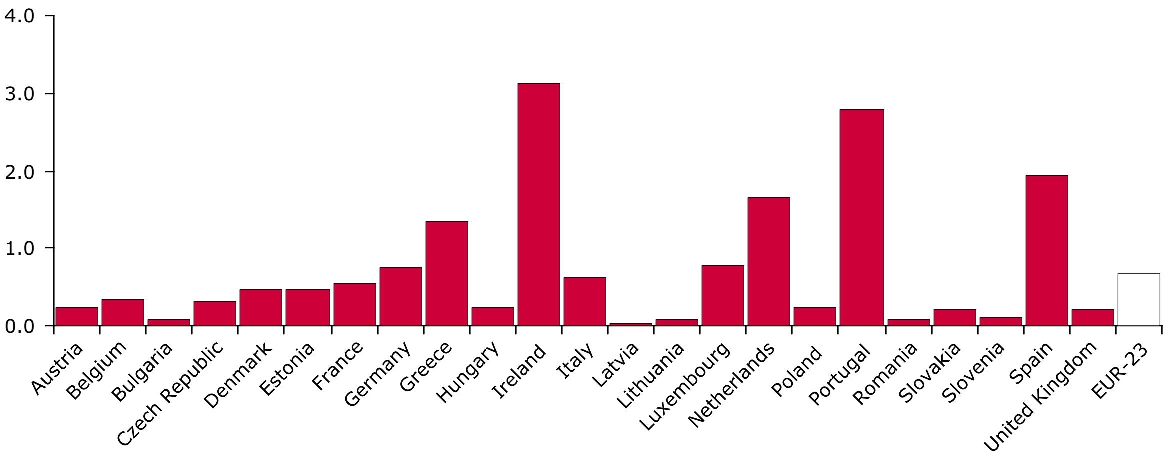
Land use by urban and related infrastructures has the highest impacts on the environment due to sealing of soil as well as disturbances resulting from transport, noise, resource use, waste dumping and pollution. Transport networks which connect cities add to the fragmentation and degradation of the natural landscape. The intensity and patterns of urban sprawl are the result of three main factors: economic development, demand for housing and extension of transport networks. Although subsidiarity rules assign land and urban planning responsibilities to national and regional levels, most European policies have a direct or indirect effect on urban development.

Figure 3 **Mean annual urban land take as a percentage of total Europe-23 urban land take 1990–2000**



Note: Data source: Land and ecosystems accounts based on Corine land cover database (Ref: www.eea.eu.int/coreset).

Figure 4 **Mean annual urban land take 1990–2000 as a percentage of 1990 artificial land**



Note: Data source: Land and ecosystems accounts, based on Corine land cover database (Ref: www.eea.eu.int/coreset).

Built-up areas have been increasing steadily all over Europe for ten years, continuing the trend observed during the 1980s. The same is true for transport infrastructures, as a result of rising living standards, people living further from work, liberalisation of the EU internal market, globalisation of the economy, and more complex chains and networks of production. Increasing prosperity is increasing the demand for second homes. The growth in demand for land, both for building and for new transport infrastructure, is continuing.

Policy context

The main policy objective of this indicator is to measure the pressure from the development of urban and other artificial land on natural and managed landscapes that are necessary 'to protect and restore the functioning of natural systems and halt the loss of biodiversity' (included in the 6th environment action programme).

Important references can be found in the 6th Environment Action Programme (6EAP, COM (2001) 31) and the thematic documents related to it, such as the Commission Communication 'Towards a Thematic Strategy on the Urban Environment' (COM (2004) 60), the EU Strategy for Sustainable Development (COM (2001) 264), the new general regulation for the Structural Funds (Council Regulation EC no 1260/1999), the guidelines for INTERREG III (published on 23/05/2000 (OJ C 143)) and the ESDP Action programme and ESPON guidelines for 2001–2006.

There are no quantitative targets for land take for urban development at the European level, although different documents reflect the need for better planning of urban development and the extension of infrastructures.

Indicator uncertainty

Surfaces monitored with Corine land cover relate to the extension of urban systems that may include parcels not covered by construction, streets or other sealed surfaces. This is particularly the case for discontinuous urban fabric, which is considered as a whole. Monitoring the indicator with satellite images leads to the exclusion of small urban features in the countryside and most of the linear transport infrastructures, which are too narrow to be observed directly. Therefore, differences exist between CLC results and other statistics collected with different methodologies such as point or area sampling or farm surveys; this is often the case for agriculture and forest statistics. However, the trends are generally similar.

Geographical and time coverage at the EU level

All the EU-25 (except Sweden, Finland, Malta and Cyprus) as well as Bulgaria and Romania are covered with both '1990' and 2000 results. '1990' refers to the first experimental phase of CLC, which ran from 1986 up to 1995. 2000 is considered to be a reasonable characterisation (a few satellite images only being from 1999 or 2001, for cloud coverage reasons). Comparisons between countries therefore have to be done on the basis of annual mean values. The average number of years between two CLCs in each country can be seen in Table 1.

Representativeness of data at the national level

At the national level, there may be time differences between regions in large countries and these are documented in the CLC metadata.

Table 1 Average number of years between two CLCs per country

AT	BE	BG	CZ	DE	DK	EE	ES	FR	GR	HU	IE	IT	LT	LU	LV	NL	PL	PT	RO	SI	SK	UK
15	10	10	8	10	10	6	14	10	10	8	10	10	5	11	5	14	8	14	8	5	8	10

15 Progress in management of contaminated sites

Key policy question

How are the problems of contaminated sites being addressed (clean-up of historical contamination and prevention of new contamination)?

Key message

Several economic activities are still causing soil pollution in Europe, particularly those related to inadequate waste disposal and losses during industrial operations. In the coming years, the implementation of preventive measures introduced by the legislation already in place is expected to limit inputs of contaminants into the soil. As a consequence, most of the future management efforts will be concentrated on the clean-up of historical contamination. This is going to require large sums of public money which currently already accounts for an average of 25 % of total remediation expenditure.

Indicator assessment

The major localised sources of soil contamination in Europe derive from the inadequate disposal of waste, losses during industrial and commercial operations, and the oil industry (extraction and transport). However, the range of polluting activities and their importance may vary considerably from country to country. These variations may reflect different industrial and commercial structures, different classification systems or incomplete information.

A broad range of industrial and commercial activities have produced impacts on soil through the release of a broad variety of pollutants. The main contaminants causing soil contamination from local sources at industrial and commercial sites are reported to be heavy metals, mineral oil, polycyclic aromatic hydrocarbons (PAH), and chlorinated and aromatic hydrocarbons. Globally, these alone affect 90 % of the sites for which information on contaminants is available, while their relative contribution may vary greatly from country to country.

The implementation of existing legislative and regulatory frameworks (such as the Integrated Pollution Prevention and Control Directive and the Landfill Directive) should result in less new contamination of soil. However, large amounts of time and financial resources from the private and the public sector are still needed to deal with historical contamination. This is a tiered process, where the final steps (remediation) involve much larger resources than the first steps (site investigations).

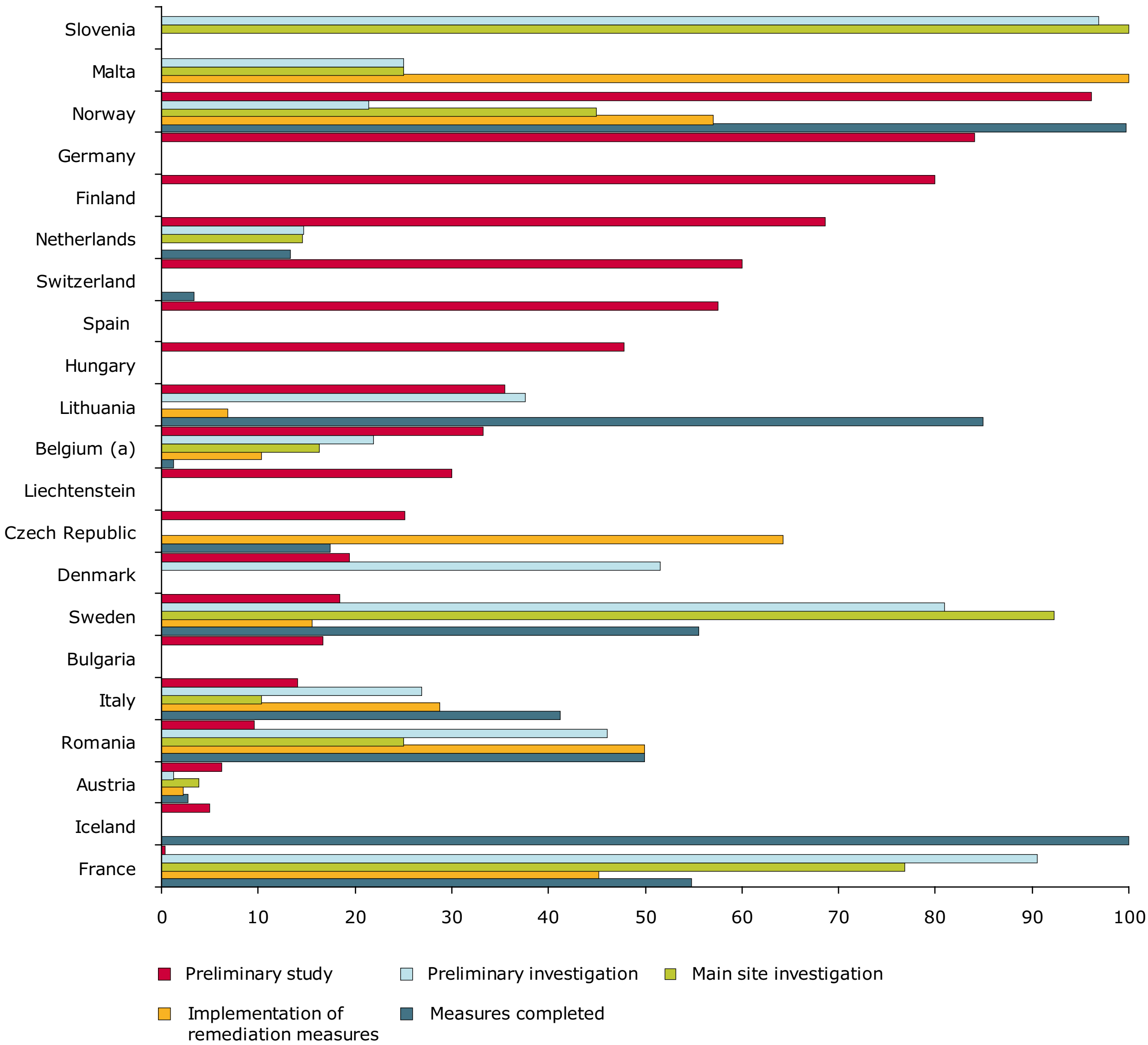
In most of the countries for which data are available, site identification activities are generally far advanced, while detailed investigations and remediation activities are generally progressing slowly (Figure 1). However, progress in management may vary considerably from country to country.

The progress in each country (i.e. the numbers of sites treated in each management step) cannot be compared directly, due to different legal requirements and different degrees of industrialisation, and local conditions and approaches. For example, a large percentage of completed remediations compared with the estimated remediation needs in some countries could be interpreted as a well-advanced management process. However, surveys in these countries are also usually incomplete, which generally results in an underestimation of the problem.

Although most of the countries in Europe have legislative instruments which apply the 'polluter-pays' principle to the clean-up of contaminated sites, large sums of public money — on average 25 % of total costs — have to be provided to fund the necessary remediation activities. This is a common trend across Europe (Figure 2). Annual expenditures on the full clean-up process in the countries analysed in the period 1999–2002 varied from less than EUR 2 to EUR 35 per capita per year.

Although a considerable amount of money has already been spent on remediation, this is relatively little (up to 8 %) compared with the estimated total costs.

Figure 1 **Overview of progress in control and remediation of soil contamination by country**

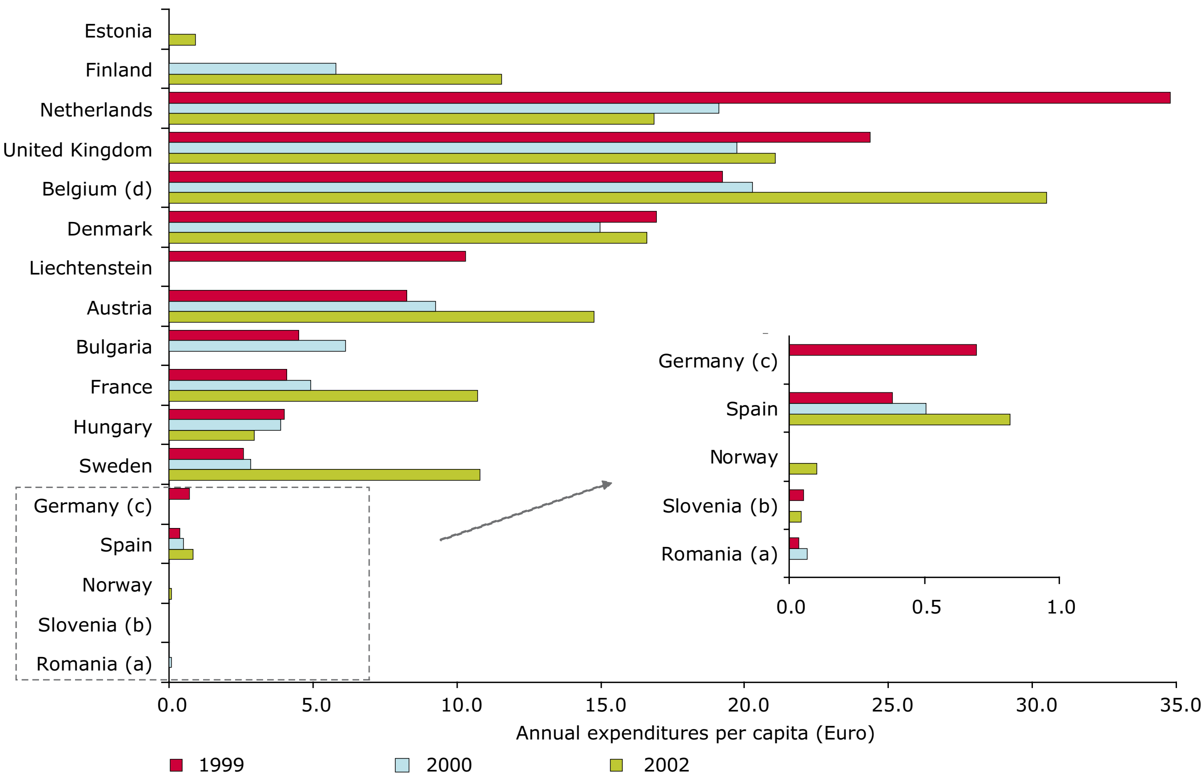


a) Data for Belgium refer to Flanders.

Note: Information on 'remediation completed' has not been included. Missing information indicates that no data have been reported for the particular country.

Data source: Eionet priority data flow; September 2003. 1999 and 2000 data: for EU countries and Liechtenstein: pilot Eionet data flow; January 2002; for accession countries: data request to new EEA member countries, February 2002 (Ref: www.eea.eu.int/coreset).

Figure 2 **Annual expenditure on contaminated site remediation by country**



a) Romania: data from 1997 and 2000.
b) Slovenia: data from 1999 and 2001.
c) Germany: projection from estimates of expenditures from some of the 'Länder'.
d) Data for Belgium refer to Flanders.

Note: Data source: (Ref: www.eea.eu.int/coreset).

Indicator definition

The term 'contaminated site' refers to a delimited area where the presence of soil contamination has been confirmed and the severity of possible impacts on ecosystems and human health are such that remediation is needed, specifically in relation to the current or planned use of the site. The remediation or clean-up of contaminated sites can result in full elimination or a reduction of these impacts.

The term 'potentially contaminated site' includes any site where soil contamination is suspected but not verified and investigations are needed to verify whether relevant impacts exist.

The management of contaminated sites is a tiered process, designed to ameliorate any adverse effects where impairment of the environment is suspected or has been proved, and to minimise any potential threats (to human health, water bodies, soil, habitats, foodstuffs, biodiversity, etc.). The management of a site starts with a basic survey and investigation, which may lead to remediation, after-care measures and brown-field redevelopment.

Indicator rationale

Emissions of dangerous substances from local sources may have far-reaching effects on the quality of soil and water, particularly groundwater, with important impacts on human and ecosystem health.

A number of economic activities causing soil pollution can be clearly identified across Europe. These relate, in particular, to losses during industrial operations and waste disposal from municipal and industrial sources. Management of contaminated sites aims at assessing the impacts of contamination by local sources and taking measures to satisfy environmental standards according to existing legal requirements.

The indicator tracks progress in the management of contaminated sites in Europe and related expenditures by the public and private sectors. It also shows the contributions of the main economic activities responsible for soil contamination and the major pollutants involved.

Policy context

The main policy objective of legislation aimed at protecting soil from contamination from local sources is to achieve a quality of the environment where the levels of contaminants do not give rise to significant impacts or risks to human health.

At the European level, remediation and prevention of soil contamination will be addressed by the forthcoming soil thematic strategy (STS). Existing EU legislation addresses the protection of water and sets standards for water quality, whereas no legal standards for soil quality exist or are likely to be established in the near future. Nevertheless, specific standards for soil quality and policy targets have been put in place in several EEA member countries. In general, legislation aims at preventing new contamination and setting targets for the remediation of sites where environmental standards have already been exceeded.

Indicator uncertainty

The information provided by this indicator has to be interpreted and presented with caution, due to uncertainties in methodology and problems of data comparability.

There are no common definitions of contaminated sites across Europe, which creates problems when comparing national data to produce European assessments. For this reason, the indicator focuses on the impacts of the contamination and progress in management, rather than on the extent of the problem (e.g. number of contaminated sites). Comparability of national data is expected to improve as common EU definitions are introduced in the context of the STS.

In reporting progress against a national baseline (number of sites expected) some countries may change their estimates in successive years. This may depend on the status of completion of national inventories (e.g. not all sites are included at the beginning of registration, but the number of sites may increase dramatically after more accurate screening; the reverse has also been observed due to changes in national legislation).

Moreover, cost estimates for remediation are difficult to obtain, especially from the private sector, and little information on quantities of contaminants is available.

Insufficiently clear methodology and data specifications may have resulted in countries interpreting requests for data in different ways and may therefore result in not fully comparable information. This is expected to improve in the future as better specifications and documentation of the methodology is provided.

Not all countries have been included in the calculations of the indicator (due to the unavailability of national data). The data available do not allow the evaluation of time trends. Most of the data integrates information from the whole country. However the process differs from country to country, depending on the degree of decentralisation. In general, data quality and representativeness increase with centralisation of the information (national registers).

16 Municipal waste generation

Key policy question

Are we reducing the generation of municipal waste?

Key message

The generation of municipal waste per capita in western European ([1]) countries continues to grow while remaining stable in central and eastern European ([2]) countries.

The EU target to reduce municipal waste generation to 300 kg/capita/year by 2000 was not achieved. No new targets have been set.

Indicator assessment

One of the targets set in the 5th environment action programme was to reduce the generation of municipal waste per capita per year to the average 1985 EU level of 300 kg by the year 2000 and then stabilise it at that level. The indicator (Figure 1) shows that the target is far from being reached. The target has not been repeated in 6th EAP.

The average amount of municipal waste generated per capita per year in many western European countries has reached more than 500 kg.

Municipal waste generation rates in central and eastern Europe are lower than in western European countries and generation is decreasing slightly. Whether this is due to different consumption patterns or underdeveloped municipal waste collection and disposal systems needs further clarification. Reporting systems also need further development.

Indicator definition

The indicator presents municipal waste generation, expressed in kg per person per year. Municipal waste refers to waste collected by or on behalf of municipalities; the main part originates from households, but waste from commerce and trade, office buildings, institutions and small businesses is also included.

Indicator rationale

Waste represents an enormous loss of resources in the form of both materials and energy. The amount of waste produced can be seen as an indicator of how efficient we are as a society, particularly in relation to our use of natural resources and waste treatment operations.

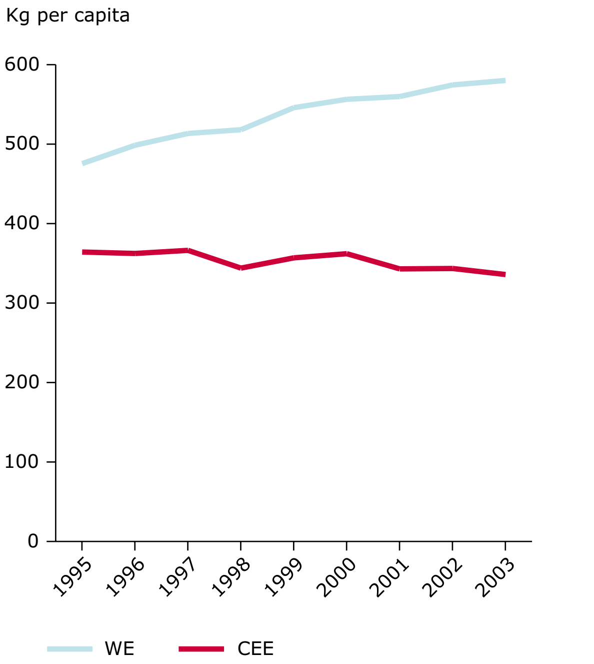
Municipal waste is currently the best indicator available for describing the general development of waste generation and treatment in European countries. This is because all countries collect data on municipal waste; data coverage for other waste, for example total waste or household waste, is more limited.

Municipal waste constitutes only around 15 % of total waste generated, but because of its complex character and its distribution among many waste generators, environmentally sound management of this waste is complicated. Municipal waste contains many materials for which recycling is environmentally beneficial.

Despite its limited share of total waste generation, the political focus on municipal waste is very high.

([1]) Western European countries are the EU-15 countries + Norway and Iceland.
([2]) Central and eastern European countries are the EU-10 + Romania and Bulgaria.

Figure 1 **Municipal waste generation in western European (WE) and central and eastern European (CEE) countries**



Note: Data source: Eurostat, World Bank (Ref: www.eea.eu.int/coreset).

Policy context

EU 6th environment action programme:

- Better resource efficiency and resource and waste management to bring about more sustainable production and consumption patterns, thereby decoupling the use of resources and the generation of waste from the rate of economic growth and aiming to ensure that the consumption of renewable and non-renewable resources does not exceed the carrying capacity of the environment.

- Achieving a significant overall reduction in the volumes of waste generated through waste prevention initiatives, better resource efficiency and a shift towards more sustainable production and consumption patterns.

- A significant reduction in the quantity of waste going to disposal and the volumes of hazardous waste produced while avoiding an increase in emissions to air, water and soil.

- Encouraging reuse. Preference should be given to recovery, and especially to recycling, of waste that are still generated.

EU waste strategy (Council Resolution of 7 May 1990 on waste policy):

- Where the production of waste is unavoidable, recycling and reuse of waste should be encouraged.

Communication from the Commission on the review of the Community strategy for waste management (COM(96) 399):

- There is considerable potential for reducing and recovering municipal waste in a more sustainable fashion, for which new targets need to be set.

This indicator is one of the structural indicators and is used for monitoring the Lisbon Strategy.

Target

The EU 5th EAP had a target of 300 kg household waste per capita per year, but no new targets have been set in the 6th EAP because of very little success with the 300 kg target. The target is therefore no longer relevant and is used here only for illustration purposes.

Indicator uncertainty

If no data on waste generation are available for a particular country and year, estimates are made by Eurostat to fill the gap, based on the linear best-fit method.

Table 1 **Municipal waste generation in western European (WE) and central and eastern European (CEE) countries**

Western Europe (municipal waste generation in kg per capita)									
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Austria	437	516	532	533	563	579	577	611	612
Belgium	443	440	474	470	475	483	461	461	446
Denmark	566	618	587	593	626	664	660	667	675
Finland	*413*	*410*	447	466	484	503	465	456	450
France	500	509	516	523	526	537	544	555	*560*
Germany	533	542	556	546	605	609	600	640	638
Greece	306	344	372	388	405	421	430	436	441
Ireland	513	*523*	*545*	554	*576*	598	700	695	*735*
Italy	451	452	463	466	492	502	510	519	*520*
Luxembourg	585	582	600	623	644	651	648	*653*	*658*
Netherlands	548	562	588	591	597	614	610	613	598
Portugal	391	404	410	428	432	447	462	454	461
Spain	*469*	*493*	*513*	526	570	587	590	587	*616*
Sweden	*379*	*397*	416	430	428	428	442	468	470
United Kingdom	433	510	531	541	569	576	590	599	610
Iceland	914	933	949	967	975	993	1 011	1 032	1 049
Norway	624	630	617	645	594	613	634	675	695
Western Europe	476	499	513	518	546	556	560	575	580
Central and eastern Europe (municipal waste generation in kg per capita)									
Bulgaria	694	618	579	497	504	517	506	501	501
Cyprus	529	571	582	599	607	620	644	654	672
Czech Republic	*302*	310	318	293	327	334	274	279	280
Estonia	371	399	424	402	414	462	353	386	420
Hungary	465	474	494	492	491	454	452	457	*464*
Latvia	261	261	254	248	244	271	302	370	363
Lithuania	426	401	422	444	350	310	300	288	263
Malta	*331*	*342*	*352*	377	461	481	545	471	547
Poland	285	301	315	306	319	316	287	275	260
Romania	342	326	326	278	315	355	336	375	*357*
Slovak Republic	339	348	316	315	315	316	390	283	*319*
Slovenia	*596*	*590*	*589*	584	*549*	*513*	482	487	458
Central and eastern Europe	364	362	366	344	357	362	343	343	336

Note: Italics — estimates.

Data source: Eurostat, World Bank (Ref: www.eea.eu.int/coreset).

Because of different definitions of the concept 'municipal waste' and the fact that some countries have reported data on municipal waste and others on household waste, data are in general not comparable between member countries. Thus, Finland, Greece, Ireland, Norway, Portugal, Spain and Sweden do not include data on bulky waste as part of municipal waste, and very often not data on separately collected food and garden waste. Southern European countries in general include very few waste types under municipal waste, indicating that traditionally collected (bagged) waste is apparently the only big contributor to the total amount of municipal waste in these countries. The term, 'waste from household and commercial activities' is an attempt to identify common and comparable parts of municipal waste. This concept and further details on comparability were presented in EEA topic report No 3/2000.

17 Generation and recycling of packaging waste

Key policy question

Are we preventing the generation of packaging waste?

Key message

There is a general increase in per capita quantities of packaging being put on the market. This is not in line with the primary objective of the Directive on Packaging and Packaging Waste, which aims at preventing the production of packaging waste.

However, the EU target to recycle 25 % of packaging waste in 2001 has been significantly exceeded. In 2002 the recycling rate in the EU-15 was 54 %.

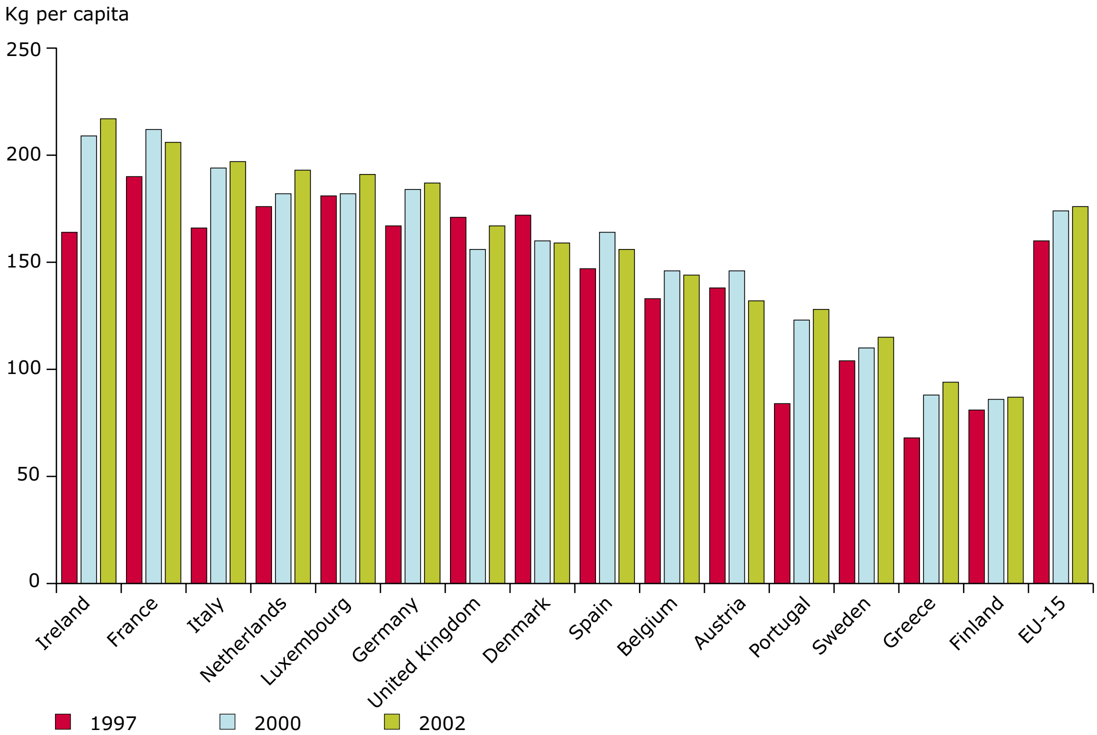
Indicator assessment

Only the United Kingdom, Denmark and Austria have reduced their per capita generation of packaging waste since 1997; in the remaining countries, the quantities have increased. However the 1997 data are less certain than those for later years, due to first-year problems of newly established data collection systems, which in turn may influence the apparent trends.

Between 1997 and 2002 the growth in packaging waste generation in the EU-15 almost followed the growth in GDP: generation increased by 10 % and GDP by 12.6 %.

There are large variations between Member States in the use of packaging per capita, ranging from

Figure 1 **Packaging waste generation per capita and by country**



Note: Data source: DG Environment and the World Bank (Ref: www.eea.eu.int/coreset).

87 kg/capita in Finland to 217 kg/capita in Ireland (2002). The average 2002 figure for the EU-15 was 172 kg/capita. This variation can be partly explained by the fact that Member States have differing definitions of packaging and understanding of which types of packaging waste need to be reported to DG Environment. This illustrates the need to harmonise the methodology for reporting data in accordance with the directive on packaging and packaging waste.

The target of 25 % recycling of all packaging materials in 2001 was achieved by a good margin in virtually all countries. Seven Member States already comply with the overall recycling target for 2008, when not taking the 'new' material, wood, into account. The total EU-15 recycling rate increased from 45 % in 1997 to 54 % in 2002.

As with consumption of packaging per capita, the total recycling rate in Member States in 2002 varied greatly, from 33 % in Greece to 74 % in Germany.

To achieve these targets, several Member States have introduced producer responsibility and established packaging recycling companies. Other countries have improved their existing collection and recycling system.

Figure 2 **Generation of packaging waste and GDP in the EU-15**

Note: Data source: DG Environment and Eurostat (Ref: www.eea.eu.int/coreset).

Indicator definition

The indicator is based on total packaging used in EU Member States expressed as kg per capita per year. The amount of packaging used is expected to equal the amount of packaging waste generated. This assumption is based on the short lifetime of packaging.

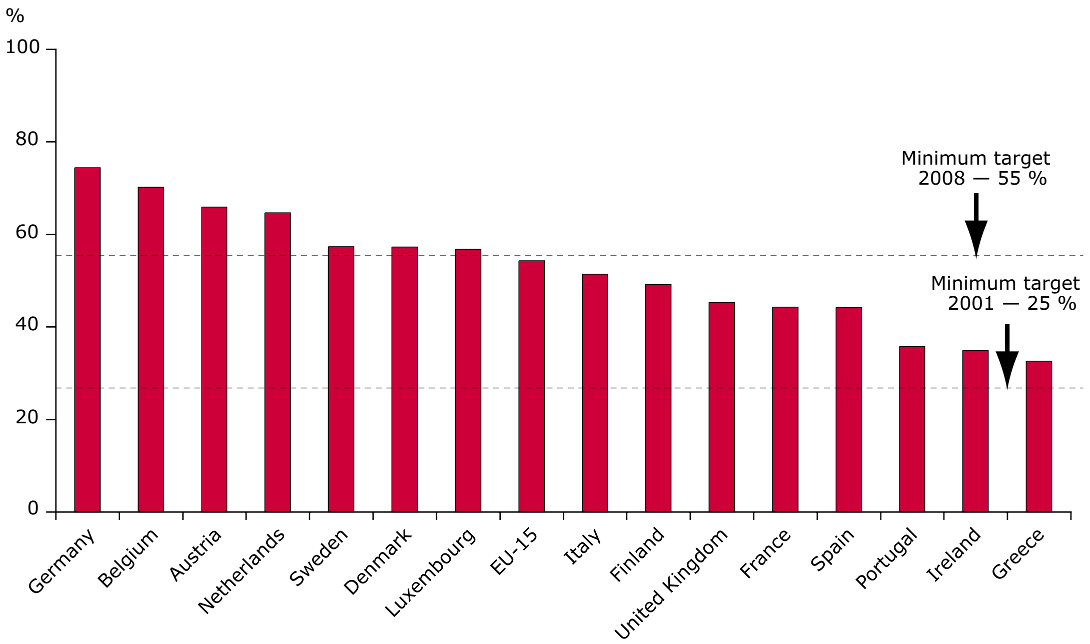
Packaging waste recycled as a share of packaging used in EU Member States is derived by dividing the quantity of packaging waste recycled by the total quantity of packaging waste generated and expressing this as a percentage.

Indicator rationale

Packaging uses a lot of resources, and typically has a short lifetime. There are environmental impacts from the extraction of resources, production of the packaging, collection of packaging waste and treatment or disposal of the waste.

Packaging waste is covered by specific EU regulations and there are specific targets for recycling and recovery. Information on the amounts of packaging waste generated therefore provides an indicator of the effectiveness of waste prevention policies.

Figure 3 **Recycling of packaging waste by country, 2002**



Note: Data source: DG Environment (Ref: www.eea.eu.int/coreset).

Table 1 **Packaging waste generation per capita and by country**

	1997	1998	1999	2000	2001	2002
Ireland	164	184	187	209	212	217
France	190	199	205	212	208	206
Italy	166	188	193	194	195	197
Netherlands	176	161	164	182	186	193
Luxembourg	181	181	182	182	181	191
Germany	167	172	178	184	182	187
United Kingdom	171	175	157	156	158	167
Denmark	172	158	159	160	161	159
Spain	147	159	155	164	146	156
Belgium	133	140	145	146	138	144
Austria	138	140	141	146	137	132
Portugal	84	102	120	123	127	128
Sweden	104	108	110	110	114	115
Greece	68	76	81	88	92	94
Finland	81	82	86	86	88	87
EU-15	160	168	169	174	172	176

Note: Data source: DG Environment and the World Bank (see Figure 1) (Ref: www.eea.eu.int/coreset).

Table 2 **Targets of the packaging and packaging waste directive**

By weight	Targets in 94/62/EC	Targets in 2004/12/EC
Overall recovery target	Min. 50 %, max. 65 %	Min. 60 %
Overall recycling target	Min. 25 %, max. 45 %	Min. 55 %, max. 80 %
Date to achieve targets	30 June 2001	31 December 2008

Policy context

Council Directive 94/62 of 15 December 1994 on packaging and packaging waste as amended by Directive 2004/12 of 11 February 2004 establishes targets for recycling and recovery of selected packaging materials.

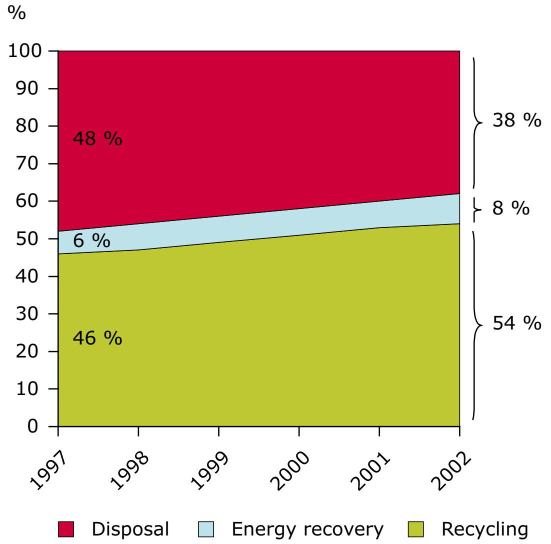
The EU 6th environment action programme aims to achieve a significant overall reduction in the volumes of waste generated. This will be done through waste prevention initiatives, better resource efficiency, and a shift towards more sustainable production and consumption patterns. The 6th EAP also encourages reuse, recycling and recovery rather than disposal of waste that is still being generated.

Indicator uncertainty

The Commission decision of 3 February 1997 establishes the formats which Member States are to use in annual reporting on the directive on packaging and packaging waste. However, the decision does not define methods of estimating the quantities of packaging put on the market or calculating the recovery and recycling rates in enough detail to ensure full data comparability.

Due to the absence of harmonised methodology, national data on packaging waste are not always comparable. Some countries include all packaging waste in the figure for total packaging waste generation while others include only the total for the four obligatory packaging waste streams: glass, metal, plastics and paper.

Figure 4 **Treatment of packaging waste**



Note: Data source: DG Environment (Ref: www.eea.eu.int/coreset).

18 Use of freshwater resources

Key policy question

Is the abstraction rate of water sustainable?

Key message

The water exploitation index (WEI) decreased in 17 EEA countries between 1990 and 2002, representing a considerable decrease in total water abstraction. But nearly half of Europe's population still lives in water-stressed countries.

Indicator assessment

The warning threshold for the water exploitation index (WEI), which distinguishes a non-stressed from a stressed region, is around 20 %. Severe water stress can occur where the WEI exceeds 40 %, indicating unsustainable water use.

Eight European countries can be considered water-stressed, i.e. Germany, England and Wales, Italy, Malta, Belgium, Spain, Bulgaria and Cyprus, representing 46 % of Europe's population. Only in Cyprus does the WEI exceed 40 %. However, it is necessary to take into account the high water abstraction for non-consumptive uses (cooling water) in Germany, England and Wales, Bulgaria and Belgium. Most of the water abstracted in the other four countries (Italy, Spain, Cyprus and Malta) is for consumptive uses (especially irrigation) and there is therefore higher pressure on water resources in these four countries.

The WEI decreased in 17 countries during the period 1990 to 2002, representing a considerable decrease in total water abstraction. Most of the decrease occurred in the EU-10, as a result of the decline in abstraction in most economic sectors. This trend was the result of institutional and economic changes. However, five countries (the Netherlands, the United Kingdom, Greece, Portugal, and Turkey) increased their WEI in the same period because of the increase in total water abstraction.

All economic sectors need water for their development. Agriculture, industry and most forms of energy production are not possible if water is not available. Navigation and a variety of recreational activities also depend on water. The most important uses, in terms of total abstraction, have been identified as urban (households and industry connected to the public water supply system), industry, agriculture and energy (cooling of power plants). The main water consumption sectors are irrigation, urban, and the manufacturing industry.

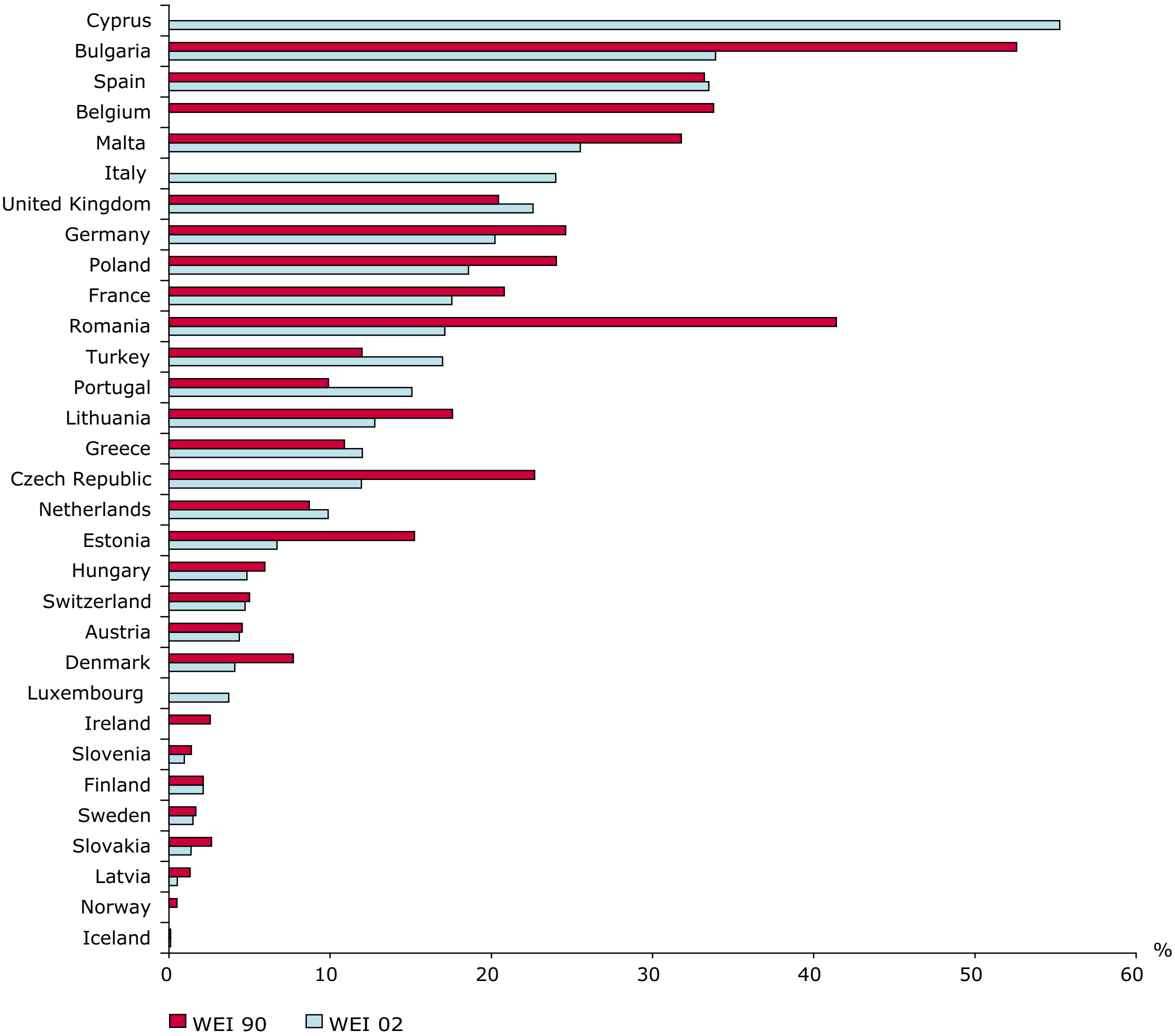
Southern European countries use the largest percentages of abstracted water for agriculture, generally accounting for more than two-thirds of total abstraction. Irrigation is the most significant use of water in the agriculture sector in these countries. Central and Nordic countries use the largest percentages of abstracted water for cooling in energy production, industrial production and public water supply.

The decrease in agricultural and industrial activities in the EU-10 and Romania and Bulgaria during the transition process led to decreases of about 70 % in water abstraction for agricultural and industrial uses in most of the countries. Agricultural activities reached their minima around the mid-1990s but more recently countries have been increasing their agricultural production.

Water use for agriculture, mainly irrigation, is on average four times higher per hectare of irrigated land in southern Europe than elsewhere. The water abstraction for irrigation in Turkey increased, and the increase in the area of irrigated land exacerbated the pressure on water resources; this trend is expected to continue with new irrigation projects.

Data show a decreasing trend in water use for public water supply in most countries. This trend is more pronounced in the EU-10 and Bulgaria and Romania, with a 30 % reduction during the 1990s. In most of these countries, the new economic conditions led to water supply companies increasing the price of water and installing water meters in houses. This resulted

Figure 1 **Water exploitation index. Total water abstraction per year as a percentage of long-term freshwater resources in 1990 and 2002**



Note: 1990 = 1991 for Germany, France, Spain and Latvia;
1990 = 1992 for Hungary and Iceland;
2002 = 2001 for Germany, the Netherlands, Bulgaria and Turkey;
2002 = 2000 for Malta;
2002 = 1999 for Luxembourg, Finland and Austria;
2002 = 1998 for Italy and Portugal;
2002 = 1997 for Greece.

Belgium and Ireland 1994 data and Norway 1985 data.

Data source: EEA based on data from Eurostat data tables (Ref: www.eea.eu.int/coreset): renewable water resources (million m³/year), LTAA and annual water abstraction by source and by sector (million m³/year), total freshwater abstraction (surface and groundwater).

in people using less water. Industries connected to the public systems also reduced their industrial production and hence their water use. However the supply network in most of these countries is obsolete and losses in distribution systems require high abstraction volumes to maintain supply.

Water abstracted for cooling in energy production is considered a non-consumptive use and accounts for around 30 % of all water use in Europe. The western European countries and the central and northern countries of eastern Europe are the largest users of water for cooling; in particular more than half of water abstracted in Belgium, Germany and Estonia is used for this purpose.

Indicator definition

The water exploitation index (WEI) is the mean annual total abstraction of freshwater divided by the mean annual total renewable freshwater resource at the country level, expressed in percentage terms.

Indicator rationale

Monitoring the efficiency of water use by different economic sectors at the national, regional and local level is important for ensuring that rates of extraction are sustainable over the long term, an objective of the EU's sixth environment action programme (2001–2010).

Water abstraction as a percentage of the freshwater resource provides a good picture, at the national level, of the pressures on resources in a simple manner that is easy to understand, and shows trends over time. The indicator shows how total water abstraction puts pressure on water resources by identifying countries with high abstraction in relation to resources and therefore prone to water stress. Changes in the WEI help to analyse how changes in abstraction impact on freshwater resources by increasing pressure on them or making them more sustainable.

Policy context

Achieving the objective of the EU's sixth environment action programme (2001–2010), to ensure that rates of extraction from water resources are sustainable over the long term, requires monitoring of the efficiency of water use in different economic sectors at the national, regional and local level. The WEI is part of the set of water indicators of several international organisations such as UNEP, OECD, Eurostat and the Mediterranean Blue Plan. There is an international consensus on the use of this indicator.

There are no specific quantitative targets directly related to this indicator. However, the Water Framework Directive (2000/60/EC) requires countries to promote sustainable use based on long-term protection of available water resources and ensure a balance between abstraction and recharge of groundwater, with the aim of achieving good groundwater status by 2015.

Indicator uncertainty

Data at the national level cannot reflect water stress situations at the regional or local level. The indicator does not reflect the uneven spatial distribution of resources and may therefore mask regional or local risks of water stress.

Caution should be used when comparing countries, because of different definitions and procedures for estimating water use (for example, some include cooling water, others do not) and freshwater resources, in particular internal flows. Some sectoral abstractions, such as cooling water included in the industrial abstraction data, do not correspond to the specified uses.

Data need to be considered with reservation due to the lack of common European definitions and procedures for calculating water abstraction and freshwater resources. Current work is being carried out between Eurostat and EEA to standardise definitions and methodologies for data estimation.

Data are not available for all the countries considered, especially for 2000 and 2002, and the data series from 1990 are not complete. There are gaps in water use in some years and for some countries, particularly in the Nordic and the southern accession countries.

Accurate assessments that take climatic conditions into account would require the use of more disaggregated data at the spatial and geographical level.

Better indicators of the evolution of freshwater resources in each country are needed (for example by using information on trends in discharges at some representative gauging stations per country). If groundwater abstractions are considered separately from surface water abstractions, it would be necessary to have some indicators on the evolution of the groundwater resource (for example by using information on the head levels of selected piezometers per country). Better estimates of water abstraction could be developed by considering the uses involved in each economic sector.

19 Oxygen consuming substances in rivers

Key policy question

Is pollution of rivers by organic matter and ammonium decreasing?

Key message

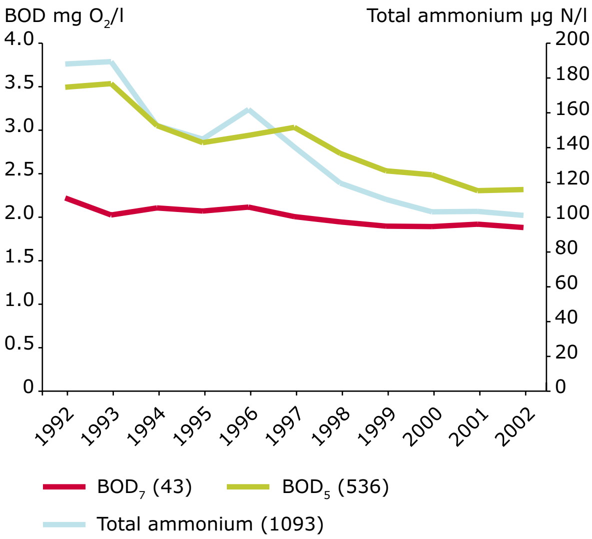
Concentrations of organic matter and ammonium generally fell at 50 % of stations on European rivers during the 1990s, reflecting improvements in wastewater treatment. However, there were increasing trends at 10 % of the stations over the same period. Northern European rivers have the lowest concentrations of oxygen-consuming substances measured as biochemical oxygen demand (BOD) but concentrations are higher in rivers in some of the EU-10 Member States and accession countries where wastewater treatment is not so advanced. Ammonium concentrations in many rivers in EU Member States and accession countries are still far above background levels.

Indicator assessment

There has been a decrease in BOD and ammonium concentrations in the EU-15, reflecting implementation of the urban wastewater treatment directive and consequently an increase in the levels of treatment of wastewater. BOD and ammonium concentrations also declined in the EU-10 and accession countries, as a result partly of improved wastewater treatment but also of economic recession resulting in a decline in polluting manufacturing industries. However, levels of BOD and ammonium are higher in the EU-10 and accession countries in which wastewater treatment is still less advanced than in the EU-15. Ammonium concentrations in many rivers are considerably higher than the background concentrations of around 15 µg N/l.

The decline in the level of BOD is evident in nearly all countries for which data are available (Figure 2). The steepest declines are observed in the countries with the highest levels of BOD at the beginning of the 1990s (i.e. the EU-10 and accession countries). However, some of these countries, such as Hungary, the Czech Republic and Bulgaria, although showing steep declines, still have the highest concentrations. There have also been dramatic decreases in the level of ammonium in some of the EU-10 and accession countries, such as Poland and Bulgaria (Figure 3). The EU-10 and accession countries have a wide range of median concentration values, with Poland and Bulgaria above 300 µg N/l, but Latvia and Estonia below 100 µg N/l. Levels are generally still highest in the eastern and lowest in the northern European countries.

Figure 1 BOD and total ammonium concentrations in rivers between 1992 and 2002

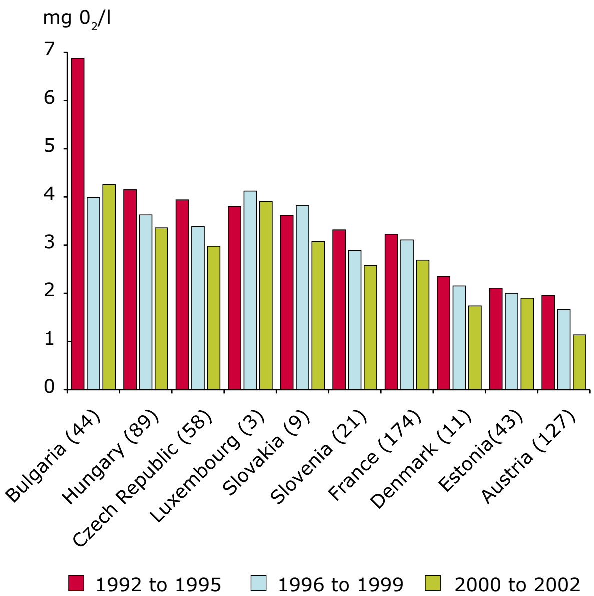


Note: BOD_5 data from Austria, Bulgaria, Czech Republic, Denmark, France, Hungary, Luxembourg, Slovak Republic and Slovenia; BOD_7 data from Estonia. Ammonium data from Austria, Bulgaria, Denmark, Estonia, Finland, France, Germany, Hungary, Latvia, Luxembourg, Poland, Slovak Republic, Slovenia, Sweden and the United Kingdom.

Number of river monitoring stations included in analysis noted in brackets.

Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

Figure 2 **Trends in the concentration of BOD in rivers between 1992 and 2002 in different countries**

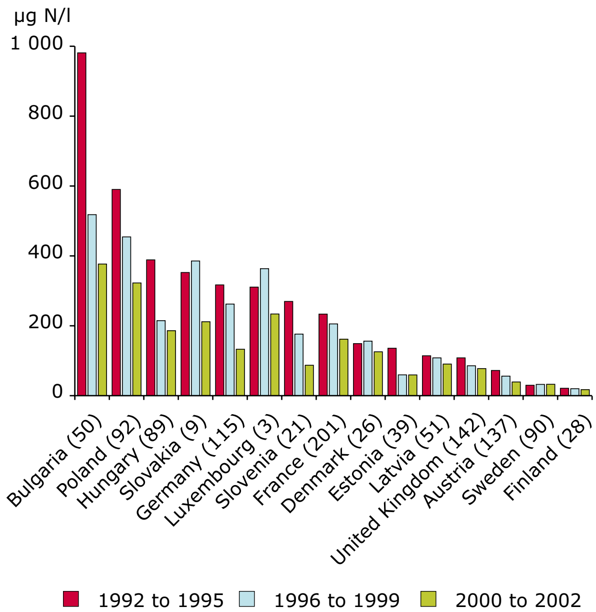


Note: BOD_5 data used for all countries except Estonia where BOD_7 data used.

Number of monitoring stations in brackets.

Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

Figure 3 **Trends in the concentration of total ammonium in rivers between 1992 and 2002 in different countries**



Note: Number of monitoring stations in brackets.

Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

In countries with a large proportion of its population connected to efficient sewage treatment plants, river concentrations of BOD and ammonia are low. Many of the EU-10 still have a lower proportion of their population connected to treatment plants (see indicator CSI 24), and when treatment is applied it is mainly primary or secondary. Concentrations in these countries are still high.

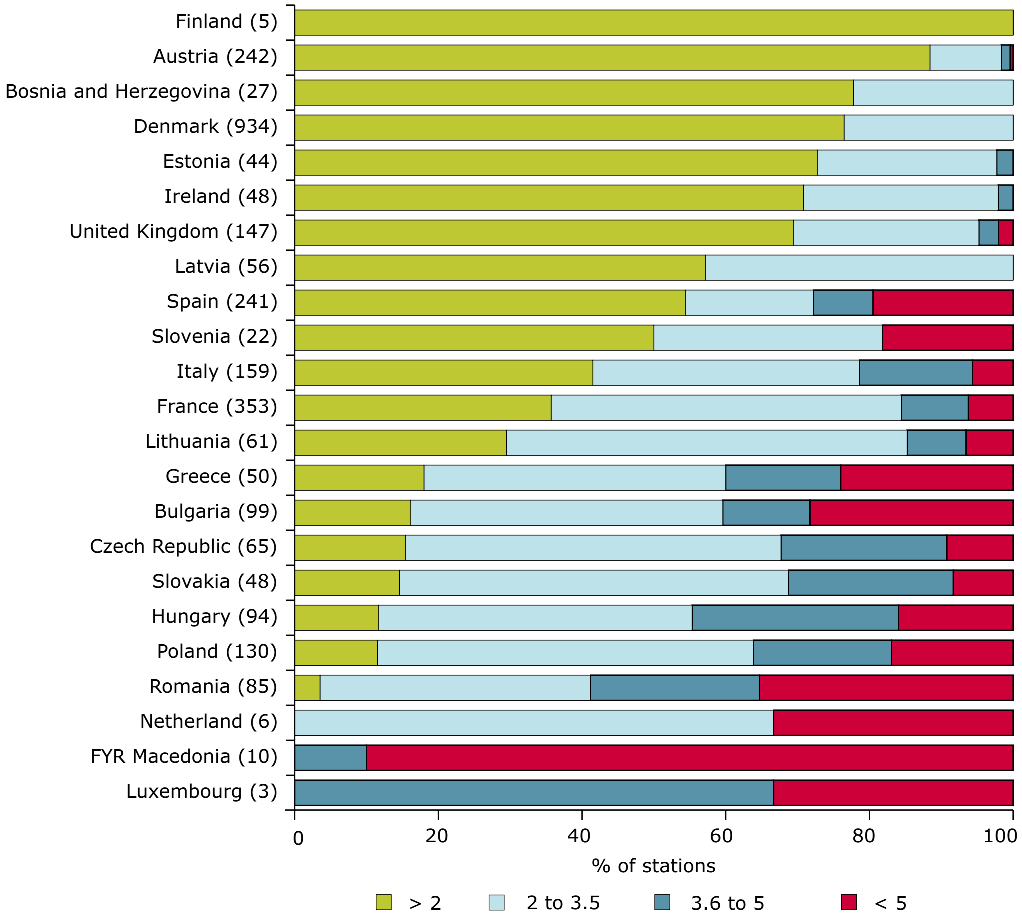
Indicator definition

The key indicator for the oxygenation status of water bodies is the biochemical oxygen demand (BOD) which is the demand for oxygen resulting from organisms in water that consume oxidisable organic matter. The indicator illustrates the current situation and trends regarding BOD and concentrations of ammonium (NH_4) in rivers. Annual average BOD after 5 or 7 days incubation (BOD_5/BOD_7) is expressed in mg O_2/l and annual average total ammonium concentrations in micrograms N/l. For all graphs, data are from representative river stations. Stations that have no designation of type are assumed to be representative and are included in the analysis. For Figures 1, 2 and 3, consistent time-series trends are calculated, using only stations that have recorded concentrations for each year included in the time-series; for Figures 2 and 3, consistent time-series are averaged for the three time periods 1992 to 1995, 1996 to 1999 and 2000 to 2002.

Indicator rationale

Large quantities of organic matter (microbes and decaying organic waste) can result in reduced chemical and biological quality of river water, impaired biodiversity of aquatic communities, and microbiological contamination that can affect the quality of drinking and bathing water. Sources of organic matter are discharges from wastewater treatment plants, industrial effluents and agricultural run-off. Organic pollution leads to higher rates of metabolic processes that demand oxygen. This could result in the development of water zones without oxygen (anaerobic conditions). The transformation

Figure 4 **Present concentration of BOD_5, BOD_7 (mg O_2/l) in rivers**



Note: BOD_5 data used for all countries except Estonia, Finland, Latvia and Lithuania where BOD_7 data used; The number of stations with annual means within each concentration band are calculated for the latest year for which data are available. The latest year is 2002 for all countries except the Netherlands (1998), Ireland (2000) and Romania (2001).

Number of river monitoring stations in brackets.

Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

of nitrogen to reduced forms under anaerobic conditions in turn leads to increased concentrations of ammonium, which is toxic to aquatic life above certain concentrations, depending on water temperature, salinity and pH.

Policy context

The indicator is not related directly to a specific policy target but shows the efficiency of wastewater treatment (see CSI 24). The environmental quality of surface waters with respect to organic pollution and ammonium and the reduction of the loads and impacts of these pollutants are, however, objectives of several directives including: the Surface Water for Drinking Directive (75/440/EEC) which sets standards for BOD and ammonium content of drinking water, the Nitrates Directive (91/676/EEC) aimed at reducing nitrate and organic matter pollution from agricultural land, the Urban Waste Water Treatment Directive (91/271/EEC) aimed at reducing pollution from sewage treatment works and certain industries, the Integrated Pollution Prevention and Control Directive (96/61/EEC) aimed at controlling and preventing the pollution of water by industry, and the water framework directive which requires the achievement of good ecological status or good ecological potential of rivers across the EU by 2015.

Indicator uncertainty

The data sets for rivers include almost all countries in the EEA area, but the time coverage varies from country to country. The data set provides a general overview of concentration levels and trends of organic matter and ammonia in European rivers. Most countries measure organic matter as BOD over five days but a few countries measure BOD over seven days, which may introduce a small uncertainty in comparisons between countries.

20 Nutrients in freshwater

Key policy question

Are concentrations of nutrients in our freshwaters decreasing?

Key message

Concentrations of phosphorus in European inland surface waters generally decreased during the 1990s, reflecting the general improvement in wastewater treatment over this period. However, the decrease was not sufficient to halt eutrophication.

Nitrate concentrations in Europe's groundwaters have remained constant and are high in some regions, threatening drinking water abstractions. There was a small decrease in nitrate concentrations in some European rivers during the 1990s. The decrease was less than for phosphorus because of limited success with measures to reduce agricultural inputs of nitrate.

Indicator assessment

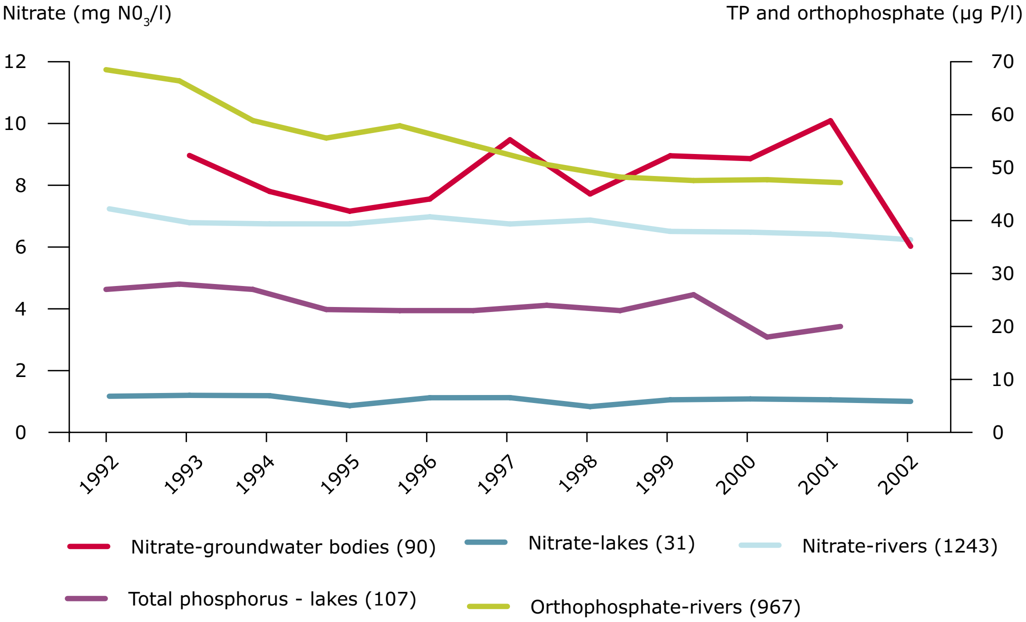
Concentrations of orthophosphate in European rivers have been decreasing steadily in general over the past 10 years. In the EU-15 this is because of the measures introduced by national and European legislation, in particular the urban waste water treatment directive which has increased levels of wastewater treatment with, in many cases, increased tertiary treatment that involves the removal of nutrients. There has also been an improvement in the level of wastewater treatment in the EU-10, though not to the same levels as in the EU-15. In addition, the transition recession in the economies of the EU-10 may have played a part in the decreasing phosphorus trends because of the closure of potentially-polluting industries and a decrease in agricultural production leading to less use of fertilisers. The economic recession in many of the EU-10 ended by the end of the 1990s. Since then many new industrial plants with better effluent treatment technologies have been opened. Fertiliser applications have also started to increase to some extent.

During the past few decades there has also been a gradual reduction in phosphorus concentrations in many European lakes. However the rate of decrease appears to have slowed or even stopped during the 1990s. As with rivers, discharges of urban wastewater have been a major source of pollution by phosphorus, but as purification has improved and many outlets have been diverted away from lakes, this source of pollution is gradually becoming less important. Agricultural sources of phosphorus, from animal manure and from diffuse pollution by erosion and leaching, are both important and need increased attention to achieve good status in lakes and rivers.

The improvements in some lakes have generally been relatively slow despite the pollution abatement measures taken. This is at least partly because of the slow recovery due to internal loading and because the ecosystems can be resistant to improvement and thereby remain in a bad state. Such problems may call for restoration measures, particularly in shallow lakes.

At the European level, there is some evidence of a small decrease in concentrations of nitrate in rivers. The decrease has been slower than for phosphorus because measures to reduce agricultural inputs of nitrate have not been implemented in a consistent way across EU countries and because of the probable time lags between reduction of agricultural nitrogen inputs and soil surpluses, and resulting reductions in surface and groundwater concentrations of nitrate. In terms of nitrate, 15 of the 25 countries with available information had a number of river stations where the drinking water directive guide concentration for nitrate of 25 mg NO_3/l was exceeded, and three of these countries had stations where the maximum allowable concentration of 50 mg NO_3/l was also exceeded. Countries with the highest agricultural land-use and highest population densities (such as Denmark, Germany, Hungary and the United Kingdom), generally had higher nitrate concentrations than those with the lowest (such as Estonia, Norway, Finland, and Sweden) reflecting the impact of emissions of nitrate from agriculture in the former and wastewater treatment works in the latter group of countries.

Figure 1 **Nitrate and phosphorus concentrations in European freshwater bodies**



Note: Concentrations are expressed as annual median concentrations in groundwater, and median of annual average concentrations in rivers and lakes.

Numbers of groundwater bodies, lake and river monitoring stations in brackets.

Lakes: nitrate data from: Estonia, Finland, Germany, Hungary, Latvia and United Kingdom; total phosphorus data from Austria, Denmark, Estonia, Finland, Germany, Hungary, Ireland and Latvia.

Groundwater bodies: data from Austria, Belgium, Bulgaria, Denmark, Estonia, Finland, Germany, Lithuania, the Netherlands, Norway, Slovak Republic and Slovenia.

Rivers: data from Austria, Bulgaria, Denmark, Estonia, Finland, France, Germany, Hungary, Latvia, Lithuania, Poland, Slovenia, Sweden and the United Kingdom.

Data are from representative river and lake stations. Stations that have no designation of type are assumed to be representative and are included in the analysis.

Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

Mean nitrate concentrations in groundwaters in Europe are above background levels (< 10 mg/l as NO_3) but do not exceed 50 mg/l as NO_3. At the European level, annual mean nitrate concentrations in groundwaters have remained relatively stable since the early 1990s but show different levels regionally. Due to a very low level of mean nitrate concentrations (< 2 mg/l as NO_3) in the Nordic countries, the European mean nitrate concentration shows an unbalanced view of nitrate distribution. The presentation above is therefore separated in the following sub-indicators into western, eastern and Nordic countries.

On average, groundwaters in western Europe have the highest nitrate concentration, due to the most intensive agricultural practices, twice as high as in eastern Europe, where agriculture is less intense. Groundwaters in Norway and Finland generally have low nitrate concentrations.

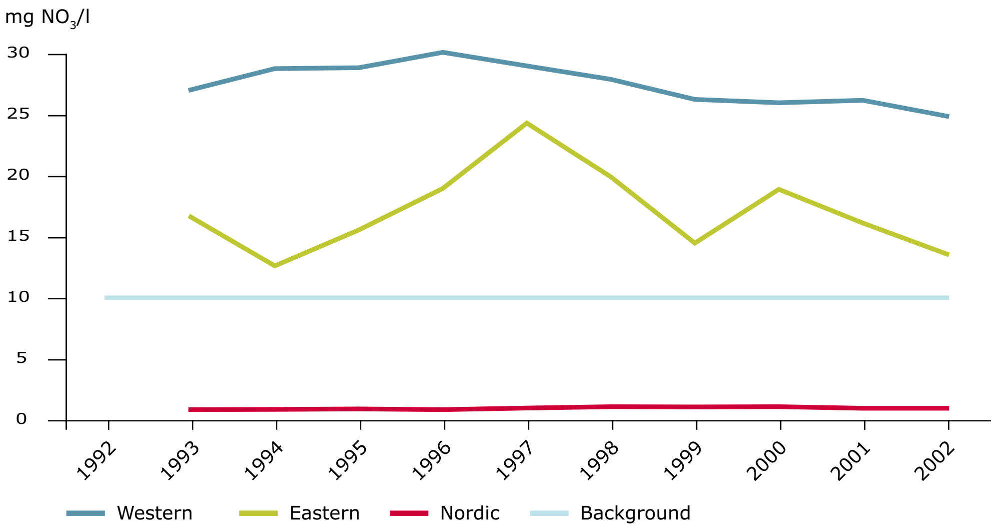
Agriculture is the largest contributor of nitrogen pollution to groundwater, and also to many surface water bodies, since nitrogen fertilisers and manure are used on arable crops to increase yields and productivity. In the EU, mineral fertilisers account for almost 50 % of nitrogen inputs into agricultural soils and manure for 40 % (other inputs are biological fixation and atmospheric deposition). Consumption of nitrogen fertiliser (mineral fertilisers and animal manure) increased until the late 1980s and then started to decline, but in recent years it has increased again in some EU countries. Consumption of nitrogen fertiliser per hectare of arable land is higher in the EU-15 than in the EU-10 and accession countries. Nitrogen from excess fertiliser percolates through the soil and is detectable as elevated nitrate levels under aerobic conditions and as elevated ammonium levels under anaerobic conditions. The rate of percolation is often slow and excess nitrogen levels may be the effects of pollution on the surface up to 40 years ago, depending on the hydrogeological conditions. There are also other sources of nitrate, including treated sewage effluents, which may also contribute to nitrate pollution in some rivers.

Indicator definition

Concentrations of orthophosphate and nitrate in rivers, total phosphorus and nitrate in lakes and nitrate in groundwater bodies. The indicator can be used to illustrate geographical variations in current nutrient concentrations and temporal trends.

The concentration of nitrate is expressed as mg nitrate (NO_3)/l, and orthophosphate and total phosphorus as µg P/l.

Figure 2 **Nitrate concentrations in groundwater in different regions of Europe**



Note: Western Europe: Austria, Belgium, Denmark, Germany, Netherlands; 27 GW-bodies.
Eastern Europe: Bulgaria, Estonia, Lithuania, Slovak Republic, Slovenia; 38 GW-bodies.
Nordic countries: Finland, Norway; 25 GW-bodies; Swedish data are not included due to a data gap.

The drinking water maximum admissible concentration (MAC) for nitrate of 50 mg NO_3/l is laid down in Council Directive 98/83/EC on the quality of water intended for human consumption.

Background concentrations of nitrate in groundwater (< 10 mg NO_3/l) are shown to aid the assessment of the significance of the nitrate concentrations (in association with the drinking water MAC).

Data source: EEA Data service (Ref: www.eea.eu.int/coreset).

Indicator rationale

Large inputs of nitrogen and phosphorus to water bodies from urban areas, industry and agricultural areas can lead to eutrophication. This causes ecological changes that can result in a loss of plant and animal species (reduction in ecological status) and have negative impacts on the use of water for human consumption and other purposes.

The environmental quality of surface waters with respect to eutrophication and nutrient concentrations is an objective of several directives: the water framework directive, the nitrate directive, the urban waste water treatment directive, the surface water directive and the freshwater fish directive. In future years, phosphorus concentrations in lakes will be highly relevant to work under the water framework directive.

Policy context

The indicator is not directly related to a specific policy target. The environmental quality of freshwaters with respect to eutrophication and nutrient concentrations is however an objective of several directives. These include: the Nitrates Directive (91/676/EEC) aimed at reducing nitrate pollution from agricultural land, the Urban Waste Water Treatment Directive (91/271/EEC) aimed at reducing pollution from sewage treatment works and certain industries, the Integrated Pollution Prevention and Control Directive (96/61/EEC) aimed at controlling and preventing pollution of water from industry, and the water framework directive which requires the achievement of good ecological status or good ecological potential of rivers across the EU by 2015. The water framework directive also requires the achievement of good groundwater status by 2015 and also the reversal of any significant and sustained upward trend in the concentration of any pollutant. In addition, the Drinking Water Directive (98/83/EC) sets the maximum allowable concentration for nitrate of 50 mg/l. It has been shown that drinking water in excess of the nitrate limit can result in adverse health effects, especially in infants less than two months of age. Groundwater is a very important source of drinking water in many countries and is often used untreated, particularly from private wells.

One key approach of the sixth environment action programme of the European Community 2001–2010 is to 'integrate environmental concerns into all relevant policy areas' which could result in a more intense consideration of applying agri-environmental measures to reduce nutrient pollution of the aquatic environment (e.g. in the common agricultural policy).

Indicator uncertainty

The data sets for groundwater and rivers include almost all EEA countries, but the time coverage varies from country to country. The coverage of lakes is less good. Countries are asked to provide data on rivers and lakes and on important groundwater bodies according to specified criteria. These rivers, lakes and groundwater bodies are expected to be able to provide a general overview, based on truly comparable data, of river, lake and groundwater quality at the European level.

Nitrate concentrations in groundwaters originate mainly from anthropogenic influence caused by agricultural land use. Concentrations in water are the effect of a multidimensional and time-related process which varies from groundwater body to groundwater body and is as yet less quantified. To evaluate the nitrate concentration in groundwater and its development, closely related parameters such as ammonium and dissolved oxygen have to be taken into account. However, there is a lack of data, especially for dissolved oxygen which provides information on the oxygen state of the water body (reducing or not).

21 Nutrients in transitional, coastal and marine waters

Key policy question

Are nutrient concentrations in our surface waters decreasing?

Key message

Phosphate concentrations in some coastal sea areas of the Baltic and North Seas have decreased over recent years, but they have remained stable in the Celtic Sea and increased in some Italian coastal areas. Nitrate concentrations have generally remained stable over recent years in the Baltic, North and Celtic Seas but have increased in some Italian coastal areas.

Indicator assessment

Nitrate

In the OSPAR (the North Sea, the English Channel and the Celtic Seas) and Helcom (the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57 °44.8'N) areas the available time-series show no clear trend in winter surface concentrations of nitrate. Both decreasing and increasing trends are observed at 3–4 % of the stations (Figure 1) which is certainly attributable to the temporal variability of nutrient loads resulting from varying run-offs.

In the Baltic Sea, winter surface nitrate concentrations are low, even in many coastal waters (the background concentration in the open Baltic Proper is around 65 µg/l). The higher concentrations observed in the Belt Sea and the Kattegat are due mainly to the mixing of Baltic waters with the more nutrient-rich North Sea and Skagerrak waters. The enhanced concentrations resulting from local *loading* are particularly noticeable in the coastal waters of Lithuania, the Gulf of Riga, the Gulf of Finland, the Gulf of Gdansk, the Pommeranian Bay and Swedish estuaries.

In the OSPAR area the nitrate concentrations are high (> 600 µg/l) due to land-based *loads* into the coastal waters of Belgium, the Netherlands, Germany, Denmark, and in a few UK and Irish estuaries.

Background concentrations in the open North Sea and Irish Sea are about 129 µg/l and 149 µg/l, respectively. In the Dutch coastal waters, an overall decrease of 10–20 % in winter nitrate concentrations has been observed. In the Mediterranean Sea, nitrate concentrations have increased at 24 %, and decreased at 5 % of the Italian coastal stations (Figure 1). The background concentration is low, i.e. 7 µg/l. Relatively low concentrations are observed in the Greek coastal waters, around Sardinia and the Calabrian Peninsula. Slightly higher concentrations are observed along the north-west and south-east Italian coasts. High concentrations are observed in most of the northern and western Adriatic Sea, as well as close to rivers and cities along the Italian west coast.

In the Black Sea, the background concentration of nitrate is very low, i.e. 1.4 µg/l. A slight decrease in nitrate concentration has been reported in the Romanian coastal waters, with a steady decline in the Turkish waters at the entrance to the Bosporus. An increased level of both nitrate and phosphate in Ukrainian waters during recent years is connected to high river run-offs.

Phosphate

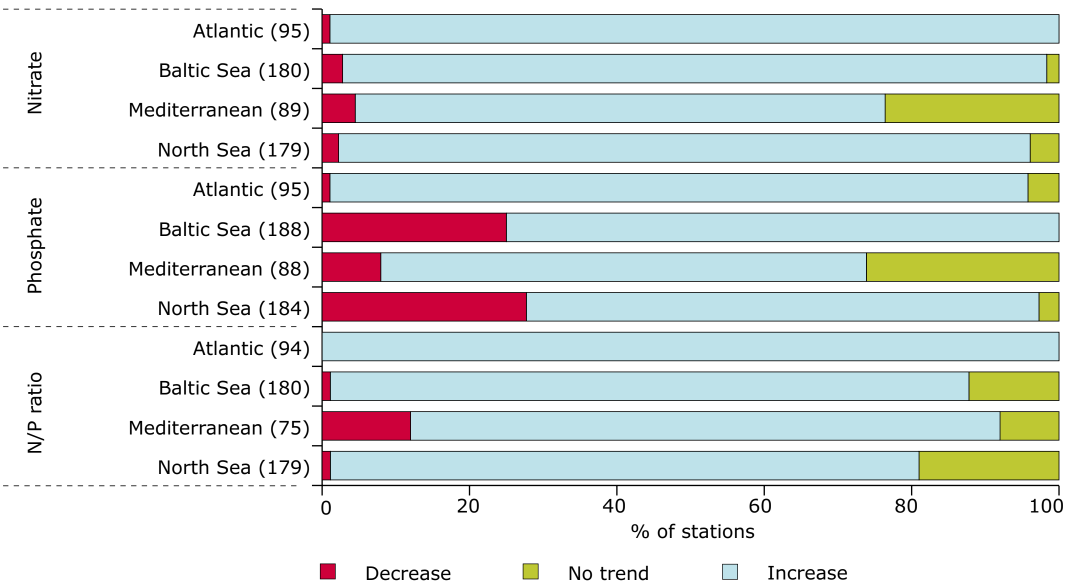
In the Baltic and North Seas, phosphate concentrations have decreased at 25 % and 33 % of the coastal stations, respectively (Figure 1). In the Greater North Sea, the decline in phosphate concentrations is especially evident in the Dutch and Belgian coastal waters, which is probably due to reduced phosphate loads from the river Rhine. Decreases in phosphate concentrations have also been observed at some stations in the German, Norwegian and Swedish coastal waters, and in the open North Sea (more than 20 km from the coast). In the Baltic Sea area, decreases in phosphate concentrations were observed in the coastal waters of most countries, except Poland, as well as in the open waters.

In the Baltic Sea area, the winter surface phosphate concentration is very low in the Bothnian Bay compared with the background concentrations in the open Baltic Proper, and is potentially limiting primary production in the area. The concentration is slightly higher in the Gulf of Riga, the Gulf of Gdansk, in some Lithuanian, German and Danish coastal waters and in estuaries. Remedial measures have been taken in the catchment areas and a reduction in the use of fertilisers has occurred. However, recent research indicates that phosphate concentrations, for example in the open Baltic waters including the Kattegat, are strongly influenced by processes and transport within the water body due to variable oxygen regimes in the bottom water layer. The phosphate concentration is exceptionally high in the Gulf of Finland due to hypoxia and the up-welling of phosphate-rich bottom water in the late 1990s. In the North Sea, the English Channel and the Celtic Seas, phosphate concentrations in the coastal waters of Belgium, the Netherlands, Germany and Denmark are elevated compared to those of the open North Sea. The concentrations in the estuaries are generally high due to local loads.

In the Mediterranean Sea, phosphate concentrations have increased at 26 % and decreased at 8 % of the Italian coastal stations (Figure 1). Concentrations higher than the background value (i.e. about 1 µg/l) are observed in most coastal waters, and much higher concentrations are observed in hot spots along the east and west coasts of Italy.

In the open Black Sea, the background phosphate concentration is relatively high (about 9 µg/l) compared with the Mediterranean Sea and the background nitrogen value. This is probably due to the permanently anoxic conditions in the bottom waters of most of the

Figure 1 Summary of trends in winter nitrate and phosphate concentration, and N/P ratio in the coastal waters of the North Atlantic (mostly Celtic Seas), the Baltic Sea, the Mediterranean and the North Sea



Note: Trend analyses are based on time-series 1985–2003 from each monitoring station having at least 3 years data in the period 1995–2003 and at least 5 years data in all. Number of stations in brackets.

Atlantic (incl. the Celtic Seas) data from: the United Kingdom, Ireland and ICES. Baltic Sea (incl. the Belt Sea and the Kattegat) data from: Denmark, Finland, Germany, Lithuania, Poland, Sweden and ICES. Mediterranean data from: Italy. North Sea (incl. the Channel and the Skagerrak) data from: Belgium, Denmark, Germany, the Netherlands, Norway, Sweden, the United Kingdom and ICES.

Data source: EEA Data service, data from OSPAR, Helcom, ICES and EEA member countries (www.eea.eu.int).

Black Sea, which prevent the phosphate from being bound in the sediments. The phosphate concentration along the Turkish coast is lower than in the open sea, while it is higher in the Romanian coastal waters influenced by the Danube River. In the Black Sea, a slow decline in the concentrations of phosphate has been reported in the Turkish waters at the entrance to the Bosporus.

N/P Ratio

In the Baltic Sea, the N/P ratio, based on winter surface nitrate and phosphate concentrations, is increasing in all areas (Figure 1) except the Polish coastal waters. The N/P ratio is high (> 32) in the Bothnian Bay, where it is likely that phosphorus limits the primary production of phytoplankton. However, the N/P ratio is low (< 8) to relatively low (< 16) in most of the open and coastal Baltic Sea area, indicating that nitrogen can be a potential growth-limiting factor.

In the Greater North Sea and Celtic Seas, high N/P ratios (> 16) are observed in the Belgian, Dutch, German and Danish coastal waters and estuaries, indicating potential phosphorus limitation, at least early in the growing season. In more open waters, the N/P ratio is generally below 16, indicating potential nitrogen limitation.

In the Mediterranean Sea, high N/P ratios (> 32) are found along the northern Adriatic coast and at hot spots along the Italian coasts and the north coast of Sardinia, indicating potential phosphorus limitation, at least during some periods of the growing season.

In the Black Sea, the N/P ratio is generally low, especially in the open sea and along the Turkish coast, indicating potential nitrogen limitation. High N/P ratios (> 32) are found only at a few Romanian coastal stations, indicating potential phosphorus limitation.

Indicator definition

The indicator illustrates overall trends in winter nitrate and phosphate concentration (microgram/l), and N/P ratio in the regional seas of Europe. The N/P ratio is based on molar concentrations. The winter period is January, February and March for stations east of longitude 15 degrees (Bornholm) in the Baltic Sea, and January and February for all other stations. The following sea areas are covered: the Baltic including the Belt Sea and the Kattegat; the North Sea — the OSPAR Greater North Sea including the Skagerrak and the Channel, but not the Kattegat; the Atlantic — the north-east Atlantic including the Celtic Seas, the Bay of Biscay and the Iberian coast; and the whole Mediterranean Sea.

Indicator rationale

Nitrogen and phosphorus enrichment can result in a chain of undesirable effects, starting from excessive growth of plankton algae that increases the amount of organic matter settling on the bottom. This may be enhanced by changes in the species composition and functioning of the pelagic food web (e.g. growth of small flagellates rather than larger diatoms), which leads to lower grazing by copepods and increased sedimentation. The consequent increase in oxygen consumption can, in areas with stratified water masses, lead to oxygen depletion, changes in community structure and death of the benthic fauna. Eutrophication can also increase the risk of algal blooms, some of them consisting of harmful species that cause the death of benthic fauna, wild and caged fish, and shellfish poisoning of humans. Increased growth and dominance of fast-growing filamentous macroalgae in shallow sheltered areas is another effect of nutrient overload which can change the coastal ecosystem, increase the risk of local oxygen depletion and reduce biodiversity and nurseries for fish.

The N/P ratio provides information on the potential nitrogen or phosphorus limitation of the primary phytoplankton production.

Policy context

Measures to reduce the adverse effects of excess anthropogenic inputs of nutrients and protect the marine environment are being taken as a result of various initiatives at all levels — global, European, national and regional conventions and Ministerial Conferences. There are a number of EU directives aimed at reducing the loads and impacts of nutrients, including the Nitrates Directive (91/676/EEC) aimed at reducing nitrate pollution from agricultural land; the Urban Waste Water Treatment Directive (91/271/EEC) aimed at reducing pollution from sewage treatment works and from certain industries; the Integrated Pollution Prevention and Control Directive (96/61/EEC) aimed at controlling and preventing pollution of water from industry; and the Water Framework Directive (2000/60/EC) which requires the achievement of good ecological status or good ecological potential of transitional and coastal waters across the EU by 2015. The European Commission is also developing a Thematic Strategy on the Protection and Conservation of the Marine Environment. Additional measures arise from international initiatives and policies including: the UN Global Programme of Action for the Protection of the Marine Environment from Land-based Activities; the Mediterranean Action Plan (MAP) 1975; the Helsinki Convention 1992 (Helcom); the OSPAR Convention 1998; and the Black Sea Environmental Programme (BSEP).

Targets

The most pertinent target with regard to concentrations of nutrients in water arises from the Water Framework Directive where one of the environmental objectives is to achieve good ecological status. This equates to water body type-specific nutrient concentrations/ranges that support the biological quality elements in a good state. As natural and background concentrations of nutrients vary between and within the regional seas, and between types of coastal water bodies, nutrient targets or thresholds for achieving good ecological status have to be determined locally.

Indicator uncertainty

The Mann-Kendall test for the detection of trends is a robust and accepted approach. Due to the multiple trend analyses, approximately 5 % of the tests conducted will turn out significant if in fact there is no trend. Data for this assessment are still scarce considering the large spatial and temporal variations inherent to the European transitional, coastal and marine waters. Long stretches of European coastal waters are not covered in the analysis due to lack of data. Trend analyses are consistent only for the North Sea and the Baltic Sea (data updated yearly within the OSPAR and Helcom conventions) and Italian coastal waters. Due to variations in freshwater discharge and the hydro-geographic variability of the coastal zone and internal cycling processes, trends in nutrient concentrations as such cannot be directly related to measures taken. For the same reasons the N/P ratio based on winter surface nutrient concentrations cannot be used directly to determine the degree of nutrient limitation of the primary phytoplankton production. Assessments based on N/P ratios can be regarded as describing only a potential nitrogen or phosphorus limitation to the marine plants.

22 Bathing water quality

Key policy question

Is bathing water quality improving?

Key message

The quality of water at designated bathing beaches in Europe (coastal and inland) has improved throughout the 1990s and early 2000s. In 2003, 97 % of coastal bathing waters and 92 % of inland bathing waters complied with the mandatory standards.

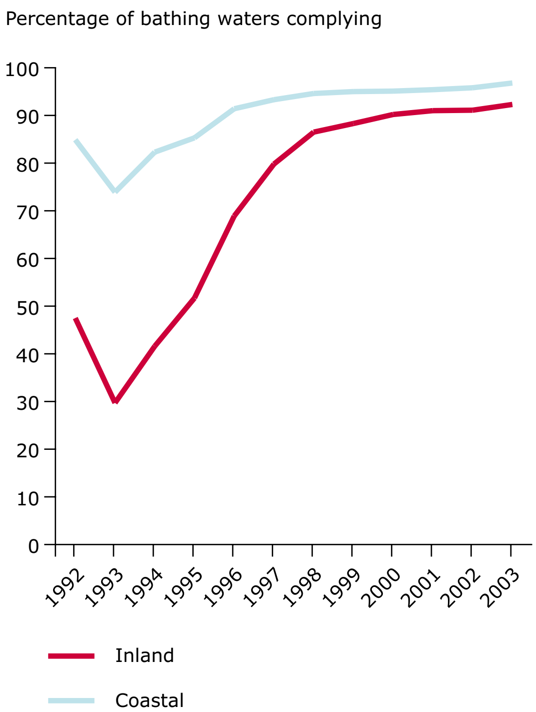
Indicator assessment

The quality of EU bathing waters in terms of compliance with the mandatory standards laid down in the bathing waters directive has improved, but at a slower rate than initially envisaged. The original target of the 1975 directive was for Member States to comply with the mandatory standards by the end of 1985. In 2003, 97 % of coastal bathing waters and 92 % of inland bathing waters complied with these standards. Despite the significant improvement in bathing water quality since the adoption of the bathing water directive 25 years ago, 11 % of Europe's coastal bathing waters and 32 % of Europe's inland bathing beaches still did not meet (non-mandatory) guide values in 2003. The level of achievement of (non-mandatory) guide levels has been much lower than that for the mandatory standards. This is probably because the achievement of the guide levels would entail considerably more expenditure by Member States for sewage treatment works and the control of diffuse pollution sources.

Two countries (the Netherlands and Belgium) achieved 100 % compliance with mandatory standards in their coastal bathing waters in 2003 (Figure 2). The worst performance in terms of coastal waters and mandatory standards was found in Finland with 6.8 % non-compliant bathing waters in 2003. In contrast to its 100 % compliance with mandatory standards, only 15.4 % of Belgium's coastal bathing water met the guide levels, the lowest for the EU countries.

Three countries, Ireland, Greece and the United Kingdom, achieved 100 % compliance with mandatory standards in their inland bathing waters in 2003 (Figure 3). It should, however, be noted that these countries have designated the least number of inland bathing waters in the EU (9, 4 and 11, respectively) compared with Germany (1 572) and France (1 405) which have designated the highest number. Italy had the lowest compliance rate with mandatory standards (70.6 %) for its inland bathing waters in 2003.

Figure 1 Percentage compliance of EU coastal and inland bathing waters with mandatory standards of the bathing water directive, 1992 to 2003 for EU-15



Note: 1992–1994, 12 EU Member States; 1995–1996, 14 EU Member States; 1997–2003, 15 EU Member States.

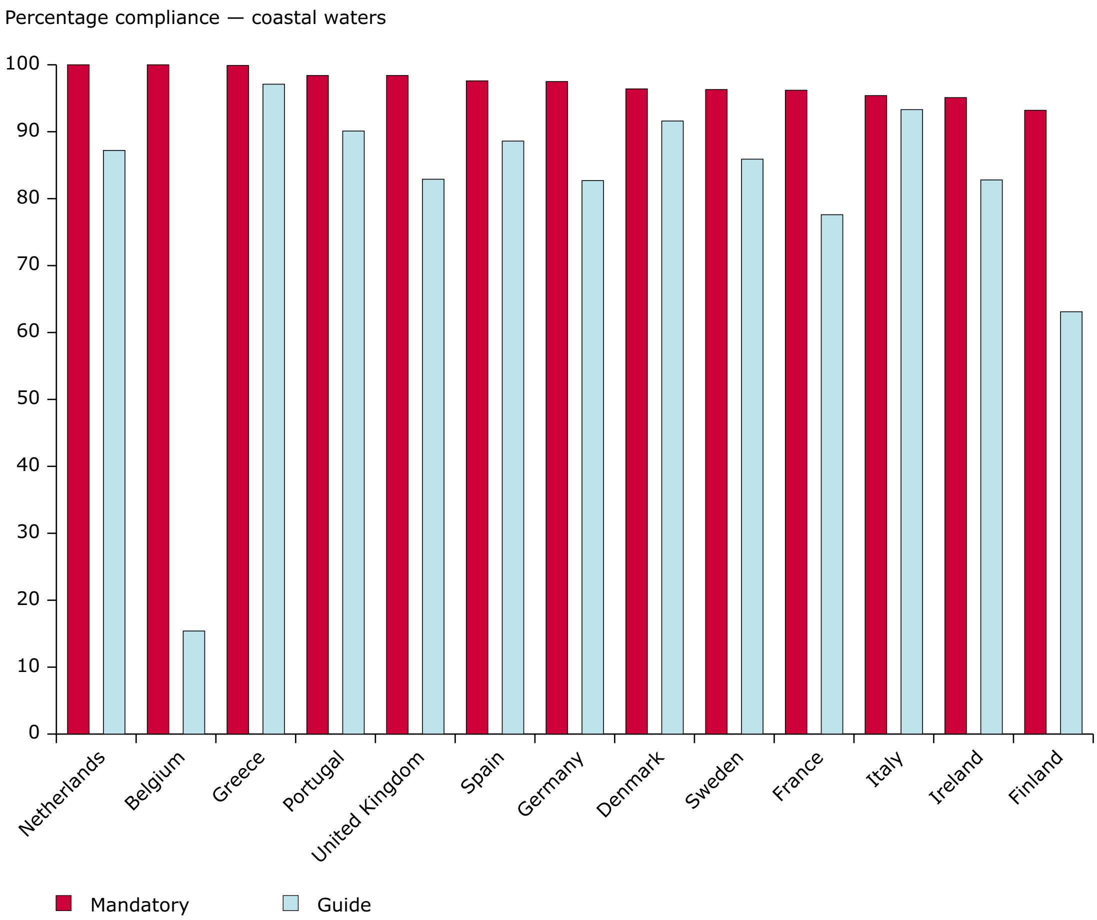
Data source: DG Environment from annual Member States' reports (Ref: www.eea.eu.int/coreset).

In 2003, the European Commission conducted infringement proceedings against nine of the EU-15 Member States (Belgium, Denmark, Germany, Spain, France, Ireland, the Netherlands, Portugal, and Sweden) for non-compliance with aspects of the bathing waters directive. Common reasons were non-compliance with standards and insufficient sampling. The Commission also noted that the number of inland UK bathing waters is low by comparison with most other Member States.

Indicator definition

The indicator describes the changes over time in the quality of designated bathing waters (inland and marine) in EU Member States in terms of compliance with standards for microbiological parameters (total coliforms and faecal coliforms) and physico-chemical parameters (mineral oils, surface-active substances and phenols) introduced by the EU Bathing Water Directive

Figure 2 **Percentage of EU coastal bathing waters complying with mandatory standards and meeting guide levels of the bathing waters directive for the year 2003 by country**



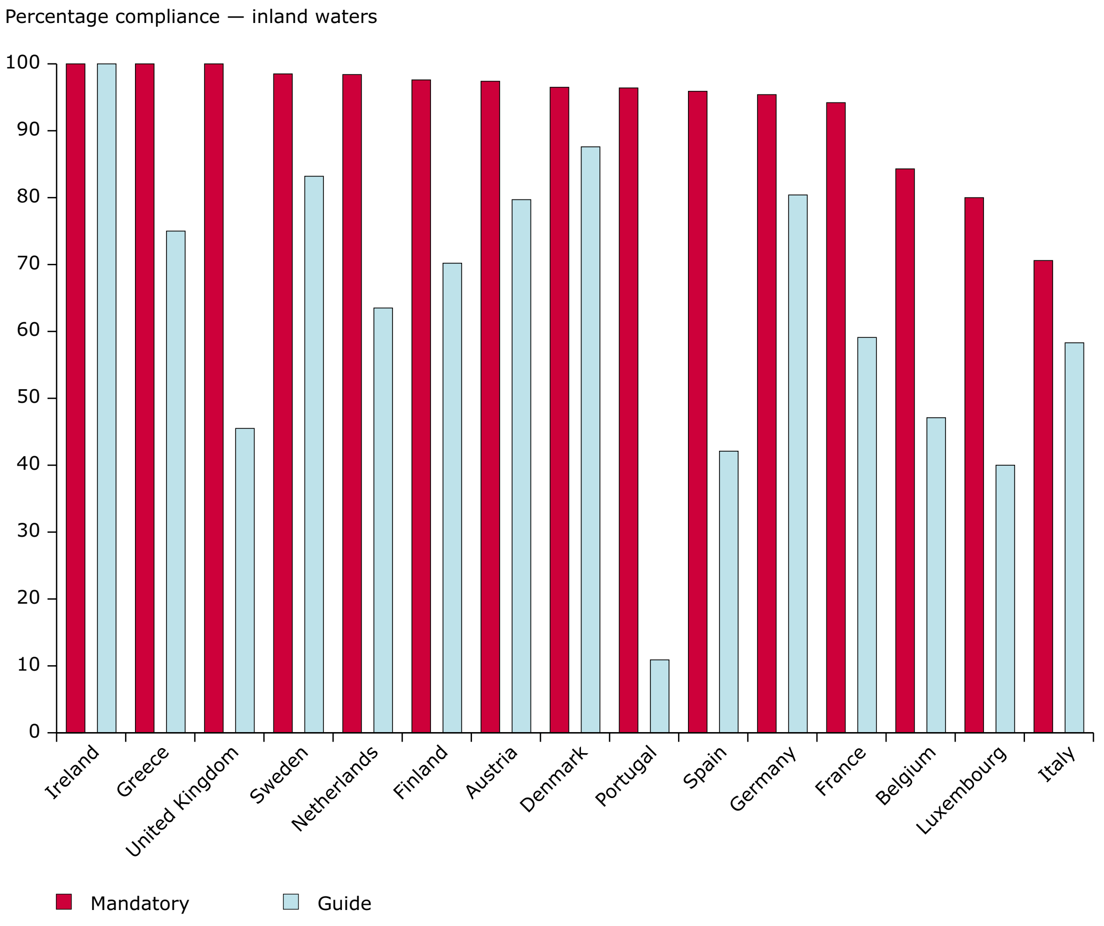
Note: Data source: DG Environment from annual Member States' reports (Ref: www.eea.eu.int/coreset).

(76/160/EEC). The compliance status of individual Member States is presented for the last reported year. The indicator, based on the annual reports made by Member States to the European Commission, is expressed in terms of percentage of inland and marine bathing waters complying with the mandatory standards and guide levels for microbiological and physico-chemical parameters.

Indicator rationale

The Bathing Water Directive (76/160/EEC) was designed to protect the public from accidental and chronic pollution incidents which could cause illness from recreational water use. Examining compliance with the directive therefore indicates the status of bathing water quality in terms of public health and also

Figure 3 **Percentage of EU inland bathing waters complying with mandatory standards and meeting guide levels of the bathing waters directive for the year 2003 by country**



Note: Data source: DG Environment from annual Member States' reports (Ref: www.eea.eu.int/coreset).

the effectiveness of the directive. The bathing water directive is one of the oldest pieces of environmental legislation in Europe and data on compliance goes back to the 1970s. Under the directive, Member States are required to designate coastal and inland bathing waters and monitor the quality of the water throughout the bathing season.

Policy context and targets

Under the Bathing Water Directive (76/160/EEC) Member States are required to designate coastal and inland bathing waters and monitor the quality of the water throughout the bathing season. Bathing waters are designated where bathing is authorised by the competent authority and also where bathing is traditionally practised by a large number of bathers. The bathing season is then determined according to the period when there are the largest number of bathers (May to September in most European countries). The quality of the water has to be monitored fortnightly during the bathing season and also two weeks before. The sampling frequency may be reduced by a factor of two when samples taken in previous years show results better than the guide values and when no new factor likely to lower the quality of the water has appeared. Annex 1 of the directive lists a number of parameters to be monitored but the focus has been on bacteriological quality. The directive sets both minimum standards (mandatory) and optimum standards (guide). For compliance with the directive, 95 % of the samples must comply with the mandatory standards. To be classified as achieving guide values, 80 % of the samples must comply with the total and faecal coliform standards and 90 % with the standards for the other parameters. On 24 October 2002, the Commission adopted the proposal for a revised Directive of the European Parliament and of the Council concerning the Quality of Bathing Water (COM(2002)581). The draft directive proposes the use of only two bacteriological indicator parameters, but sets a higher health standard than the 1976/160 Directive. Based on international epidemiological research and the experience with implementing the current bathing water and water framework directives, the revised directive provides long-term quality assessment and management methods in order to reduce both monitoring frequency and monitoring costs.

Indicator uncertainty

There are differences in how countries have interpreted and implemented the directive, leading to differences in the representativeness of bathing waters included in terms of recreational water use.

During the life of the directive, the EU expanded from 12 countries in 1992 to 15 in 2003. The time-series is thus not consistent in terms of geographic coverage. The EU-10 Member States are expected to report on the quality of their bathing waters in 2005.

Human enteric viruses are the most likely pathogens responsible for waterborne diseases from recreational water use but detection methods are complex and costly for routine monitoring, and so the main parameters analysed for compliance with the directive are indicator organisms: total and faecal coliforms. Compliance with the mandatory standards and guide levels for these indicator organisms does not therefore guarantee that there is no risk to human health.

23 Chlorophyll in transitional, coastal and marine waters

Key policy question

Is eutrophication in European surface waters decreasing?

Key message

There has been no general reduction in eutrophication (as measured by chlorophyll-a concentrations) in the Baltic Sea, the Greater North Sea or the coastal waters of Italy and Greece. Chlorophyll-a concentrations have increased in a few coastal areas and decreased in others.

Indicator assessment

No overall trend has been observed in summer surface chlorophyll-a concentrations, either in the open-sea areas of the Baltic Sea and the Greater North Sea, or the coastal waters of Italy and Greece in the Mediterranean Sea (Figure 1). The majority of the coastal stations in the three seas show no trend, however some stations show increasing or decreasing trends. For example, in the Baltic Sea, 11 % of the coastal stations show an increase in chlorophyll-a concentrations and 3 % a decrease. This lack of a clear general trend indicates that measures to reduce loads of nutrients have not yet succeeded in significantly reducing eutrophication.

In the Baltic Proper and the Gulf of Finland, high mean summer surface chlorophyll-a concentrations (> 2.8 µg/l) are found in open waters, probably due to summer blooms of cyano-bacteria, specific to the Baltic Sea. Concentrations > 4 µg/l are observed in estuaries and coastal waters influenced by rivers or cities in some Swedish, Estonian, Lithuanian, Polish and German coastal waters.

In the North Sea, high chlorophyll-a concentrations (> 5.8 µg/l) are observed in the Elbe estuary and Belgian, Dutch and Danish coastal waters influenced by river discharges. High concentrations are also observed in Liverpool Bay in the Irish Sea. In the open North Sea and Skagerrak, chlorophyll-a concentrations are generally low (< 1.4 µg/l).

In the Mediterranean Sea, 12 % of the stations in Italian coastal waters show a decrease in concentrations of chlorophyll-a, while 8 % show an increase (Figure 1). The lowest concentrations (< 0.35 µg/l) are observed around Sardinia and in southern Italian and Greek coastal waters. Higher concentrations (> 0.6 µg/l) are observed along the Italian east and west coasts and in the Greek Saronikos Bay. High concentrations (> 1.95 µg/l) are found in the northern Adriatic and along the Italian west coast from Naples to the north of Rome.

Very few chlorophyll-a data are available for the Black Sea. The available data show the highest level (> 1.7 µg/l) in the Ukrainian waters of the north-western Black Sea.

Indicator definition

The indicator illustrates trends in mean summer surface concentrations of chlorophyll-a in the regional seas of Europe. The concentration of chlorophyll-a is expressed as microgram/l in the uppermost 10 m of the water column during summer.

The summer period is:

- June to September for stations north of latitude 59 degrees in the Baltic Sea (Gulf of Bothnia and Gulf of Finland);
- May to September for all other stations.

The following sea areas are covered:

- Baltic: the Helcom area including the Belt Sea and the Kattegat;
- North Sea: the OSPAR Greater North Sea including the Skagerrak and the Channel, but not the Kattegat;

- Atlantic: the north-east Atlantic including the Celtic Seas, the Bay of Biscay and the Iberian coast;

- Mediterranean: the whole Mediterranean Sea.

Indicator rationale

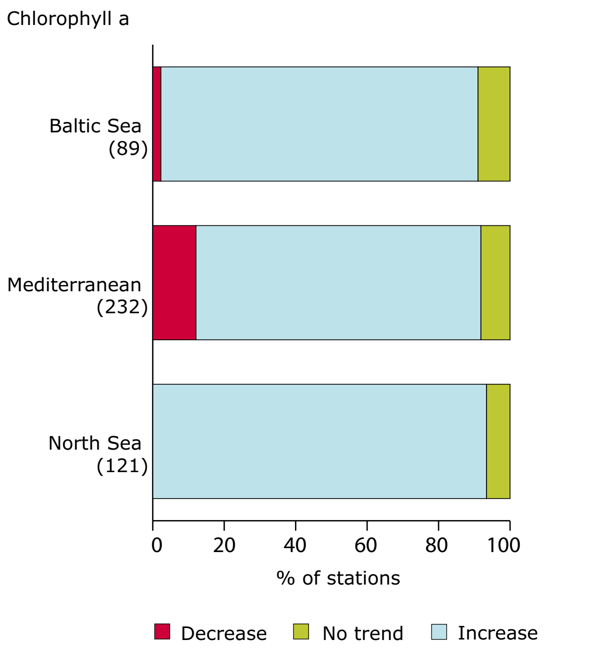
The objective of the indicator is to demonstrate the effects of measures taken to reduce discharges of nitrogen and phosphate on coastal concentrations of phytoplankton expressed as chlorophyll-a. This is an indicator of eutrophication (See also CSI 21 Nutrients in transitional, coastal and marine waters).

The primary effect of eutrophication is excessive growth of plankton algae increasing the concentration of chlorophyll-a and the amount of organic matter settling to the bottom. The biomass of phytoplankton is most frequently measured as the concentration of chlorophyll-a in the euphotic part of the water column. Measurements of chlorophyll-a are included in most eutrophication monitoring programmes, and chlorophyll-a represents the biological eutrophication indicator with best geographical coverage at the European level.

The negative effects of excessive phytoplankton growth are 1) changes in species composition and functioning of the pelagic food web, 2) increased sedimentation, and 3) increase in oxygen consumption that may lead to oxygen depletion and the consequent changes in community structure or death of the benthic fauna.

Eutrophication can also promote harmful algal blooms that may cause discoloration of the water, foam formation, death of benthic fauna, wild and caged fish, or shellfish poisoning of humans. The shadowing effect of increased phytoplankton biomass will reduce the depth distribution of sea grasses and macroalgae. Secondary production of benthic fauna is most often food-limited and related to the input of phytoplankton settling at the bottom, which in turn is also related to the chlorophyll-a concentration.

Figure 1 Trends in mean summer chlorophyll-a concentrations in coastal waters of the Baltic Sea, the Mediterranean (mainly Italian waters) and the Greater North Sea (mainly the eastern North Sea and the Skagerrak)



Note: Trend analyses are based on time series 1985–2003 from each monitoring station having at least three years of data in the period 1995–2003 and at least 5 years of data in all. Number of stations in brackets.

Baltic Sea (incl. the Belt Sea and the Kattegat) data from: Denmark, Finland, Lithuania, Sweden and the International Council for the Exploration of the Seas (ICES).

Mediterranean data from: Greece and Italy.

North Sea (incl. the Skagerrak) data from: Belgium, Denmark, Norway, Sweden, the United Kingdom and ICES.

Data source: EEA Data service, data from OSPAR, Helcom, ICES and EEA member countries (www.eea.eu.int).

Table 1 **Number of coastal stations per country showing no trend, decreasing or increasing trend in summer surface concentrations of chlorophyll-a**

Country	Chlorophyll			Number of stations
	Decrease	No trend	Increase	Total
Baltic Sea area				
Denmark	1	31	1	33
Finland	0	2	1	3
Lithuania	0	3	3	6
Open waters	0	23	1	24
Sweden	1	20	2	23
Mediterranean				
Greece	0	6	0	6
Italy	28	178	19	225
Open waters	0	1	0	1
North Sea area				
Belgium	0	12	3	15
Denmark	0	9	0	9
United Kingdom	0	3	0	3
Norway	0	20	0	20
Open waters	0	64	2	66
Sweden	0	5	3	8

Note: Trend analyses are based on time series 1985–2003 from each monitoring station having at least 3 years of data in the period 1995–2003 and at least 5 years of data in all (Ref: www.eea.eu.int/coreset).

Policy context

There are a number of EU directives aimed at reducing the loads and impacts of nutrients. These include: the Nitrates Directive (91/676/EEC) aimed at reducing nitrate pollution from agricultural land; the Urban Waste Water Treatment Directive (91/271/EEC) aimed at reducing pollution from sewage treatment works and certain industries; the Integrated Pollution Prevention and Control Directive (96/61/EEC) aimed at controlling and preventing pollution of water from industry; and the Water Framework Directive (2000/60/EC) which requires the achievement of good ecological status or good ecological potential of transitional and coastal waters across the EU by 2015. The European Commission is also developing the thematic strategy on the protection and conservation of the marine environment which will incorporate open marine waters and principal environmental threats, such as impact of eutrophication.

Measures also arise from a number of other international initiatives and policies including: the UN global programme of action for the protection of the marine environment against land-based activities; the Mediterranean action plan (MAP) 1975; the Helsinki Convention 1992 (Helcom) on the protection of the marine environment of the Baltic Sea area; OSPAR Convention 1998 for the protection of the marine environment of the North East Atlantic; and the Black Sea environmental programme (BSEP).

Targets

The most pertinent target with regard to concentrations of chlorophyll in water arises from the water framework directive where one of the environmental objectives is to achieve good ecological status. Good ecological status equates to water body type-specific chlorophyll concentrations/ranges that support the biological quality elements at a good status.

Type-specific chlorophyll concentrations/ranges do not necessarily relate to natural or background concentrations. Natural and background concentrations of chlorophyll vary between regional seas, from sub-area to sub-area within regional seas, and between types of coastal water bodies within a sub-area, depending on factors such as natural nutrient loads, water residence time and annual biological cycling. Chlorophyll targets or thresholds for achieving good ecological status therefore have to be determined locally.

Indicator uncertainty

Because of confounding factors such as variations in freshwater discharge, hydro-geographic variability of the coastal zone and internal nutrient cycling in water, biota and sediments, trends in chlorophyll-a concentrations are sometimes difficult to relate directly to, or demonstrate, nutrient reduction measures.

The Mann-Kendall test for the detection of trends used for statistical analysis of the data is a robust and accepted approach. Due to the multiple trend analyses, approximately 5 % of the conducted tests will turn out significant if in fact there is no trend.

Data for this assessment are still scarce considering the large spatial and temporal variations inherent in European transitional, coastal and marine waters. Long stretches of European coastal waters are not covered by the analysis due to lack of data. Trend analyses are only consistent for the eastern North Sea, the Baltic Sea area and Italian coastal waters.

24 Urban wastewater treatment

Key policy question

How effective are existing policies in reducing loading discharges of nutrients and organic matter?

Key message

Wastewater treatment in all parts of Europe has improved significantly since the 1980s, however the percentage of the population connected to wastewater treatment in southern and eastern Europe and the accession countries is relatively low.

Indicator assessment

Over the past twenty years, marked changes have occurred in the proportion of the population connected to wastewater treatment and in the technology involved. Implementation of the urban waste water treatment (UWWT) directive has largely accelerated this trend. Decreases in discharges in eastern Europe (EU-10) and the accession countries are due to economic recession resulting in a decline in polluting manufacturing industries.

Most of the population in the Nordic countries is connected to wastewater treatment plants with the highest levels of tertiary treatment, which efficiently removes nutrients (phosphorus or nitrogen or both) and organic matter. More than half of the wastewater in central European countries receives tertiary treatment. Only around half of the population in southern and eastern countries and the accession countries is currently connected to any wastewater treatment plants and 30 to 40 % to secondary or tertiary treatment. This is because policies to reduce eutrophication and improve bathing water quality were implemented earlier in the northern and central than in the southern and eastern countries and in the accession countries.

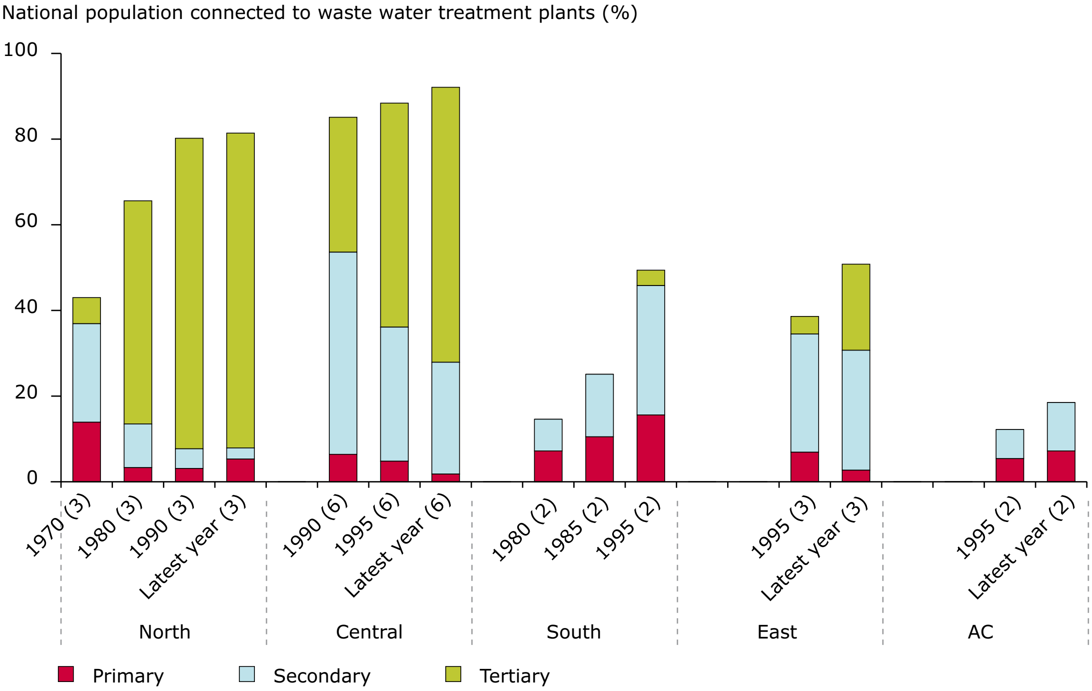
A comparison with indicators CSI 19 and CSI 20 shows that these changes in treatment have improved surface water quality, including bathing water quality, with a decrease in the concentrations of orthophosphates, total ammonium and organic matter over the past ten years. Member States have made considerable investments to achieve these improvements but most of them are however late in implementing the UWWT directive or have interpreted it differently and in ways that differ from the Commission's view.

The UWWT directive requires Member States to identify water bodies as sensitive areas, for example according to the risk of eutrophication. Wastewater treatment facilities with tertiary treatment had to be available in all agglomerations with a population equivalent greater than 10 000 discharging into a sensitive area by 31 December 1998. As shown in Figure 2, only two EU Member States, Denmark and Austria, were close to conforming to the directive's requirements in these terms. Germany and the Netherlands have designated their whole territory as a sensitive area, but are not in conformity with the goal of 75 % reduction of nitrogen.

For large cities with population equivalents greater than 150 000, Member States were required to provide more advanced (than secondary) treatment by 31 December 1998 when discharging into sensitive areas, and at least secondary treatment by 31 December 2000 for those discharging into 'normal' waters. However, on 1 January 2002, 158 of the 526 cities with population equivalents greater than 150 000 did not have a sufficient standard of treatment, and 25 agglomerations had no treatment at all, including Milan, Cork, Barcelona and Brighton. The situation has since improved, partly due to more comprehensive reporting to the Commission, partly to real improvements in treatment. Some of the cities made the necessary investment during 1999–2002, others plan to complete work soon.

An additional threat to the environment comes from the disposal of the sewage sludge produced in the treatment plants. The increase in the proportion of the population connected to wastewater treatment, as well as in the level of treatment, leads to an increase in the quantities of sewage sludge. This has to be disposed of, mainly by spreading on soils, to landfills or by incineration. These disposal routes can transfer

Figure 1 **Changes in wastewater treatment in regions of Europe between the 1980s and the late 1990s**



Note: Only countries with data from all periods included, the number of countries in parentheses.
Nordic: Norway, Sweden, Finland.
Central: Austria, Denmark, England and Wales, the Netherlands, Germany, Switzerland.
Southern: Greece, Spain.
East: Estonia, Hungary and Poland.
AC: Bulgaria and Turkey.

Data source: EEA Data service, based on Member States data reported to OECD/Eurostat, Joint questionnaire, 2002 (Ref: www.eea.eu.int/coreset).

pollution from water to soil or air and have to be taken into account in the respective policy implementation processes.

Indicator definition

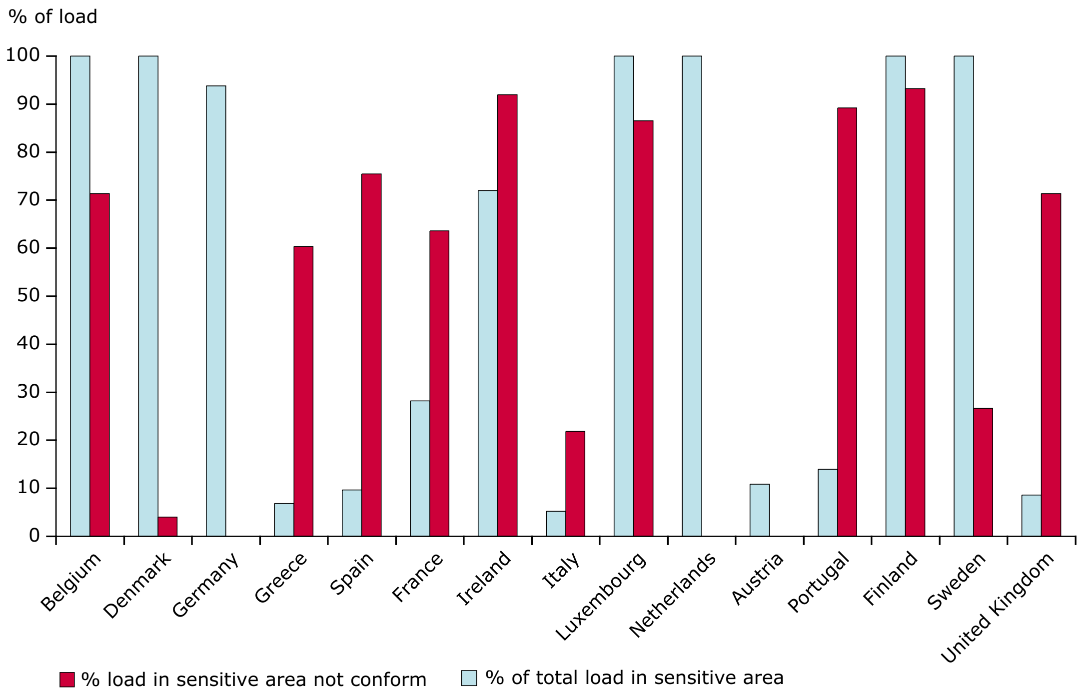
The indicator tracks the success of policies to reduce pollution from wastewater by tracking the trends in the percentage of population connected to primary, secondary and tertiary wastewater treatment plants since the 1980s.

The level of conformity with the UWWTD is illustrated in terms of the percentage of the total load to sensitive area from large agglomerations and in terms of the levels of urban wastewater treatment in large cities in the EU (agglomerations > 150 000 p.e.).

Indicator rationale

Wastewater from households and industry represents a significant pressure on the water environment because of the loads of organic matter and nutrients as well as hazardous substances. With high levels of the population in EEA member countries living in urban

Figure 2 **Percentage of total load in sensitive area, and percentage of load in sensitive area by country, not conforming to the requirements of the urban waste water treatment directive, 2001**



Note: For Sweden change in methodology between 1995 and 2000.

Data source: DG Environment, 2004 (Ref: www.eea.eu.int/coreset).

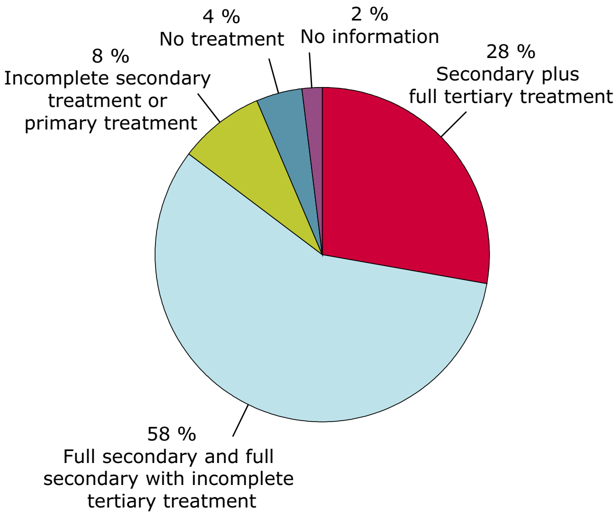
agglomerations, a significant fraction of wastewater is collected by sewers connected to public wastewater treatment plants. The level of treatment before discharge and the sensitivity of the receiving waters determine the scale of impacts on aquatic ecosystems. The types of treatments and conformity with the directive are seen as proxy indicators for the level of purification and the potential improvement of the water environment.

Primary (mechanical) treatment removes part of the suspended solids, while secondary (biological) treatment uses aerobic or anaerobic micro-organisms to decompose most of the organic matter and retain some of the nutrients (around 20–30 %). Tertiary (advanced) treatment removes the organic matter even more efficiently. It generally includes phosphorus retention and in some cases nitrogen removal. Primary treatment alone removes no ammonium whereas secondary (biological) treatment removes around 75 %.

Policy context and targets

The Urban Waste Water Treatment Directive (UWWTD; 91/271/EEC) aims to protect the environment from the adverse effects of urban wastewater discharges. It prescribes the level of treatment required before discharge and has to be fully implemented in the EU-15 by 2005 and in the EU-10 by 2008–2015. The directive requires Member States to provide all agglomerations of more than 2 000 population equivalent (p.e.) with collecting systems and all wastewaters collected to be provided with appropriate treatment by 2005.

Figure 3 **Number of EU-15 agglomerations of more than 150 000 p.e. by treatment level, situation on 1 January 2002**



Note: Data source: DG Environment, 2004 (Ref: www.eea.eu.int/coreset).

Secondary treatment (i.e. biological treatment) must be provided for all agglomerations of more than 2 000 p.e. that discharge into fresh waters, while more advanced treatment (tertiary treatment) is required for discharges into sensitive areas. To help minimise pollution from various point sources, the integrated pollution prevention and control directive (IPPC), which came into force 1996, has a set of common rules on permission for industrial installations.

The achievements through the UWWTD and the IPPC directive have to be seen as an integrated part of objectives under the water framework directive (WFD) which aim at a good chemical and ecological status for all waters by 2015.

The European Commission reported on Member States implementation of the urban waste water treatment directive in 2002 and 2004 (http://europa.eu.int/comm/environment/water/water-urbanwaste/report/report.html and http://europa.eu.int/comm/ environment/water/water-urbanwaste/report2/report.html).

Indicator uncertainty

For the assessment shown in Figure 1, countries have been grouped to show the relative contribution on a larger statistical basis and to overcome the incomplete nature of the data. The data and time trends are most complete for central Europe and the Nordic countries and least complete for the southern European and accession countries, with the exception of Estonia and Hungary.

Data gained from the UWWTD focuses on connection to collecting systems and the performance of waste water treatment plants of agglomerations. But wastewater treatment systems could also include sewer networks with storm water overflows and storages which are complex and whose overall performance is difficult to assess. In addition there are other possible treatments, mostly industrial, but also independent treatments of smaller settlements outside urban agglomeration which are partly covered by the UWWTD but not included in the reporting and in this indicator assessment. Compliance with the levels defined in the directive therefore does not guarantee that there is no pollution due to urban wastewater. To deal with the independent treatments, different methodologies for calculating connectivity have been applied, for example Sweden uses persons connected instead of person-equivalents ([1]).

([1]) For 1985 and 1995 loadings per person equivalents, for 2000 and 2002 loadings per person connected were used instead; Based on register studies on wastewater conditions in rural areas, the following assumption have been made (year 2000): everybody living in urban areas is connected to a treatment plant (UWWTP) Among people not living in urban areas, 192 000 persons are connected to UWWTP, 70 000 have no treatment at all and the remaining 1 163 000 have septic tanks. 60 % of the septic tanks have at least secondary treatment.

25 Gross nutrient balance

Key policy question

Is the environmental impact of agriculture improving?

Key message

The agricultural gross nutrient balance shows whether nutrient inputs and outputs per hectare farmland are in balance or not. A large positive nutrient balance (i.e. inputs are larger than the outputs) indicates a high risk of nutrient leaching and subsequent water pollution.

The gross nitrogen balance at the EU-15 level in 2000 was calculated to be 55 kg/ha, which is 16 % lower than the estimate for 1990, 66 kg/ha. It ranged from 37 kg/ha (Italy) to 226 kg/ha (the Netherlands). All national gross nitrogen balances showed a decline between 1990 and 2000, apart from Ireland (22 % increase) and Spain (47 % increase). The general decline in nitrogen balance surpluses is due to a small decrease in nitrogen input rates (by 1 %) and a significant increase in nitrogen output rates (by 10 %).

Indicator assessment

- The gross nutrient balance for nitrogen provides an indication of the risk of nutrient leaching by identifying agricultural areas that have very high nitrogen loadings. As the indicator integrates the most important agricultural parameters with regard to potential nitrogen surplus, it is currently the best-available approximation of agricultural pressures on water quality. High nutrient balances exert pressures on the environment in terms of an increased risk of leaching of nitrates to groundwater. The application of mineral and organic fertilisers can also lead to emissions to the atmosphere in the form of nitrous dioxide and ammonia, respectively.

- Gross nitrogen balances are particularly high (i.e. above 100 kg N per ha and year) in the Netherlands, Belgium, Luxembourg and Germany. They are particularly low in most Mediterranean countries which is linked to the overall lower livestock production in this part of Europe. It is currently not possible to provide gross nitrogen balance estimates for the EU-10 or the accession countries, since the relevant statistical data are under elaboration.

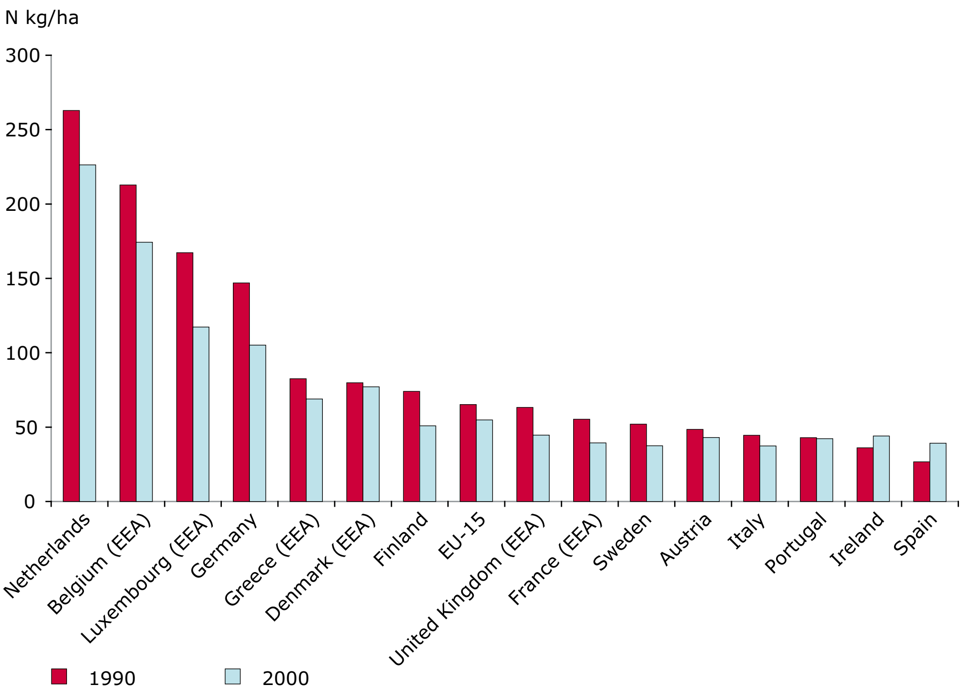
- National balances, however, can mask important regional differences in the gross nutrient balance that determine the actual risk of nitrogen leaching at the regional or local level. Individual Member States can thus have overall acceptable gross nitrogen balances at the national level but still experience significant nitrogen leaching in certain regions, for example in areas with high concentrations of livestock. There are a number of regions with particularly high livestock densities in the EU-15 (for example northern Italy, western France, north-eastern Spain and parts of the Benelux countries), which are likely to be regional hot spots for high gross nitrogen balances that lead to environmental pressures. Member States with high nitrogen balances are making efforts to reduce these pressures on the environment. They build on a range of different policy instruments, requiring considerable political effort to succeed given the significant social and economic consequences of reducing livestock production in the affected areas.

Indicator definition

The indicator estimates the potential surplus of nitrogen on agricultural land. This is done by calculating the balance between all nitrogen added to an agricultural system and all nitrogen removed from the system per hectare of agricultural land.

The inputs consist of the amount of nitrogen applied via mineral fertilisers and animal manure as well as nitrogen fixation by legumes, deposition from the air, and some other minor sources. Nitrogen output is that contained in the harvested crops, or grass and crops eaten by livestock. Escape of nitrogen to the atmosphere, e.g. as N_2O, is difficult to estimate and therefore not taken into account.

Figure 1 **Gross nutrient balance at the national level**



Note: EEA calculations on the basis of: harvested crops and forage crop area (Eurostat's ZPA1 data set or farm structure survey); livestock numbers (Eurostat's ZPA1 data set or farm structure survey); livestock excretion rates (OECD or averaged coefficients from Member States); fertiliser rates (EFMA); nitrogen fixation (OECD or averaged coefficients from Member States farm structure survey); atmospheric deposition (EMEP); yields (Eurostat's ZPA1 data set or average coefficients from Member States).

Data source: OECD website (http://webdomino1.oecd.org/comnet/agr/aeiquest.nsf) and EEA calculations.

Indicator rationale

Nutrient or mineral balances provide insight into links between agricultural nutrient use, changes in environmental quality, and the sustainable use of soil nutrient resources. A persistent surplus indicates potential environmental problems; a persistent deficit indicates potential agricultural sustainability problems. With respect to environmental impacts, however, the main determinant is the absolute size of the nutrient surplus/deficit linked to local farm nutrient management practices and agro-ecological conditions, such as soil type and weather patterns (rainfall, vegetation period, etc.).

The gross nutrient balance for nitrogen provides an indication of the risks of nutrient leaching by identifying agricultural areas that have very high nitrogen loadings. As the indicator integrates the most important agricultural parameters with regard to potential nitrogen surplus, it is currently the best available measure for the risk of nutrient leaching.

Policy context

The gross nitrogen balance is relevant to two EU directives: the Nitrates Directive (91/676/EC) and the Water Framework Directive (2000/60/EC). The nitrates directive has the general purpose of 'reducing water pollution caused or induced by nitrates from agricultural sources and prevent further such pollution' (Art. 1). A threshold nitrate concentration of 50 mg/l is set as the maximum permissible level, and the directive limits applications of livestock manure to land to 170 kg N/ha/yr. The water framework directive requires all inland and coastal waters to reach 'good status' by 2015. Good ecological status is defined in terms of the quality of the biological community, hydrological characteristics and chemical characteristics. The sixth environment action programme encourages the full implementation of both the nitrates and the water framework directives in order to achieve levels of water quality that do not give rise to unacceptable impacts on and risks to human health and the environment.

Indicator uncertainty

The approach used for calculating gross nutrient balance partly requires expert estimates of different physical relations for the country as a whole. However, in reality there may be large regional variations in some of these, and the regional figures should therefore be interpreted with care. Before comparing Member States, it should also be borne in mind that the calculations are based on a harmonised methodology, which may not in all cases reflect country-specific particularities. Moreover, the N-coefficients supplied by Member States also differ remarkably between countries, to an extent which is sometimes difficult to explain.

As a general rule, the data on inputs are estimated to be more accurate and reliable than those on outputs. Not only are the calculations on outputs mainly based on statistics at the national level extrapolated to the regional level, but the lack of (reliable) data on harvested fodder and grass adds a further element of uncertainty to the figures. As this uncertainty is carried through to the total N-balance, the same precautions should be taken before drawing conclusions from the results for the total balance. Nevertheless, the indicator is a good tool for identifying agricultural areas at risk of nutrient leaching.

Areas where data sets are not sufficiently developed include statistics on organic fertilisers, areas under cultivation for secondary crops, statistics for seeds and other planting material, and statistics for non-marketed production and residues.

26 Area under organic farming

Key policy question

What are environmentally relevant key trends in agricultural production systems?

Key message

The share of organic farming is increasing strongly and now stands at about 4 % of the agricultural area of the EU-15 and the EFTA countries. EU agri-environment programmes and consumer demand have been key factors for this strong increase. The share of organic land remains far below 1 % in most of the EU-10 Member States and the accession countries.

Indicator assessment

- The share of organic farming is far higher in northern and central European countries than in other parts of Europe — with the exception of Italy. Furthermore, there is considerable regional variation of this share within individual countries. In contrast, the share of organic farming is particularly low in most of the EU-10 and accession countries. The overall distribution seems to be influenced by the presence of consumer demand for organic products and government support in the form of agri-environment schemes and other measures.

- Recent literature reviews provide information on the environmental impacts of organic agriculture compared with conventional management systems but the results are not always unambiguous. The environmental benefits of organic farming are most clearly documented for biodiversity as well as for water and soil conservation. However, there is no clear evidence of reduced greenhouse gas emissions. Organic agriculture is likely to have a more positive environmental impact in areas with highly intensive agriculture than in areas with low-input farming systems. So far the regional uptake of organic farming is concentrated in extensive grassland regions where fewer changes are needed to convert to organic farming than in regions dominated by intensive, arable farming, where the benefits would be greater.

Indicator definition

Share of organic farming area (sum of current organically farmed areas and areas in process of conversion) as a proportion of total utilised agricultural area (UAA).

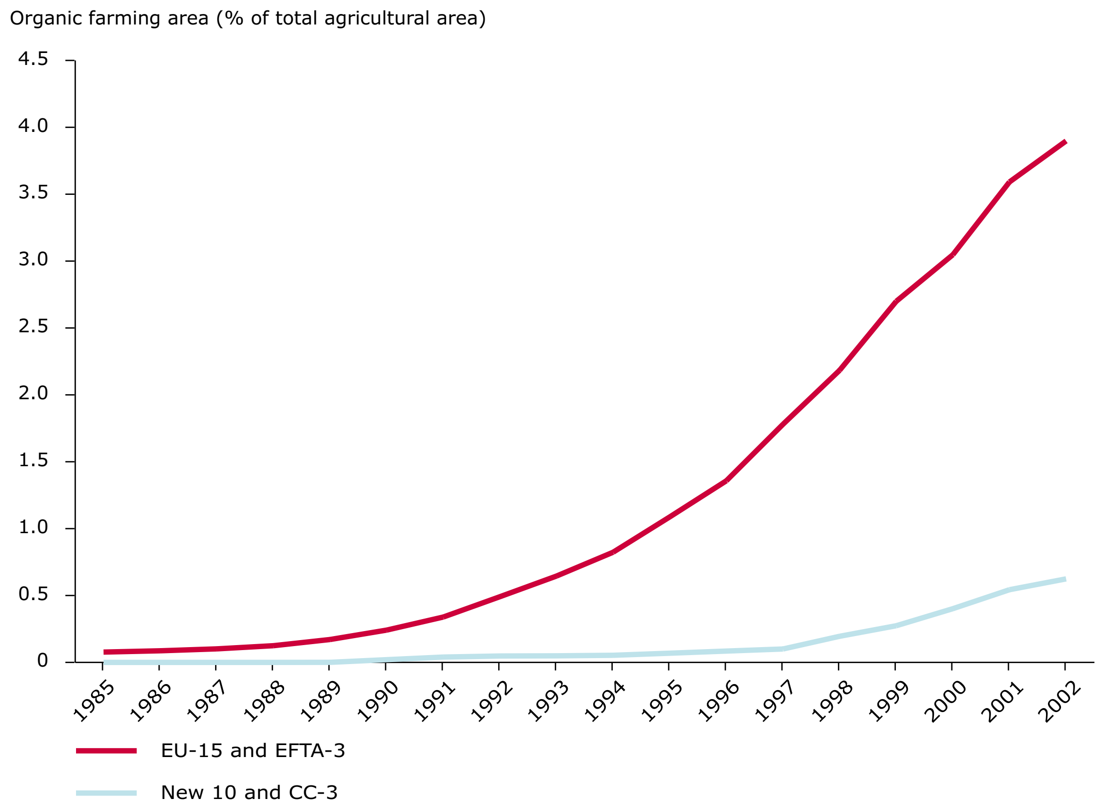
Organic agriculture can be defined as a production system which puts a high emphasis on environmental protection and animal welfare by reducing or eliminating the use of GMOs and synthetic chemical inputs such as fertilisers, pesticides and growth promoters/regulators. Instead, organic farmers promote the use of cultural and agro-ecosystem management practices for crop and livestock production. The legal framework for organic farming in the EU is defined by Council Regulation 2092/91 and amendments.

Indicator rationale

Organic farming is a system that has been explicitly developed to be environmentally sustainable, and is governed by clear, verifiable rules. It thus appears most suited for identifying environment-friendly farming practices compared with other types of farming that also take account of environmental requirements, such as integrated farming.

Farming is only considered to be organic at the EU level if it complies with Council Regulation (EEC) No 2092/91 (and amendments). In this framework, organic farming is differentiated from other approaches to agricultural production by the application of regulated standards (production rules), certification procedures (compulsory inspection schemes) and a specific labelling scheme, resulting in the existence of a specific market, partially isolated from non-organic foods.

Figure 1 **Organic farming area in Europe**



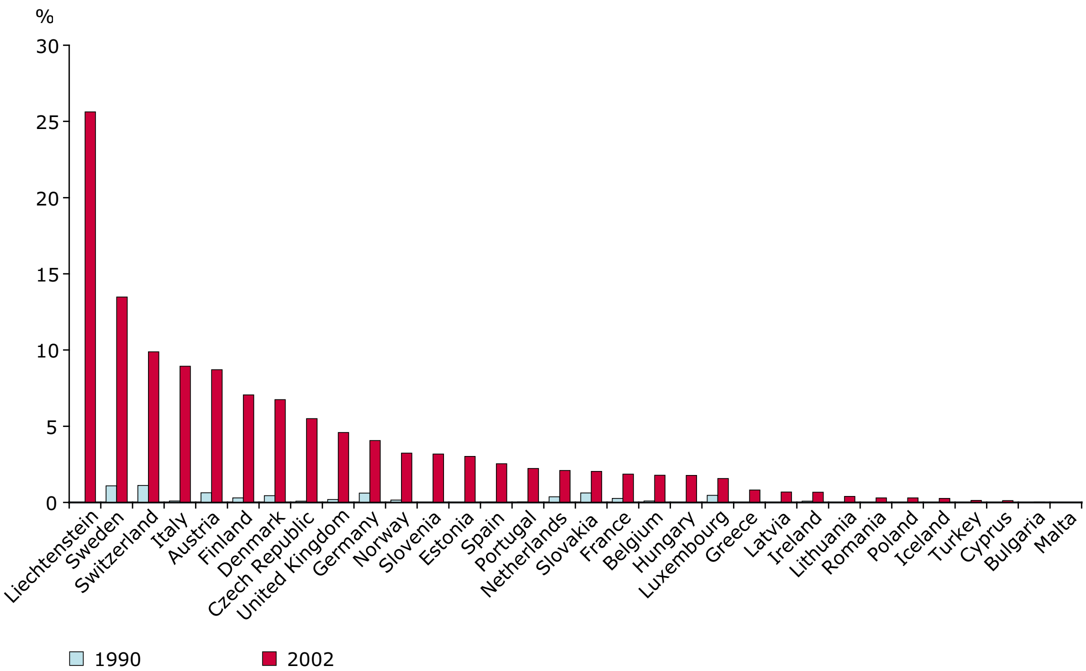
Note: Data source: Institute of Rural Sciences, University of Wales, Aberystwyth (Ref: www.eea.eu.int/coreset).

Policy context

Organic farming aims to establish environmentally sustainable agricultural production systems. Its legal framework is defined by Council Regulation 2092/91 and amendments. The adoption of organic farming methods by individual farmers is supported through agri-environment scheme payments and other rural development measures at the Member State level. In 2004 the EU Commission published a 'European Action Plan for Organic Food and Farming' (COM(2004) 415 final) to further promote this farming approach.

There are no specific EU targets for the share of organic farming area. However, a number of EU Member States have already set targets for area under organic farming, often 10–20 % in 2010.

Figure 2 **Share of organic farming area in total utilised agricultural area**



Note: Data source: Institute of Rural Sciences, University of Wales, Aberystwyth (Ref: www.eea.eu.int/coreset).

Table 1 **Member States targets for area under organic farming**

Member State	Name of programme	Target year	Target
EU	European action plan for organic food and farming (2004)	None	Sets out 21 key actions regarding the organic food market, public policy, standards and inspection
Austria	Aktionsprogramm Biologische Landwirtschaft 2003–2004	2006	At least 115 000 ha of arable land in 2006 (~ 8 % of arable land) *
Belgium	'Vlaams actieplan biologische landbouw' — Flemish Action Plan (2000–2003)	2010	10 % of farmland by 2010
Germany	'Bundesprogramm Ökologischer Landbau' (2000)	2010	20 % of farmland by 2010
Netherlands	'An organic market to conquer' (2001–2004)	2010	10 % of farmland by 2010
Sweden	Action plan (1999)	2005	20 % of farmland by 2005 10 % of all dairy cattle/beef cattle/lambs
United Kingdom	'Action Plan to develop organic food and farming in England — two years on' (2004)	2010	The United Kingdom produced share of the market for organic food products should be 70 % by 2010

* Austria has a higher share of grassland under organic production than of arable; hence the focus of the target on arable land.

Indicator uncertainty

The accuracy of data on organic farming varies somewhat between countries and includes provisional estimates. Nevertheless, available data are considered to be very representative and comparable ([1]). Some countries still have a rather low share of organic farming which limits the possibility of identifying trends at national level that may be not be significant from a European perspective.

A drawback of the data set used is that its maintenance depends on research funding and support from organic farming associations.

(1) Please note that the Swedish organic farming area includes a large share of farmland that is not certified according to Regulation 2092/91 but farmed in line with its specifications.

27 Final energy consumption by sector

Key policy question

Are we using less energy?

Key message

Final energy consumption in the EU-25 increased by about 8 % over the period 1990 to 2002. Transport has been the fastest-growing sector since 1990 and is now the largest consumer of final energy.

Indicator assessment

Final energy consumption in the EU-25 increased by about 8 % between 1990 and 2002, thus partly counteracting the reductions in the environmental impact of energy production achieved as a result of fuel-mix changes and technological improvements. Between 2001 and 2002, final energy consumption decreased by 1.4 percentage points, driven mainly by reductions in the household sector as a result of lower space heating requirements due to higher than average temperatures during 2002.

The structure of final energy consumption has undergone significant changes in recent years. Transport was the fastest-growing sector in the EU-25 between 1990 and 2002, with final energy consumption increasing by 24.3 %. Final energy consumption by services (including agriculture) and households grew by 10.2 % and 6.5 % respectively while final energy consumption in the industry sector fell by 7.7 % over the same period. These developments meant that by 2002, transport was the largest consumer of final energy, followed by industry, households and services.

Changes in the structure of final energy consumption were stimulated by the rapid growth of a wide range of service sectors and a shift to less energy-intensive manufacturing industries. The development of the internal market has resulted in increased freight transport as companies exploit the competitive advantages of different regions. Rising personal incomes have permitted higher standards of living, with resultant increases in the ownership of private cars and domestic appliances. Higher comfort levels, reflected in increased demand for space heating and cooling, have also contributed to higher final energy consumption.

There are significant differences in the pattern of final energy consumption between the pre-2004 EU-15 and EU-10 Member States. The EU-10 have seen falling final energy consumption mainly as a result of economic restructuring following the political changes of the early 1990s. However, with the economic recovery in these countries, final energy consumption since 2000 has increased slightly.

Indicator definition

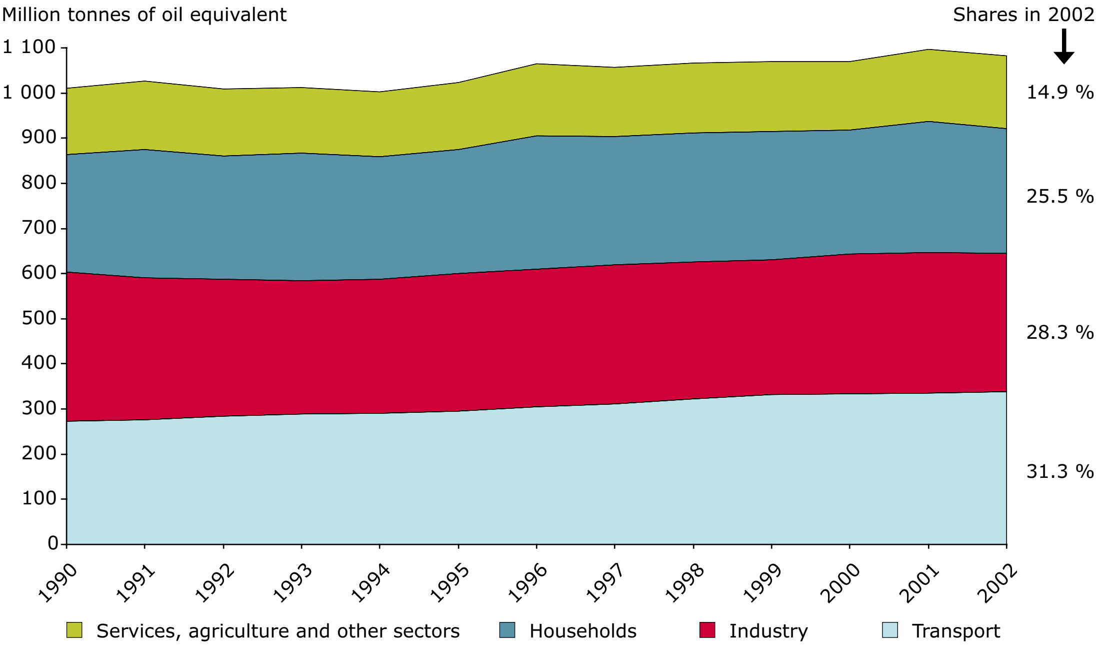
Final energy consumption covers energy supplied to the final consumer for all energy uses. It is calculated as the sum of final energy consumption of all sectors. These are disaggregated to cover industry, transport, households, services and agriculture.

The indicator can be presented in relative or absolute terms. The relative contribution of a specific sector is measured by the ratio between the final energy consumption of that sector and total final energy consumption calculated for a calendar year. It is a useful indicator which highlights a country's sectoral needs in terms of final energy demand. Because sectoral shares depend on the country's economic circumstances, country comparisons of the shares are meaningless unless accompanied by a relevant measure of the importance of the sector in the economy. Because the focus is on the reduction of final energy consumption and not on the sectoral redistribution of such consumption, the trends in the absolute values (in thousand tonnes of oil equivalent) should be preferred as a more meaningful indicator of progress.

Indicator rationale

The trend in final energy consumption by sector provides a broad indication of progress in reducing energy consumption and associated environmental

Figure 1 **Final energy consumption by sector, EU-25**



Note: Data source: Eurostat (Ref: www.eea.eu.int/coreset).

impacts by the different end-use sectors (transport, industry, services and households). It can be used to help monitor the success of key policies that attempt to influence energy consumption and energy efficiency.

Final energy consumption helps to estimate the scale of environmental impacts of energy use, such as air pollution, global warming and oil pollution. The type and extent of energy-related pressures on the environment depends both on the sources of energy (and how they are used) and on the total amount of energy consumed. One way of reducing energy-related pressures on the environment is thus to use less energy. This may result from reducing the energy consumption of energy-related activities (e.g. for warmth, personal mobility or freight transport), or by using energy in a more efficient way (thereby using less energy per unit of demand), or from a combination of the two.

Policy context

The reduction in final energy consumption should be seen in the context of reaching the target of an 8 % reduction in greenhouse gas emissions by 2008–2012 from 1990 levels for the EU-15 and individual targets for most EU-10, as agreed in 1997 under the Kyoto Protocol of the United Nations framework convention on climate change, and of enhancing the security of energy supply.

The Action Plan to Improve Energy Efficiency in the European Community (COM(2000)247 Final) outlines a wide range of policies and measures aimed at removing barriers to energy efficiency. It builds on the Communication (COM(98)246 Final) 'Energy efficiency in the European Community — towards a strategy for the rational use of energy' (supported by Council Resolution 98/C 394/01 on energy efficiency in the

Table 1 Final energy consumption by country

	Final energy consumption (1000 TOE) 1990–2002								
	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
EEA	1 108 173	1 116 435	1 168 855	1 156 256	1 164 531	1 169 296	1 174 172	1 198 205	1 187 846
EU-25	1 002 778	1 023 541	1 065 662	1 056 682	1 066 852	1 069 130	1 068 965	1 096 900	1 082 742
EU-15 pre-2004	858 290	895 951	933 514	926 098	942 069	947 238	950 282	972 694	959 928
EU-10	151 657	127 590	132 148	130 581	124 781	121 891	118 683	124 206	122 815
Austria	18 595	20 358	21 976	21 580	22 256	21 855	22 280	24 583	24 990
Belgium	31 277	34 489	36 383	36 529	37 092	36 931	36 922	37 211	35 816
Bulgaria	16 041	11 402	11 520	9 247	9 772	8 782	8 485	8 532	8 621
Cyprus	1 264	1 409	1 458	1 461	1 531	1 575	1 634	1 689	1 647
Czech Republic	36 678	25 405	25 612	25 566	24 323	23 167	24 114	24 131	23 829
Denmark	13 797	14 736	15 322	14 955	14 997	14 933	14 608	14 947	14 708
Estonia	6 002	2 648	2 895	2 962	2 609	2 355	2 362	2 516	2 586
Finland	21 634	22 227	22 478	23 484	24 172	24 637	24 555	24 739	25 489
France	135 709	141 243	148 621	145 654	150 829	150 719	151 624	158 652	152 686
Germany	227 142	222 342	230 895	226 131	224 450	219 934	213 270	215 174	210 485
Greece	14 534	15 811	16 870	17 257	18 159	18 157	18 508	19 112	19 497
Hungary	18 751	15 155	15 863	15 160	15 274	15 853	15 798	16 400	16 915
Iceland	1 602	1 660	1 726	1 753	1 819	1 953	2 057	2 071	2 152
Ireland	7 265	7 910	8 229	8 655	9 308	9 835	10 520	10 932	11 038
Italy	106 963	113 563	114 339	115 335	118 451	123 073	123 005	125 625	125 163
Latvia	3 046	2 845	3 118	2 930	2 688	2 755	2 913	3 642	3 620
Lithuania	9 423	4 097	3 931	3 930	4 340	3 954	3 639	3 778	3 902
Luxembourg	3 325	3 148	3 235	3 224	3 183	3 341	3 544	3 689	3 732
Malta	332	435	505	548	529	551	522	445	445
Netherlands	42 632	47 431	51 413	49 103	49 307	48 470	49 745	50 775	50 641
Norway	16 087	16 854	17 669	17 466	18 187	18 659	18 087	18 561	18 125
Poland	59 574	63 414	66 189	65 312	60 377	58 843	55 573	56 196	54 418
Portugal	11 208	13 042	13 863	14 550	15 421	15 982	16 937	18 069	18 342
Romania	33 251	25 187	30 410	27 702	25 012	21 611	22 436	22 742	23 247
Slovakia	13 219	8 242	8 218	8 242	8 838	8 486	7 605	10 883	10 864
Slovenia	3 368	3 940	4 359	4 470	4 272	4 352	4 523	4 526	4 589
Spain	56 647	63 536	65 259	67 986	71 750	74 378	79 411	83 221	85 379
Sweden	30 498	33 679	34 603	34 119	34 251	34 076	34 532	33 132	33 668
Turkey	31 245	37 791	41 868	43 409	42 891	49 162	54 142	49 399	52 958
United Kingdom	137 064	142 436	150 028	147 536	148 443	150 917	150 821	152 833	148 294

Note: TOE refers to tonnes of oil equivalent. No energy data for Liechtenstein available from Eurostat.

Data source: Eurostat (Ref: www.eea.eu.int/coreset).

European Community). It proposed an indicative EU target of reducing final energy intensity by 1 % per year above 'that which would have otherwise been attained during the period 1998–2010'.

The proposal for a Directive of the European Parliament and the Council on Energy End-use Efficiency and Energy Services (COM(2003) 739) aims at boosting the cost-effective and efficient use of energy in the EU by fostering energy-efficiency measures and promoting the market for energy services. It proposes that Member States adopt and meet mandatory targets of saving 1 % more of the energy previously used every year — this means 1 % of the average annual amount of energy distributed or sold to final customers the previous five years — through increased energy efficiency for a period of six years. In the sixth year, final energy consumption will then be 6 % lower than it would have been without the efficiency measures. The savings will have to be registered in the following sectors: households, agriculture, commerce and public, transport (excluding air and maritime transport), and industry (excluding energy-intensive industry).

The recent Green Paper on Energy Efficiency (COM(2005)265 final) states that overall, as much as 20 % of energy savings could be realised in a cost-effective way by 2020. It aims at identifying such cost-effective options and at opening a discussion on how to reach them.

Indicator uncertainty

Data have traditionally been compiled by Eurostat through the annual joint questionnaires (shared by Eurostat and the International Energy Agency), following a well-established and harmonised methodology. Data are transmitted to Eurostat electronically, using a common set of tables. Data are then treated to find inconsistencies and entered into the database. Estimations are not normally necessary since annual data are complete.

The sectoral breakdown of final energy consumption includes industry, transport, households, services, agriculture, fisheries and other sectors. The 'European energy and transport trends to 2030' produced for the DG for Energy and Transport of the European Commission aggregates agriculture, fisheries and other sectors together with the services sector, and projections are based on such aggregation. To be consistent with these projections, the core set indicator uses the same aggregation. The inclusion of agriculture and fisheries together with the services sector is however questionable given their divergent trends. Separate assessments are therefore made where appropriate.

A crude cross-country comparison of the relative sectoral distribution of final energy consumption (i.e. each sector's energy consumption as a percentage of the total for all sectors) is meaningless unless accompanied by some indications of the importance of the sector in the economy of the country. But even if the same sectors in two countries are equally important to the economy, the gross (primary) consumption of energy needed before it reaches the final user might draw from energy sources that pollute the environment in different ways. Thus, from an environmental point of view, the final energy consumption of a sector should be analysed in that broader context. Also, a decrease in the final energy consumption of one sector could result in increasing pressure on the environment if the net reduction in energy use in that sector results in a net increase in energy use in another sector or if there is a switch to more environmentally damaging energy sources.

28 Total energy intensity

Key policy question

Are we decoupling energy consumption from economic growth?

Key message

Economic growth is requiring less additional energy consumption, mainly as a result of structural changes in the economy. However, total energy consumption is still increasing.

Indicator assessment

Total energy consumption in the EU-25 grew at an average annual rate of just below 0.7 % over the period 1990 to 2002, while gross domestic product (GDP) grew at an estimated average annual rate of 2 %. As a result, total energy intensity in the EU-25 fell at an average rate of 1.3 % per year. Despite this relative decoupling of total energy consumption and economic growth, total energy consumption increased by 8.4 % over the period.

All the EU-25 countries except Portugal, Spain and Latvia experienced a decrease in total energy intensity between 1990 and 2002. The average annual decrease was 3.3 % in the EU-10 and 1 % in the pre-2004 EU-15 Member States. Despite this converging trend, total energy intensity in the EU-10 in 2002 was still significantly higher than in the EU-15 Member States.

Much of the reduction of total energy intensity was due to structural changes in the economy. These included a shift from industry towards services which are typically less energy-intensive, a shift within the industrial sector from energy-intensive industries towards higher value-added, less energy-intensive industries, and one-off changes in some Member States.

Trends in final energy consumption intensity by sector during 1990–2002 suggest that there have been substantial improvements in the energy intensity in the industry and services sectors. In contrast, the transport and households sectors show only limited decoupling of energy consumption from economic growth and population growth, respectively. The lack of improvement in final energy intensity in the household sector is influenced by rising living standards, leading to a larger number of households, lower occupancy levels and increased use of household appliances.

Indicator definition

Total energy intensity is the ratio between gross inland consumption of energy (or total energy consumption) and gross domestic product (GDP) calculated for a calendar year. It shows how much energy is consumed per unit of GDP.

Gross inland consumption of energy is calculated as the sum of gross inland consumption of the five sources of energy: solid fuels, oil, gas, nuclear and renewables. The GDP figures are taken at constant prices to avoid the impact of inflation, with 1995 as the base year.

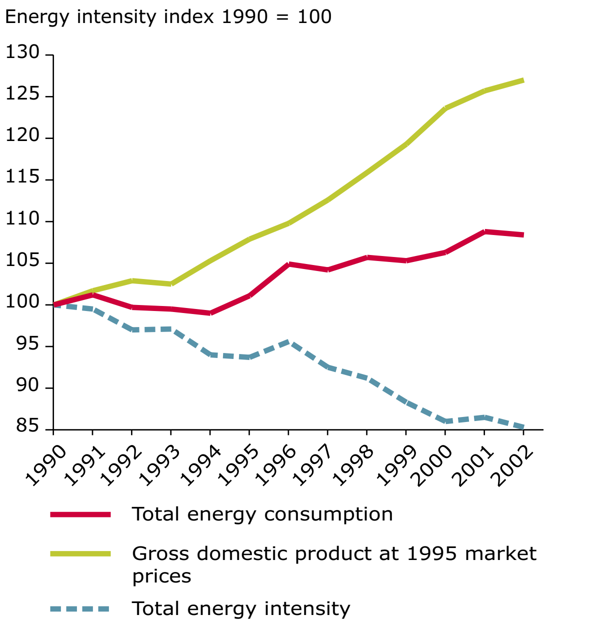
Gross inland energy consumption is measured in thousand tonnes oil equivalent (ktoe) and GDP in million Euro at 1995 market prices. To make comparisons of trends across countries more meaningful, the indicator is presented as an index. An additional column is included to show the actual energy intensity in purchasing power standards for the latest available year.

Indicator rationale

The type and extent of energy-related pressures on the environment, such as air pollution and global warming, depends on the sources of energy and how and in what quantities they are used. One way of reducing energy-related pressures on the environment is to use less energy. This may result from reducing the demand for energy-related activities (e.g. for warmth, personal mobility or freight transport), or by using energy in a more efficient way (thereby using less energy per unit of demand), or a combination of the two.

The indicator identifies the extent, if any, of decoupling between energy consumption and economic growth.

Figure 1 Total energy intensity, EU-25



Note: Some estimates have been necessary in order to compute the EU-25 GDP index for 1990. Eurostat data was not available for a particular year for some EU-25 Member States. The European Commission's annual macroeconomic database (Ameco) was therefore used as an additional data source. GDP for the missing year is estimated on the basis of the annual growth rate from Ameco, the rate being applied to the latest available GDP from Eurostat. This method was used for the Czech Republic (1990–1994), Hungary (1990), Poland (1990–1994), Malta (1991–1998) and Germany (1990). For some other countries and particular years, however, GDP was not available from Eurosat or from Ameco. Few assumptions were made for the purpose of estimating the EU-25. For Estonia, GDP in 1990–1992 is assumed constant and takes the value observed in 1993. For Slovakia, GDP in 1990–1991 takes the value ffor 1992. For Malta, GDP in 1990 is assumed to be equal to GDP in 1991. These assumptions do not distort the trend observed for EU-25 GDP, since the latter three countries represent about 0.3–0.4 % of EU-25 GDP.

Data source: Eurostat and Ameco database, European Commission (Ref: www.eea.eu.int/coreset).

Relative decoupling occurs when energy consumption grows, but more slowly than gross domestic product. Absolute decoupling occurs when energy consumption is stable or falls while GDP grows. From an environmental point of view, however, overall impacts depend on the total amount of energy consumption and the fuels used to produce the energy.

The indicator does not show any of the underlying reasons that affect the trends. A reduction in total energy intensity can be the result of improvements in energy efficiency or changes in energy demand resulting from other factors including structural, societal, behavioural or technical change.

Policy context

Even though there is no target for total energy intensity, there are a number of EU directives, action plans and Community strategies that are directly or indirectly related to energy efficiency, e.g. the sixth environment action plan calls for the promotion of energy efficiency. Several energy and environment targets are also influenced by changes in energy intensity:

- The indicative target for final energy consumption intensity in the EU, set in the 1998 Communication 'Energy Efficiency in the European Community: Towards a Strategy for the Rational Use of Energy' (COM(98) 246 final), of 1 % per year improvement in the intensity of final energy consumption from 1998 'over and above that which would otherwise be attained'.

- The EU and EU-10 targets under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) to reduce greenhouse gas emissions.

- The EU Indicative Combined Heat and Power Target Set in the Community Strategy on Cogeneration to Promote Combined Heat and Power (COM(97) 514 final), for an 18 % share of CHP electricity production in total gross electricity production by 2010.

Table 1 Total energy intensity by country

	Total energy intensity 1995–2002 (1995 = 100)									Energy intensity in 2002 (TOE per million GDP in PPS)
	1995	1996	1997	1998	1999	2000	2001	2002	Annual average change 1995–2002	
EEA	100.0	102.0	98.6	96.9	93.7	91.5	91.9	90.6	– 1.4 %	177
EU-25	100.0	102.0	98.8	97.3	94.2	91.8	92.4	91.0	– 1.3 %	174
EU-15 pre-2004	100.0	102.0	99.0	98.2	95.6	93.5	94.0	92.7	– 1.1 %	167
EU-10	100.0	99.9	93.6	87.3	81.2	77.1	77.5	75.5	– 3.9 %	249
Austria	100.0	103.5	101.6	99.2	95.7	92.1	100.2	98.2	– 0.3 %	148
Belgium	100.0	105.7	104.4	104.3	102.3	99.0	95.6	89.5	– 1.6 %	207
Bulgaria	100.0	109.4	102.8	96.8	85.4	81.7	81.8	76.6	– 3.7 %	392
Cyprus	100.0	105.5	100.7	107.5	100.4	100.5	97.7	96.1	– 0.6 %	194
Czech Republic	100.0	98.7	100.0	97.7	89.7	91.8	91.4	90.0	– 1.5 %	282
Denmark	100.0	110.0	99.7	95.8	90.0	85.1	85.9	83.6	– 2.5 %	144
Estonia	100.0	101.5	90.4	81.4	76.1	66.1	69.3	62.9	– 6.4 %	371
Finland	100.0	104.0	102.9	99.4	95.0	89.5	90.8	93.6	– 0.9 %	282
France	100.0	104.3	99.9	99.6	96.4	95.7	96.4	95.3	– 0.7 %	180
Germany	100.0	102.7	100.3	98.1	94.4	92.3	94.2	92.4	– 1.1 %	178
Greece	100.0	102.8	99.9	101.5	97.8	98.2	97.0	96.2	– 0.5 %	165
Hungary	100.0	100.9	94.6	89.4	86.7	81.1	79.5	77.6	– 3.6 %	204
Iceland	100.0	109.6	109.1	110.3	121.3	120.6	122.3	124.2	3.1 %	473
Ireland	100.0	98.3	92.9	90.7	86.5	80.7	79.5	76.6	– 3.7 %	138
Italy	100.0	98.8	98.2	99.5	99.2	97.1	95.6	95.7	– 0.6 %	132
Latvia	100.0	92.6	79.7	74.5	84.6	76.1	82.2	75.4	– 4.0 %	218
Lithuania	100.0	102.1	89.8	93.6	80.9	71.1	75.7	75.2	– 4.0 %	280
Luxembourg	100.0	98.7	89.8	82.1	80.0	77.4	79.1	81.5	– 2.9 %	199
Malta	100.0	106.1	106.9	108.6	103.8	94.7	84.9	82.8	– 2.7 %	135
Netherlands	100.0	100.9	95.7	91.6	87.4	85.9	86.8	87.0	– 2.0 %	188
Norway	100.0	93.1	93.2	94.8	97.2	92.2	92.6	89.3	– 1.6 %	184
Poland	100.0	101.1	91.2	82.0	75.5	70.2	69.6	67.6	– 5.4 %	241
Portugal	100.0	96.3	98.3	100.8	104.3	101.8	102.7	107.3	1.0 %	155
Romania	100.0	103.2	99.1	94.0	85.3	87.5	82.2	76.2	– 3.8 %	272
Slovakia	100.0	90.8	91.2	86.1	84.2	82.5	88.9	85.7	– 2.2 %	319
Slovenia	100.0	101.2	97.8	93.6	87.6	84.8	87.4	86.2	– 2.1 %	217
Spain	100.0	96.3	97.4	97.8	99.3	99.3	99.3	100.1	0.0 %	154
Sweden	100.0	101.1	96.2	93.6	89.7	81.0	86.2	84.5	– 2.4 %	238
Turkey	100.0	101.6	99.5	98.3	101.3	102.8	103.2	100.0	0.0 %	193
United Kingdom	100.0	101.8	96.2	96.5	93.2	90.4	88.9	85.3	– 2.2 %	154

Note: The year for the reference index value is 1995 because GDP for 1990 was not available for all countries. The last column shows the energy intensity measured in purchasing power standards. These are currency conversion rates that convert to a common currency and equalise the purchasing power of different currencies. They eliminate differences in price levels between countries, allowing meaningful volume comparisons of GDP. They are an optimal unit for benchmarking country performance in a particular year. TOE refers to tonnes of oil equivalent. No energy data for Liechtenstein available from Eurostat.

Data source: Eurostat (Ref: www.eea.eu.int/coreset).

- The EU Directive 2004/8/EC on the promotion of cogeneration based on useful heat demand in the internal energy market. The purpose of this Directive is to increase energy efficiency and improve security of supply by creating a framework for the promotion and development of high-efficiency cogeneration of heat and power based on useful heat demand and primary energy savings in the internal energy market.

- The proposed Directive on Energy End-use Efficiency and Energy Services (COM(2003) 739 final), sets targets for Member States to save 1 % per year of all energy supplied between 2006 and 2012 compared with current supply.

Indicator uncertainty

Data have traditionally been compiled by Eurostat through the annual joint questionnaires (shared by Eurostat and the International Energy Agency) following a well-established and harmonised methodology. Data are transmitted to Eurostat electronically, using a common set of tables. Data are then treated to find inconsistencies and entered into the database. Estimations are not normally necessary since annual data are complete.

There is no estimate of GDP for the EU-25 in 1990, needed to compute the EU-25 GDP index in 1990, available from Eurostat. Eurostat data was not available for a particular year for some EU-25 Member States. The European Commission's annual macroeconomic database (Ameco) has been used to estimate GDP for the missing years and countries by applying annual growth rates from Ameco to the latest available GDP data from Eurostat. This method was used for the Czech Republic (1990–1994), Hungary (1990), Poland (1990–1994), Malta (1991–1998) and Germany (1990). In some cases, however, GDP was not available from Eurostat or from Ameco. With the sole aim of having an estimate for the EU-25, the following assumptions were made: for Estonia, GDP in 1990–1992 is assumed constant and takes the value observed in 1993; for Slovakia, GDP in 1990–1991 takes the value for 1992; for Malta, GDP in 1990 is assumed to be equal to GDP in 1991. These assumptions are consistent with the trend observed for the EU-25, since the latter three countries represent about 0.3–0.4 % of EU-25 GDP. 1995 was chosen as the base year for the indices in the country table in order to avoid estimations.

The intensity of energy consumption is relative to changes in real GDP. Cross-country comparisons of energy intensity based on real GDP are relevant for trends but not for comparing energy intensity levels in specific years and specific countries. This is why the core set indicator is expressed as an index. In order to compare the energy intensity between countries for a specific year, an additional column is shown with the energy intensities in purchasing power standards.

Energy intensity is not sufficient to measure the environmental impact of energy use and production. Even when two countries have the same energy intensity or show the same trend over time there could be important environmental differences between them. The link to environmental pressures has to be made on the basis of the absolute amounts of the different fuels used to produce that energy. Energy intensity should therefore always be put in the broader context of the actual fuel mix used to generate the energy.

29 Total energy consumption by fuel

Key policy question

Are we switching to less polluting fuels to meet our energy consumption?

Key message

Fossil fuels continue to dominate total energy consumption, but environmental pressures have been limited by switching from coal and lignite to relatively clean natural gas.

Indicator assessment

The share of fossil fuels such as coal, lignite, oil and natural gas in total energy consumption declined only slightly between 1990 and 2002, to reach 79 %. Their use has considerable impact on the environment and is the main cause of greenhouse gas emissions. However, changes to the fossil fuel mix have benefited the environment, with the share of coal and lignite declining continuously and being replaced by relatively cleaner natural gas, which now has a 23 % share.

Most of the switch between fossil fuels was in the power generation sector. In the pre-2004 EU-15 Member States this was supported by implementation of environmental legislation and liberalisation of electricity markets, which stimulated the use of combined-cycle gas plants due to their high efficiency, low capital cost and low gas prices in the early 1990s, and by the expansion of the trans-EU gas network. Fuel mix changes in the EU-10 were induced by the process of economic transformation, which led to changes in fuel prices and taxation and removal of energy subsidies, and policies to privatise and restructure the energy sector.

Renewable energy, which typically has lower environmental impacts than fossil fuels, has seen rapid growth in absolute terms, but from a low starting point. Despite increased support at the EU and national level, its contribution to total energy consumption remains low at almost 6 %. The share of nuclear power has grown slowly to reach almost 15 % of total energy consumption in 2002. While nuclear power produces little pollution under normal operations there is a risk of accidental radioactive releases, and highly radioactive waste are accumulating for which no generally acceptable disposal route has yet been established.

Overall, the changes in the fuel mix of total energy consumption contributed to reducing emissions of greenhouse gases and acidifying substances. Rising total energy consumption, however, counteracted some of the environmental benefits of the fuel switch. Total energy consumption in the EU-25 increased by 8.4 % over the period 1990–2002 although it decreased slightly between 2001 and 2002 due to higher than average temperatures and a slowing of GDP growth.

Indicator definition

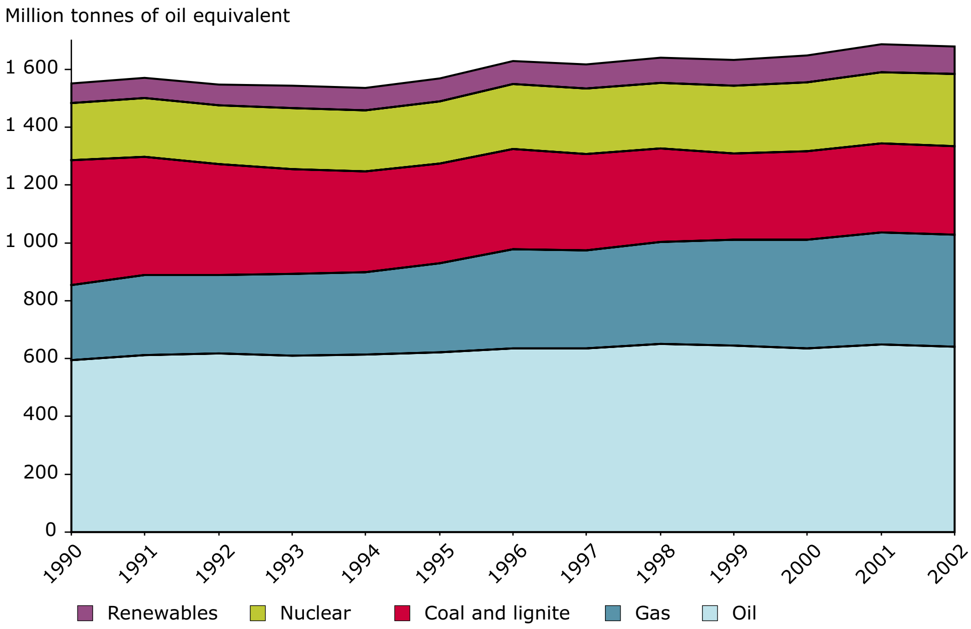
Total energy consumption or gross inland energy consumption represents the quantity of energy necessary to satisfy the inland consumption of a country. It is calculated as the sum of gross inland consumption of energy from solid fuels, oil, gas, nuclear and renewable sources. The relative contribution of a specific fuel is measured by the ratio between the energy consumption originating from that specific fuel and the total gross inland energy consumption calculated for a calendar year.

Energy consumption is measured in thousand tonnes of oil equivalent (ktoe). The share of each fuel in total energy consumption is presented in the form of a percentage.

Indicator rationale

Total energy consumption is a driving force indicator providing an indication of the environmental pressures caused by energy production and consumption. It is disaggregated by fuel source as the environmental impact of each fuel is very specific.

Figure 1 **Total energy consumption by fuel in the EU-25**



Note: Data source: Eurostat (Ref: www.eea.eu.int/coreset).

The consumption of fossil fuels (such as crude oil, oil products, hard coal, lignite and natural and derived gas) provides a proxy indicator of resource depletion, CO_2 and other greenhouse gas emissions and air pollution (e.g. SO_2 and NO_X). The degree of the environmental impact depends on the relative share of different fossil fuels and the extent to which pollution abatement measures are used. Natural gas, for instance, has approximately 40 % less carbon per unit of energy than coal and 25 % less carbon than oil and contains only marginal quantities of sulphur.

The level of nuclear energy consumption provides an indication of the trends in the amount of nuclear waste generated and the risks associated with radioactive leaks and accidents. Increasing consumption of nuclear energy at the expense of fossil fuels would on the other hand contribute to reductions in CO_2 emissions.

Renewable energy consumption measures the contribution from technologies that are more environmentally benign, as they produce no (or very little) net CO_2 and usually significantly lower levels of other pollutants. Renewable energy can, however, have impacts on landscapes and ecosystems. The incineration of municipal waste uses both renewable and non-renewable material and may also generate local air pollution. However, emissions from the incineration of waste are subject to stringent regulations including tight controls on quantities of cadmium, mercury and other such substances. Similarly, the inclusion of both large and small-scale hydropower provides only a broad indicator of environmentally benign energy supply. While small-scale hydro schemes generally have little environmental impact, large-scale hydro can have major adverse impacts (flooding, impact on ecosystems, water levels, requirements for population resettlement).

Table 1 Total energy consumption by fuel (%)

	Total energy consumption by fuel (%) in 2002							
	Coal and lignite	Oil	Gas	Nuclear	Renewables	Industrial waste	Imports-exports of electricity	Total energy consumption (1 000 TOE)
EEA	18.5	37.6	23.1	13.8	6.8	0.2	0.0	1 843 310
EU-25	18.2	38.0	23.1	14.8	5.7	0.2	0.1	1 684 042
EU-15 pre-2004	14.7	39.9	23.6	15.6	5.8	0.2	0.3	1 482 081
EU-10	43.5	23.8	19.5	8.8	5.0	0.3	– 1.0	201 961
Austria	12.3	41.5	21.4	0.0	24.0	0.6	0.2	30 909
Belgium	12.7	35.5	25.4	23.2	1.6	0.4	1.2	52 570
Bulgaria	35.6	23.4	11.6	27.9	4.4	0.0	– 2.9	18 720
Cyprus	1.5	96.7	0.0	0.0	1.9	0.0	0.0	2 420
Czech Republic	49.9	19.9	18.9	11.1	2.2	0.3	– 2.4	40 991
Denmark	21.1	44.1	23.3	0.0	12.3	0.0	– 0.9	19 821
Estonia	57.2	21.5	12.0	0.0	10.5	0.0	– 1.2	4 963
Finland	18.5	28.9	10.5	16.4	22.2	0.6	2.9	35 136
France	5.2	34.7	14.1	42.4	6.1	0.0	– 2.5	265 537
Germany	24.9	37.1	22.0	12.4	3.1	0.4	0.3	343 671
Greece	31.4	57.0	6.1	0.0	4.7	0.0	0.8	29 736
Hungary	14.1	24.8	42.2	14.0	3.5	0.0	1.4	25 633
Iceland	2.9	24.3	0.0	0.0	72.8	0.0	0.0	3 382
Ireland	17.0	56.6	24.3	0.0	1.9	0.0	0.3	15 139
Italy	7.9	50.9	33.2	0.0	5.3	0.2	2.5	173 550
Latvia	2.4	27.2	30.8	0.0	34.8	0.0	4.8	4 189
Lithuania	1.7	29.4	25.3	42.1	8.0	0.0	– 6.4	8 671
Luxembourg	2.3	62.4	26.5	0.0	1.4	0.0	7.4	3 979
Malta	0.0	100.0	0.0	0.0	0.0	0.0	0.0	823
Netherlands	10.7	37.9	45.8	1.3	2.2	0.3	1.8	78 195
Norway	3.1	29.0	23.4	0.0	47.7	0.0	– 3.2	26 278
Poland	61.7	22.4	11.4	0.0	4.7	0.6	– 0.7	88 837
Portugal	13.4	61.4	10.5	0.0	14.0	0.0	0.6	25 966
Romania	22.0	26.7	37.2	4.0	10.5	0.3	– 0.7	35 753
Slovakia	22.9	18.4	31.6	24.9	3.9	0.3	– 1.9	18 570
Slovenia	22.8	35.5	11.3	20.8	11.0	0.0	– 1.4	6 864
Spain	16.7	50.5	14.4	12.5	5.6	0.0	0.4	130 063
Sweden	5.5	30.7	1.6	34.2	27.1	0.1	0.9	51 435
Turkey	26.3	40.8	19.6	0.0	12.9	0.0	0.4	75 135
United Kingdom	15.8	34.7	37.9	10.0	1.2	0.0	0.3	226 374

Note: TOE refers to tonnes of oil equivalent. No energy data for Liechtenstein available from Eurostat.

Data source: Eurostat (Ref: www.eea.eu.int/coreset).

Policy context

Total energy consumption disaggregated by fuel type provides an indication of the extent of environmental pressure caused (or at risk of being caused) by energy production and consumption. The relative shares of fossil fuels, nuclear power and renewable energies together with the total amount of energy consumption are valuable in determining the overall environmental burden of energy consumption in the EU. Trends in the shares of these fuels will be one of the major determinants of whether the EU meets its target for reduction of greenhouse gas emissions agreed under the Kyoto Protocol.

There are two targets indirectly related to this indicator: 1) The EU target of an 8 % reduction in greenhouse gas emissions by 2008–2012 from 1990 levels, as agreed in 1997 under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC); and 2) The White Paper for a Community Strategy and Action Plan (COM(97) 599 final) which provides a framework for action by Member States to develop renewable energy and sets an indicative target of increasing the share of renewable energy in total energy consumption in the pre-2004 EU-15 to 12 % by 2010.

Indicator uncertainty

Data have traditionally been compiled by Eurostat through the annual joint questionnaires (shared by Eurostat and the International Energy Agency) following a well-established and harmonised methodology. Data are transmitted to Eurostat electronically, using a common set of tables. Data are then treated to find inconsistencies and entered into the database. Estimations are not normally necessary since annual data are complete.

The share of energy consumption for a particular fuel could decrease even though the actual amount of energy used from that fuel grows. Similarly, its share could increase despite a possible reduction in the total consumption of energy from that fuel. What makes a share for a particular fuel increase or decrease depends on the change in its energy consumption relative to the total consumption of energy.

From an environmental point of view, however, the relative contribution of each fuel has to be put in the wider context. Absolute (as opposed to relative) volumes of energy consumption for each fuel are the key to understanding the environmental pressures. These depend on the total amount of energy consumption as well as on the fuel mix used and the extent to which pollution abatement technologies are used.

Total energy consumption may not accurately represent the energy needs of a country (in terms of final energy demand). Fuel switching may in some cases have a significant effect in changing total energy consumption even though there is no change in (final) energy demand. This is because different fuels and different technologies convert primary energy into useful energy with different efficiency rates.

30 Renewable energy consumption

Key policy question

Are we switching to renewable energy sources to meet our energy consumption?

Key message

The share of renewable energies in total energy consumption increased over the period 1990–2002, but still remains at a low level. Significant further growth will be needed to meet the EU indicative target of a 12 % share by 2010.

Indicator assessment

The contribution of renewable energy sources to total energy consumption increased between 1990 and 2001 in the EU-25, but fell slightly in 2002 due to lower production of hydroelectricity (as a result of low rainfall) to reach 5.7 %. This is still substantially short of the indicative target set in the White Paper on Renewable Energy (COM(97) 599 final) to derive 12 % of EU total energy consumption from renewable sources by 2010 (at present, the 12 % aim applies only to the pre-2004 EU-15 Member States).

Between 1990 and 2002, the fastest-growing renewable energy source was wind with an average increase of 38 % per year, followed by solar energy. The increase in the use of wind to produce electricity was accounted for mainly by strong growth in Denmark, Germany and Spain, encouraged by support policies for the development of wind power. However, as wind and solar energy started from a very low level, they accounted for only 3.2 % and 0.5 % of total renewable energy consumption in 2002. Geothermal energy contributed 4.0 % of total renewable energy in 2002. The main sources of renewable energy were biomass and waste, and hydropower, accounting for 65.6 % and 26.7 % of total renewables, respectively.

A number of environmental concerns and a lack of suitable sites mean that large-scale hydropower is unlikely to contribute to significant future increases in renewable energy in the EU-25. Growth will therefore need to come from other sources such as wind, biomass, solar energy and small-scale hydropower. Expanding the use of biomass for energy purposes needs to take account of conflicting land-use for agricultural and forestry areas, and in particular nature conservation requirements.

Indicator definition

The share of renewable energy consumption is the ratio between gross inland consumption of energy from renewable sources and total gross inland energy consumption calculated for a calendar year, expressed as a percentage. Both renewable energy and total energy consumption are measured in thousand tonnes of oil equivalent (ktoe).

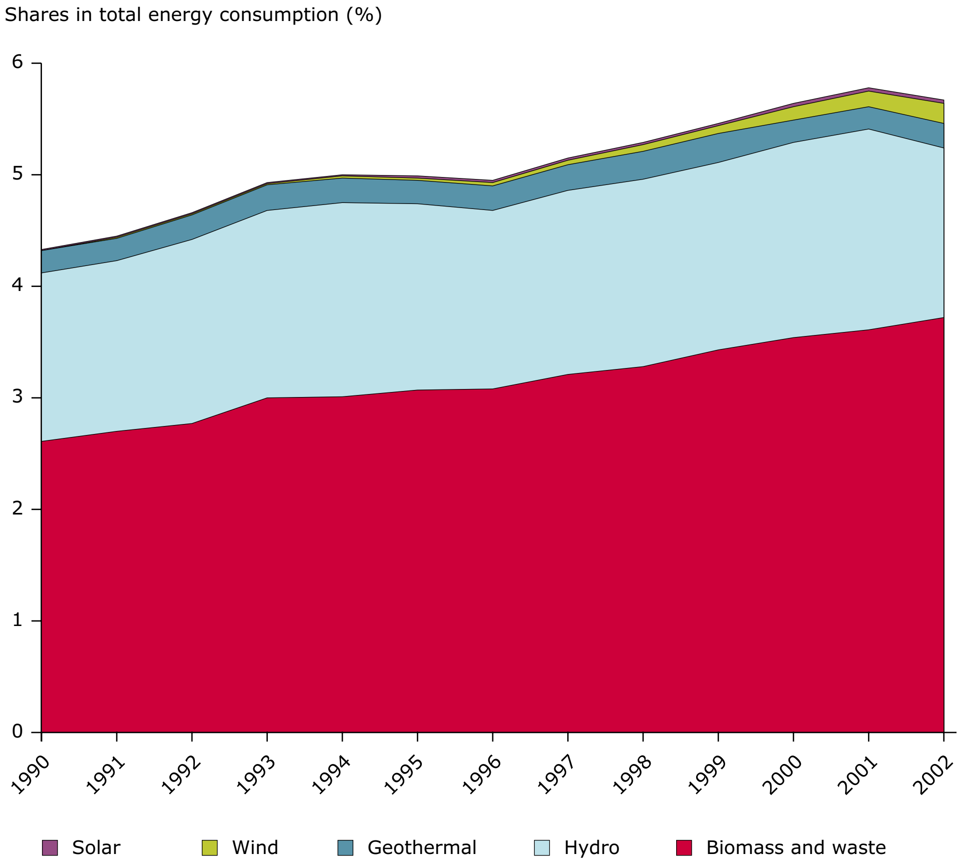
Renewable energy sources are defined as renewable non-fossil sources: wind, solar energy, geothermal energy, wave, tidal energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

Indicator rationale

The share of energy consumption from renewable energy provides a broad indication of progress towards reducing the environmental impact of energy consumption, although its overall impact has to be seen within the context of total energy consumption, the total fuel mix, potential impacts on biodiversity and the extent to which pollution abatement equipment is fitted.

Renewable energy sources are generally considered environmentally benign, with very low net emissions of CO_2 per unit of energy produced, even allowing for the emissions associated with the construction of the plant. Emissions of other pollutants are also often lower for renewable than for fossil fuel energy production. The exception is municipal and solid waste (MSW) incineration which, because of the cost associated with separation, usually involves the combustion of some mixed waste including materials contaminated

Figure 1 **Contribution of renewable energy sources to total energy consumption, EU-25**



Note: Data source: Eurostat (Ref: www.eea.eu.int/coreset).

with heavy metals. However, emissions from MSW incineration are subject to stringent regulations including tight controls on quantities of cadmium, mercury, and other such substances.

Most renewable (and non-renewable) energy sources have some impact on landscapes, noise and ecosystems, although many of these can be minimised through careful site selection. Large hydropower schemes in particular can have adverse impacts including flooding, disruption of ecosystems and hydrology, and socio-economic impacts if resettlement is required. Some solar photovoltaic schemes require relatively large quantities of heavy metals in their construction and geothermal energy can release pollutant gases carried by its hot fluid if not properly controlled. Some types of biomass and biofuel crops also have considerable land, water and agricultural input requirements such as fertilisers and pesticides.

Table 1 Share of renewable energy in total energy consumption (%)

	Share of renewable energy in total energy consumption (%) 1990-2002								
	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
EEA	5.4	6.1	6.1	6.3	6.5	6.7	6.8	6.8	6.8
EU-25	4.3	5.0	4.9	5.2	5.3	5.5	5.6	5.8	5.7
EU-15 pre-2004	4.9	5.3	5.3	5.5	5.6	5.6	5.8	5.9	5.8
EU-10	1.4	3.1	2.9	3.0	3.4	4.1	4.3	4.7	5.0
Austria	20.3	22.0	20.6	21.1	20.8	22.4	22.7	23.6	24.0
Belgium	1.4	1.4	1.3	1.2	1.3	1.3	1.3	1.4	1.6
Bulgaria	0.6	1.6	2.0	2.3	3.4	3.5	4.2	3.6	4.4
Cyprus	0.3	2.1	2.0	2.0	1.9	1.9	1.8	1.8	1.9
Czech Republic	0.3	1.5	1.4	1.6	1.6	2.0	1.6	1.8	2.2
Denmark	6.7	7.6	7.2	8.3	8.7	9.6	10.7	11.1	12.3
Estonia	4.7	9.1	10.4	10.7	9.7	10.4	11.0	10.6	10.5
Finland	19.2	21.3	19.8	20.6	21.8	22.1	24.0	22.7	22.2
France	7.0	7.6	7.2	6.9	6.8	7.0	6.8	6.8	6.1
Germany	1.6	1.9	1.9	2.2	2.4	2.6	2.9	2.8	3.1
Greece	5.0	5.3	5.4	5.2	4.9	5.4	5.0	4.6	4.7
Hungary	0.1	0.1	0.1	0.1	0.1	1.5	1.7	1.6	3.5
Iceland	65.8	64.9	65.5	66.8	67.6	71.3	71.4	73.2	72.8
Ireland	1.6	2.0	1.6	1.6	2.0	1.9	1.8	1.8	1.9
Italy	4.2	4.8	5.2	5.3	5.4	5.8	5.2	5.5	5.3
Latvia	9.4	6.8	4.5	7.6	11.4	30.1	28.8	35.0	34.8
Lithuania	0.2	0.4	0.3	0.3	6.5	7.9	9.0	8.3	8.0
Luxembourg	1.3	1.4	1.2	1.4	1.6	1.3	1.5	1.3	1.4
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	1.1	1.2	1.6	1.8	1.9	2.1	2.1	2.1	2.2
Norway	53.1	48.9	43.3	43.7	44.0	44.8	51.0	44.1	47.7
Poland	1.6	4.0	3.6	3.7	4.0	4.0	4.2	4.5	4.7
Portugal	15.9	13.3	16.1	14.7	13.6	11.1	12.9	15.7	14.0
Romania	4.2	6.2	12.9	11.2	11.8	12.5	10.9	9.3	10.5
Slovakia	1.6	3.0	2.8	2.6	2.7	2.8	3.0	4.1	3.9
Slovenia	4.6	8.9	9.4	7.7	8.3	8.8	11.6	11.5	11.0
Spain	7.0	5.5	7.0	6.4	6.3	5.2	5.8	6.5	5.6
Sweden	24.9	26.1	23.6	27.6	28.2	27.8	31.6	28.8	27.1
Turkey	18.5	17.4	16.6	15.8	15.9	15.1	13.1	13.1	12.9
United Kingdom	0.5	0.9	0.8	0.9	1.0	1.1	1.1	1.1	1.2

Note: Data source: Eurostat. No energy data for Liechtenstein available from Eurostat (Ref: www.eea.eu.int/coreset).

Policy context

Energy use (both energy production and final consumption) is the biggest contributor to greenhouse gas emissions in the EU. The energy-related share of these emissions increased from 79 % in 1990 to 82 % in 2002. Increased market penetration of renewable energy will help to reach the EU commitment under the Kyoto Protocol of the United Nations Framework Convention on climate change. The overall Kyoto target for the pre-2004 EU-15 Member States requires a 8 % reduction in emissions of greenhouse gases by 2008–2012 from 1990 levels, while most new Member States have individual targets under the Kyoto Protocol.

The main target for the indicator is defined in the White Paper for a Community Strategy and Action Plan (COM(97) 599 final), which provides a framework for action by Member States to develop renewable energy and sets an indicative target to increase the share of renewable energy in total energy consumption (GIEC) in the EU-15 to 12 % by 2010.

The biofuels directive (2003/30/EC) aims at promoting the use of biofuels to replace diesel and petrol in transport and sets an indicative target of a 5.75 % share of biofuels by 2010.

The Renewable Electricity Directive (2001/77/EC) sets an indicative target of 21 % of gross electricity consumption to be produced from renewable energy sources in the EU-25 by 2010.

Indicator uncertainty

Data have traditionally been compiled by Eurostat through the annual joint questionnaires, shared by Eurostat and the International Energy Agency, following a well-established and harmonised methodology. Methodological information on the annual joint questionnaires and data compilation can be found in Eurostat's website for metadata on energy statistics.

Biomass and waste, as defined by Eurostat, cover organic, non-fossil material of biological origin, which may be used for heat production or electricity generation. They comprise wood and wood waste, biogas, municipal solid waste (MSW) and biofuels. MSW comprises biodegradable and non-biodegradable waste produced by different sectors. Non-biodegradable municipal and solid waste are not considered to be renewable, but current data availability does not allow the non-biodegradable content of waste to be identified separately, except for industry.

The indicator measures the relative consumption of energy from renewable sources in total energy consumption for a particular country. The share of renewable energy could increase even if the actual energy consumption from renewable sources falls. Similarly, the share could fall despite an increase in energy consumption from renewable sources. CO_2 emissions depend not on the share of renewables but on the total amount of energy consumed from fossil sources. Therefore, from an environmental point of view, attaining the 2010 target for the share of renewable energy does not necessarily imply that CO_2 emissions from energy consumption will fall.

31 Renewable electricity

Key policy question

Are we switching to renewable energy sources to meet our electricity consumption?

Key message

The share of renewable energy in EU electricity consumption grew slightly over the period 1990–2001 but decreased in 2002 due to lower production from hydropower. Significant further growth will be needed to meet the EU indicative target of a 21 % share by 2010.

Indicator assessment

Renewable energy makes an important contribution to meeting electricity consumption with a share of 12.7 % in 2002. However, this share has not increased significantly since 1990 (12.2 %) despite growth in absolute terms. Total renewable electricity production grew by 32.3 % over the period 1990 to 2002, but this was only slightly faster than the growth in gross electricity consumption. Compared with 2001, the share of renewables in gross electricity consumption in 2002 declined by 1.5 percentage points due to lower production from hydropower, as a result of lower rainfall. Substantial growth is needed to meet the EU-25 indicative target of 21 % by 2010 set in Directive 2001/77/EC.

There are significant differences in the share of renewables between the EU-25 Member States. These reflect differences in the policies chosen by each country to support the development of renewable energy and the availability of natural resources.

Among the EU-25 in 2002, Austria had the largest share of renewable electricity in gross electricity consumption including large hydropower, and the third largest share excluding large hydropower. Denmark and Finland have the largest shares of renewable electricity in gross electricity consumption when large hydropower is excluded. Finland's high share is due mainly to electricity production from biomass, while Denmark's renewable electricity is produced by wind power and, to a much lesser extent, biomass and waste. In both these countries, government policies have been in place to encourage the growth of these technologies. In absolute terms, Germany has the largest production of renewable electricity excluding large hydropower, mainly from wind and biomass.

While large hydropower dominates renewable electricity production in most Member States, it is unlikely to increase significantly in the future in the EU-25 as a whole, due to environmental concerns and a lack of suitable sites. Other renewable energy sources, such as wind, biomass, solar and small-scale hydropower will therefore have to grow substantially if the 2010 target is to be met.

Indicator definition

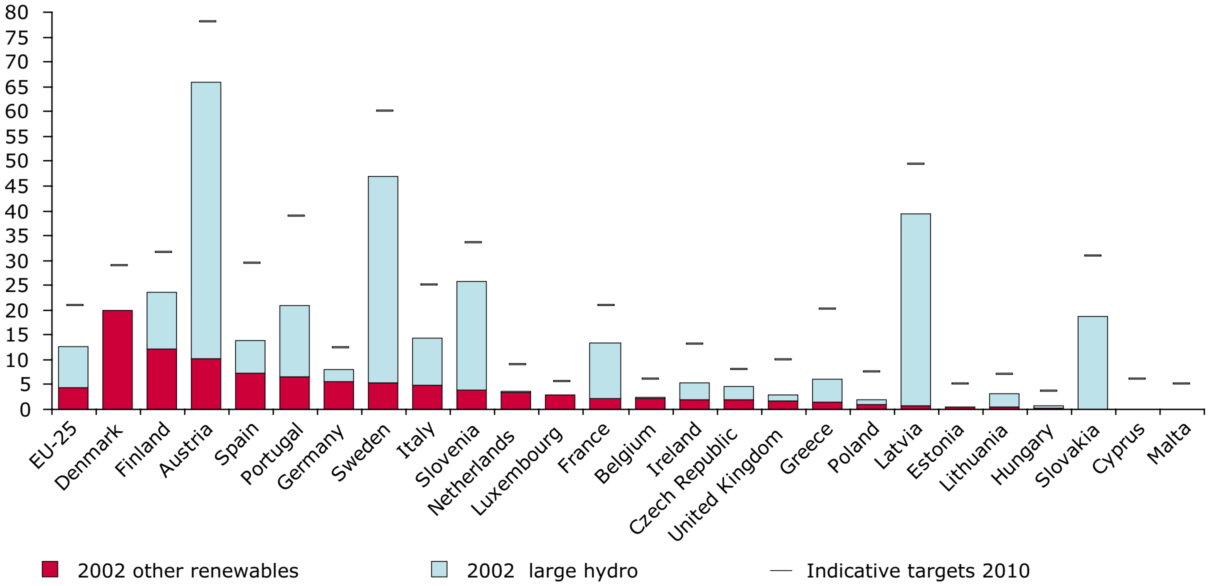
The share of renewable electricity is the ratio between the electricity produced from renewable energy sources and gross national electricity consumption calculated for a calendar year, expressed as a percentage. It measures the contribution of electricity produced from renewable energy sources to the national electricity consumption.

As well as being one of the EEA's core set indicators, it is also one of the *structural indicators* used to underpin the European Commission's analysis in its annual Spring report to the European Council. The methodologies are identical for both indicators.

Renewable energy sources are defined as renewable non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

Electricity produced from renewable energy sources comprises the electricity generation from hydroplants (excluding that produced as a result of pumping storage systems), wind, solar energy, geothermal energy and electricity from biomass/waste. Electricity from biomass/waste comprises electricity generated from wood/wood waste and the burning of other solid waste of a renewable nature (straw, black liquor), municipal solid

Figure 1 **Share of renewable electricity in gross electricity consumption in the EU-25 in 2002**



Note: The Renewable Electricity Directive (2001/77/EC) defines renewable electricity as the share of electricity produced from renewable energy sources in gross electricity consumption. The latter includes imports and exports of electricity. The electricity generated from hydropower storage systems is included in gross electricity consumption but it is not input as a renewable source of energy. Large hydropower plants have a capacity of more than 10 MW.

Data source: Eurostat.

waste incineration, biogas (including landfill, sewage, farm gas) and liquid biofuels.

Gross national electricity consumption comprises total gross national electricity generation from all fuels (including autoproduction), plus electricity imports, minus exports.

Indicator rationale

The share of electricity consumption from renewable energy sources provides a broad indication of progress towards reducing the environmental impact of electricity consumption, although its overall impact has to be seen within the context of total electricity consumption, the total fuel mix, potential impacts on biodiversity and the extent to which pollution abatement equipment is fitted.

Renewable electricity is generally considered environmentally benign, with very low net emissions of CO_2 per unit of electricity produced, even allowing for emissions associated with the construction of the electricity production facilities. Emissions of other pollutants are also generally lower for renewable electricity production than for electricity produced from fossil fuels. The exception to this is the incineration of municipal and solid waste (MSW), which, because of the high costs of separation, usually involves the combustion of some mixed waste including materials contaminated with heavy metals. Emissions to atmosphere from MSW incineration are subject to stringent regulations including tight controls on emissions of cadmium, mercury, and other such substances.

The exploitation of renewable energy sources usually has some negative impact on landscapes, habitats

Table 1 Share of renewable electricity in gross electricity consumption in the EU-25 (includes 2010 indicative targets)

	Share of renewable electricity in gross electricity consumption (%) 1990–2002 and 2010 indicative targets									
	1990	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2010 targets**
EEA	17.1	17.5	16.6	17.2	17.7	17.5	18.2	17.8	17.0	-
EU-25	12.2	12.7	12.4	12.8	13.1	13.1	13.7	14.2	12.7	21.0
EU-15 pre-2004	13.4	13.7	13.4	13.8	14.1	14.0	14.7	15.2	13.5	22.1
EU-10	4.2	5.4	4.8	5.0	5.7	5.5	5.4	5.6	5.6	-
Austria	65.4	70.6	63.9	67.2	67.9	71.9	72.0	67.3	66.0	78.1
Belgium	1.1	1.2	1.1	1.0	1.1	1.4	1.5	1.6	2.3	6.0
Bulgaria	4.1	4.2	6.4	7.0	8.1	7.7	7.4	4.7	6.0	-
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
Czech Republic	2.3	3.9	3.5	3.5	3.2	3.8	3.6	4.0	4.6	8.0
Denmark	2.4	5.8	6.3	8.8	11.7	13.3	16.4	17.4	19.9	29.0
Estonia	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.2	0.5	5.1
Finland	24.4	27.6	25.5	25.3	27.4	26.3	28.5	25.7	23.7	31.5
France	14.6	17.7	15.2	14.8	14.3	16.4	15.0	16.4	13.4	21.0
Germany	4.3	4.7	4.7	4.3	4.9	5.5	6.8	6.2	8.1	12.5
Greece	5.0	8.4	10.0	8.6	7.9	10.0	7.7	5.1	6.0	20.1
Hungary	0.5	0.7	0.8	0.8	0.7	1.1	0.7	0.8	0.7	3.6
Iceland	99.9	99.8	99.9	99.9	99.9	99.9	99.9	100.0	99.9	-
Ireland	4.8	4.1	4.0	3.8	5.5	5.0	4.9	4.2	5.4	13.2
Italy	13.9	14.9	16.5	16.0	15.6	16.9	16.0	16.8	14.3	25.0
Latvia	43.9	47.1	29.3	46.7	68.2	45.5	47.7	46.1	39.3	49.3
Lithuania	2.5	3.3	2.8	2.6	3.6	3.8	3.4	3.0	3.2	7.0
Luxembourg	2.1	2.2	1.7	2.0	2.5	2.5	2.9	1.5	2.8	5.7
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
Netherlands	1.4	2.1	2.8	3.5	3.8	3.4	3.9	4.0	3.6	9.0
Norway	114.6	104.6	91.4	95.3	96.2	100.7	112.2	96.2	107.2	-
Poland	1.4	1.6	1.7	1.8	2.1	1.9	1.7	2.0	2.0	7.5
Portugal	34.5	27.5	44.3	38.3	36.1	20.5	29.4	34.2	20.8	39.0
Romania	23.0	28.0	25.3	30.5	35.0	36.7	28.8	28.4	30.8	-
Slovakia	6.4	17.9	14.9	14.5	15.5	16.3	16.9	17.4	18.6	31.0
Slovenia	25.8	29.5	33.0	26.9	29.2	31.6	31.4	30.4	25.9	33.6
Spain	17.2	14.3	23.5	19.7	19.0	12.8	15.7	21.2	13.8	29.4
Sweden	51.4	48.2	36.8	49.1	52.4	50.6	55.4	54.1	46.9	60.0
Turkey	40.9	41.9	43.0	38.1	37.3	29.5	24.3	19.1	25.6	-
United Kingdom	1.7	2.0	1.6	1.9	2.4	2.7	2.7	2.5	2.9	10.0

Note: Almost all electricity generated in Iceland and Norway comes from renewable energy sources. The renewable electricity share in Norway is above 100 % in some years because a part of the (renewable) electricity generated domestically is exported to other countries. The share of renewable electricity in Germany in 1990 refers to West Germany only. National indicative targets for the share of renewable electricity in 2010 are taken from Directive 2001/77/EC. Notes to their 2010 indicative targets are made by Italy, Luxemburg, Austria, Portugal, Finland and Sweden in the directive; Austria and Sweden note that reaching the target is dependent upon climatic factors affecting hydropower production, with Sweden considering 52 % a more realistic figure if long-range models on hydrologic and climatic conditions were applied. No energy data for Liechtenstein available from Eurostat.

Data source: Eurostat (Ref: www.eea.eu.int/coreset).

and ecosystems, although many of the impacts can be minimised through careful site selection. Large hydropower schemes in particular can have adverse impacts including flooding, disruption of ecosystems and hydrology, and socio-economic impacts if resettlement is required. Some solar photovoltaic schemes require relatively large quantities of heavy metals in their construction, and geothermal energy can release pollutant gases carried by hot fluids if not properly controlled. Wind turbines can have visual and noise impacts on the areas in which they are sited. Some types of biomass crops have considerable land, water and agricultural input requirements such as fertilisers and pesticides.

Policy context

The original EU Directive on the promotion of electricity from renewable energy sources in the internal electricity market (2001/77/EC) sets an indicative target of 22.1 % of gross EU-15 electricity consumption from renewable sources by 2010. It requires Member States to set and meet national indicative targets consistent with the directive and national Kyoto Protocol commitments. For the EU-10 Member States, national indicative targets are included in the accession treaty: the 22.1 % target set initially for the EU-15 for 2010 becomes 21 % for the EU-25.

The power sector is responsible for a significant share of European greenhouse gas emissions and increased market penetration of renewable electricity would therefore help to reach the EU commitment under the Kyoto Protocol. The overall Kyoto target for the pre-2004 EU-15 Member States requires an 8 % reduction in emissions of greenhouse gases by 2008–2012 from 1990 levels, while most EU-10 Member States have individual targets under the Kyoto Protocol.

Indicator uncertainty

Data have traditionally been compiled by Eurostat through the annual joint questionnaires, shared by Eurostat and the International Energy Agency, following a well-established and harmonised methodology. Methodological information on the annual joint questionnaires and data compilation can be found on Eurostat's website for metadata on energy statistics.

The Renewable Electricity Directive (2001/77/EC) defines the share of renewable electricity as the percentage of electricity produced from renewable energy sources in gross electricity consumption. The numerator includes all electricity generated from renewable sources, most of which is for domestic use. The denominator contains all electricity consumed in a country, thus including imports and excluding exports of electricity. Therefore, the share of renewable electricity can be higher than 100 % in a country if all electricity is produced from renewable sources and some of the over-generated renewable electricity is exported to a neighboring country.

Biomass and waste, as defined by Eurostat, cover organic, non-fossil material of biological origin, which may be used for heat production and electricity generation. They comprise wood and wood waste, biogas, municipal solid waste (MSW) and biofuels. MSW comprises biodegradable and non-biodegradable waste produced by different sectors. Non-biodegradable municipal and solid waste are not considered to be renewable, but current data availability does not allow the non-biodegradable content of waste to be identified separately, except for industry.

The electricity produced as a result from hydropower storage systems (i.e. that needed electricity to be filled) is not classified as a renewable source of energy in terms of electricity production, but is part of the gross electricity consumption in a country.

The share of renewable electricity could increase even if the actual electricity produced from renewable sources falls. Similarly, the share could fall despite an increase in electricity generation from renewable sources. Therefore, from an environmental point of view, attaining the 2010 target for the share of renewable electricity does not necessarily imply that carbon dioxide emissions from electricity generation will fall.

32 Status of marine fish stocks

Key policy question

Is the use of commercial fish stocks sustainable?

Key message

Many commercial fish stocks in European waters remain non-assessed. Of the assessed commercial stocks in the north-east Atlantic, 22 to 53 % are outside safe biological limits (SBL). Of the assessed stocks in the Baltic Sea, the West Ireland Sea and the Irish Sea, 22, 29 and 53 %, respectively, remain outside SBL. In the Mediterranean, the percentage of stocks outside SBL range from 10 to 20 %.

Indicator assessment

Many commercial fish stocks in European waters remain non-assessed. In the north-east Atlantic, the percentage of non-assessed stocks of economic importance range from a minimum of 20 % (North Sea) to a maximum of 71 % (West Ireland) which is an increase from 13 % and 59 % respectively in the previous assessment in 2002. The Baltic Sea also shows a high percentage of non-assessed stocks at 67 % compared with the previous 56 %. In the Mediterranean region, the percentage is much higher with an average of 80 %, and a range from 65 % in the Aegean Sea to 83 % in the Adriatic (the previous highest value was 90 % in the South Alboran Sea).

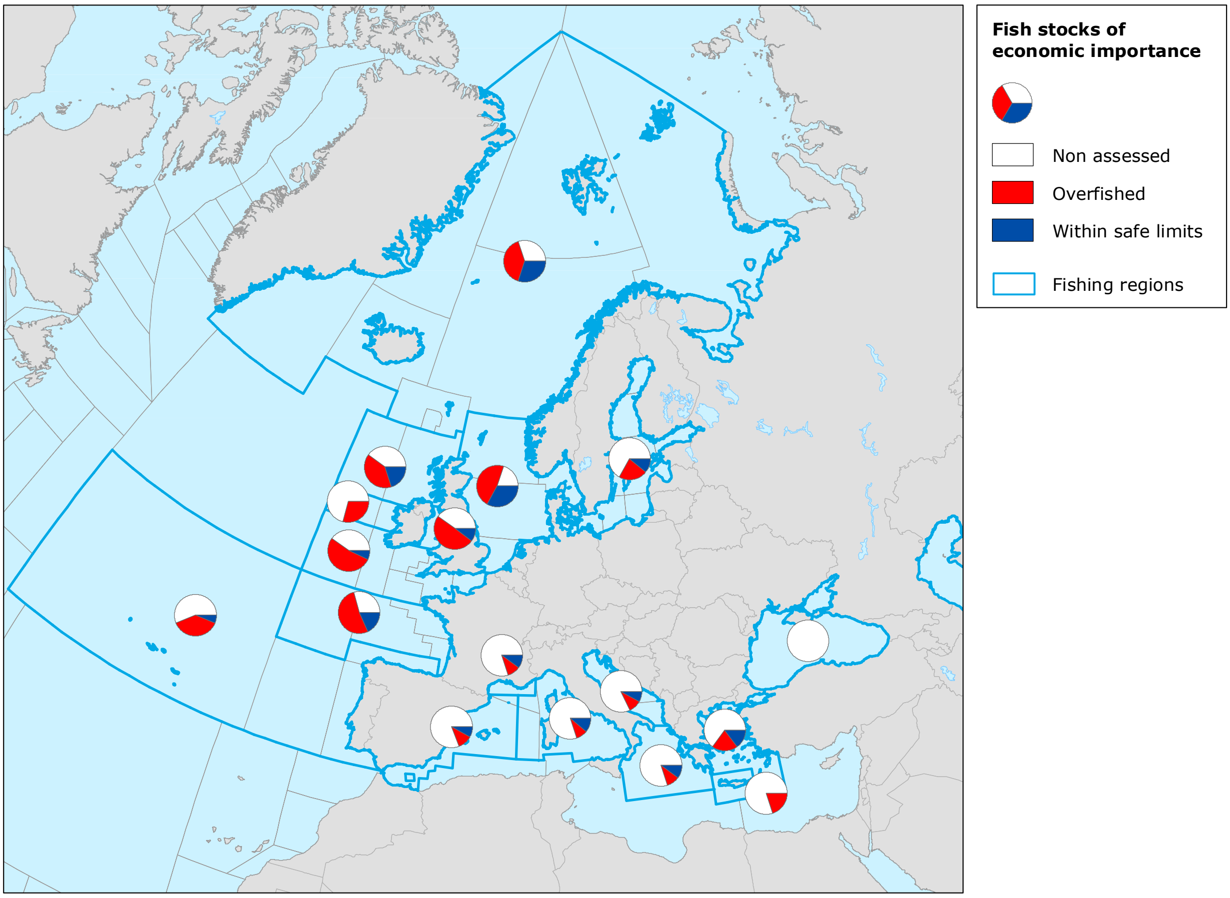
Of the assessed commercial stocks in the north-east Atlantic, 22 to 53 % are outside safe biological limits (SBL). This is an improvement compared with the last record of 33-60 %. Of the assessed stocks in the Baltic and West Ireland Seas, 22 and 29 %, respectively, are over-fished (33 % in the past) while 53 % of stocks in the Irish Sea remain outside SBL (past record held by West of Scotland at 60 %). In the Mediterranean the percentage of stocks outside SBL range from 10 to 20 %, with the Aegean and the Cretan Sea being in the worst condition.

Examination of 'safe' stocks in the north-east Atlantic shows a slight decline ranging between 0 and 33 %; these values correspond to the West Ireland and North Sea, respectively. The last assessment of 2002 showed a range of 5 to 33 % for the Celtic Sea/Western Channel and the Arctic, respectively. In the Mediterranean, the range extends from 0 % (Cretan Sea) to 11 % (Sardinia) compared with a minimum of 0 % (S. Alboran and Cretan Seas) and a maximum of 15 % (Aegean Sea) in 2002.

When examining the European stocks more closely, the following conclusions can be drawn:

- The recovery of herring stocks appears to continue.
- Almost all round fish stocks have declined and are currently not sustainable.
- Pelagic and industrial species remain in better condition but still need to be subject to reduced fishing rates.
- In the Mediterranean region, only two demersal and two small pelagic stocks are monitored by the General Fisheries Commission for the Mediterranean (GFCM), with a limited spatial coverage. Demersal stocks remain outside safe biological limits. Many assessments that cover wider areas are based on preliminary results. Small pelagic stocks in the same area exhibit large-scale fluctuations but are not fully exploited anywhere, except for anchovy and pilchard in the Southern Alboran and Cretan Seas.
- According to the latest assessment by the International Commission for the Conservation of Atlantic Tunas (ICCAT) a strong recruitment of swordfish over recent years has rendered the exploitation of the stock sustainable. Concern still remains about the over-exploitation of bluefin tuna. Uncertainties of stock assessment and lack of documented reporting (including EU Member States) still hinder management of these highly migratory species. Bluefin tuna catches continue to exceed the sustainable rate and, despite ICCAT recommendations for both the Atlantic and the Mediterranean, no measures (despite reductions in total allowable catches) have been enforced.

Map 1 **Status of commercial fish stocks in European Seas, 2003–2004**



Note: Data source: GFCM, ICCAT, ICES (Ref: www.eea.eu.int/coreset).

Indicator definition

The indicator tracks the ratio of the number of over-fished stocks to the total number of commercial stocks per fishing area in European seas. The indicator also contains information on: 1) number of commercial, exploited and over-fished stocks by sea area and 2) the state of commercial stocks (over-fished stocks per area), safe stocks, stocks for which an assessment has not been carried out, and stocks of non-commercial importance in the particular area.

Landings and spawning stock biomass are given in thousand tonnes, recruitment in million tonnes; fishing mortality is expressed as the proportion of a stock that is removed by fishing activities in a year.

Indicator rationale

EU policies, and in particular the common fisheries policy (CFP), aim for sustainable fishing over a long period through appropriate management of fisheries

Figure 1 **State of commercial fish stocks in the Mediterranean Sea up to 2004**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Anchovy	4		2			4	4	1	1	1	1	1	1	1	1	2	4	1	1	1		1	1							
Black Sea whiting																														
Blue whiting																														
Bogue																						1								
Breams			1																			1								
Flat fish																														
Greater forkbread																														
Gurnads																														
Grey mullet																														
Hake	4				n	4	3	1	3	1	1	1	1	1	1	1	1	1	1	1		1	1							
Horse mackerel			n																			1								
Mackerel																														
Megrim																														
Pilchard	4		n			4	4	1	1	1	1	1	1	1	1	1	4	1	1	1		1	1							
Poor cod																														
Red mullet	4		n		n	4	1	1	3	3	4	1	1	1	1	1	1	1	1	1		1	1							
Sea bass																														
Sardinella																														
Sole																														
Sprat																														
Bluefin tuna																														
Swordfish	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4			

Note: 1. Northern Alboran, 2. Alboran Island Sea, 3. Southern Alboran Sea, 4. Algeria, 5. Balearic Island, 6. Northern Spain, 7. Gulf of Lions, 8. Corsica Island, 9. Ligurian and North Tyrrhenian Sea, 10. South and Central Tyrrhenian Sea, 11. Sardinia, 12. Northern Tunisia, 13. Gulf of Hammamet, 14. Gulf of Gabes, 15. Malta Island, 16. South of Sicily, 19. Western Ionian Sea, 20. Eastern Ionian Sea, 21. Libya, 17. Northern Adriatic, 18. Southern Adriatic Sea, 22. Aegean Sea, 23. Crete Island, 24. South of Turkey, 25. Cyprus Island, 26. Egypt, 27. Levant, 28. Marmara Sea, 29. Black Sea, 30. Azov Sea.
Colour coding:
Blue = within safe biological limits;
Red = outside safe biological limits;
Grey = no assessment;
1, 2, 3, 4 in the cells refer to the year of assessment, i.e. 2001 (in 2002 report), 2002, 2003 and 2004 respectively;
n = new assessment.
Data source: GFCM, ICCAT (Ref: www.eea.eu.int/coreset).

within a healthy ecosystem, while offering stable economic and social conditions for all involved in the activity. An indication of the sustainability of fisheries in a particular area is the ratio of the number of over-fished stocks (those that are outside safe biological limits) to the total number of commercial stocks (for which an assessment of status has been carried out). A high value of this ratio identifies areas under heavy pressure from fishing.

In general, a stock becomes over-fished when mortality from fishing and other causes exceeds recruitment and growth. A fairly reliable picture of stock development can be derived by comparing trends over time in recruitment, spawning stock biomass, landings and fish mortality. Hence not only the quantity of fish taken from the sea is important, but also their species and size, and the techniques used to catch them.

Policy context

The sustainable exploitation of fish stocks is regulated through the EU Common Fisheries Policy (OJ C 158 27.06.1980). Regulatory arrangements, identifying harvesting levels based on the CFP, the precautionary principle and multiannual fisheries plans, were set through the Cardiff European Council (COM (2000) 803). Total Allowable Catches (TAC) and quotas for the stocks in the north-east Atlantic and the Baltic Sea are set annually by the Fisheries Council. In the Mediterranean Sea, where no TAC have been set except for the highly migratory tuna and swordfish, fisheries management is achieved by means of closed areas and seasons to keep fishing effort under control and make exploitation patterns more rational. The General Fisheries Council for the Mediterranean (GFCM) attempts to harmonise the process.

The latest action plan on fisheries management as part of the CFP reform was presented to the Fisheries Council in October 2002, and Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the common fisheries policy is now in force.

A new set of regulations has since been adopted on specific issues.

Indicator uncertainty

All international fisheries organisations use the same principles to determine the state of the stocks, and ICES has fine-tuned the methodology used. However, decisions are based on safety margins usually set at 30 % above safe limits which in turn bears a degree of uncertainty since estimates of fishing mortality (F) and spawning stock biomass (SSB) are themselves uncertain; the decision on the reference points is then a task for managers, not scientists.

Species and spatial coverage for the Mediterranean is limited. No reference points have been defined for the Mediterranean stocks. The detailed stock assessments for the north-east Atlantic and Baltic are obtained through the International Council for the Exploration of the Seas (ICES). In the Mediterranean, stock assessments are carried out by the General Fisheries Council for the Mediterranean (GFCM) and, in the absence of complete or independent information on fishing intensity or fishing mortality, are based mainly on landings. Stock assessment is thus based mainly on analysis of landing trends, biomass surveys, and analysis of commercial catch per unit effort (CPUE) data.

Data sets are fragmented both temporally and spatially. Monitoring activities are based on scientific surveys rather than commercial catches, resulting in low values of SSB estimates and thus biased exploitation patterns. In the Mediterranean, fisheries management is considered to be at an early stage compared with the north-east Atlantic. Catch and effort statistics are not considered to be fully reliable and much effort is directed at estimation of corrective factors.

Different approaches are being used in the Mediterranean and the north-east Atlantic to determine whether a stock is outside safe biological limits.

33 Aquaculture production

Key policy question

Is the current level of aquaculture sustainable?

Key message

European aquaculture production has continued to increase rapidly during the past 10 years due to expansion in the marine sector in the EU and EFTA countries. This represents a rise in pressure on adjacent water bodies and associated ecosystems, resulting mainly from nutrient release from aquaculture facilities. The precise level of local impact will vary according to production scale and techniques as well as the hydrodynamics and chemical characteristics of the region.

Indicator assessment

A significant increase in total European aquaculture production has been observed in the past 10 years. However it has not been uniform across countries or production systems. Only the mariculture sector has experienced a significant increase, while brackish water production has increased at a much slower rate and the levels of freshwater production have declined. Europe's fish farms fall into two distinct groups: the fish farms in western Europe grow high-value species such as salmon and rainbow trout, frequently for export, whereas lower-value species such as carp are cultivated in central and eastern Europe, mainly for local consumption.

The biggest European aquaculture producers are found in the EU and EFTA region. Norway has the highest production with more than 500 000 tonnes in 2001, followed by Spain, France, Italy and the United Kingdom. These five countries account for 75.5 % of all aquaculture production in 34 European countries. Turkey's production of 67 000 tonnes represents the highest production in the EU accession countries and Balkan region. The country ranking in 2001 in terms of production was very similar to that in 2000.

Norway is the dominant aquaculture producer with about 90 % of its production being Atlantic salmon. It is noteworthy that in 2001, farming of this single species in Norway exceeded the combined total of all production species from all EU accession countries and Balkan countries. Spain is the next biggest producer with production dominated by blue mussel, followed by France, with production dominated by the Pacific cupped oyster (*Crassostrea gigas*). Turkish production consists mainly of trout, sea bream and sea bass.

The major part of the increase in aquaculture production has been in marine salmon culture in northwest Europe, and to a lesser extent trout culture (throughout western Europe and Turkey), seabass and seabream cage culture (mainly Greece and Turkey), and mussel and clam cultivation (throughout western Europe), which, however, exhibits a downward trend since 1999. In contrast, inland aquaculture of carp (mainly common and silver carp) has declined significantly throughout eastern and central Europe (EU accession countries and Balkan countries) due partly to political and economic changes in eastern Europe. As in the case of production per country, no significant changes have been observed in production by major species since the last assessment (2000).

Different types of aquaculture generate very different pressures on the environment, the main ones being discharges of nutrients, antibiotics and fungicides. The main environmental pressures are associated with intensive finfish production, mainly salmonids in marine, brackish and freshwaters, and seabass and seabream in the marine environment — sectors which have experienced the highest growth rate in recent years. The pressures associated with the cultivation of bivalve molluscs are generally considered to be less severe than those from intensive finfish cultivation. Pond aquaculture of carp in inland waters usually requires less intensive feeding, and in most cases a greater proportion of the nutrients discharged are assimilated locally. Chemicals, particularly formalin and malachite green, are used in freshwater farms to control fungal and bacterial diseases. In marine farms, antibiotics are used for disease control but the amounts used have been reduced drastically in recent years following the introduction of vaccines. In general, significant improvements in the efficiency of feed and nutrient utilisation as well as environmental management have served to partially mitigate the associated increase in environmental pressure.

The environmental pressures exerted by aquaculture are not uniform. The level of local impact will vary according to production scale and techniques as well as the hydrodynamics and chemical characteristics of the region.

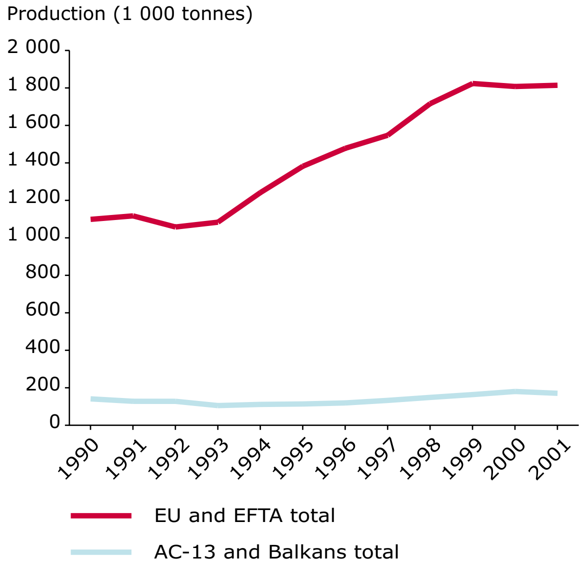
Of the EU countries, Spain, France and the Netherlands, and of the accession countries, Turkey, have the greatest marine aquaculture production in relation to coastline length. Aquaculture production intensity as measured per unit coastline length has reached an average of around 8 tonnes per km of coastline in EU and EFTA countries compared with 2 tonnes per km in the EU accession countries and Balkan region. The pressure is likely to continue to increase as the production of new species such as cod, halibut and turbot becomes more reliable.

Marine finfish culture (mainly Atlantic salmon) is making a significant contribution to nutrient loads in coastal waters, particularly in the case of countries with relatively small total nutrient discharges to coastal waters. For example in Norway (Norwegian and North Sea coasts), phosphorus discharge from mariculture appear to exceed the total from other sources. In general, the pressure from nutrients from the intensive cultivation of marine and brackish water is becoming significant in the context of total nutrient loadings to coastal environments. However the published data on total nutrient loadings to coastal waters remains poor in quality and inconsistent in coverage; the conclusions should therefore be treated with caution.

Indicator definition

The indicator quantifies the development of European aquaculture production by major sea area and country as well as the contribution of aquaculture discharges

Figure 1 **Annual aquaculture production by major area (EU and EFTA, and EU accession countries and Balkans), 1990–2001**



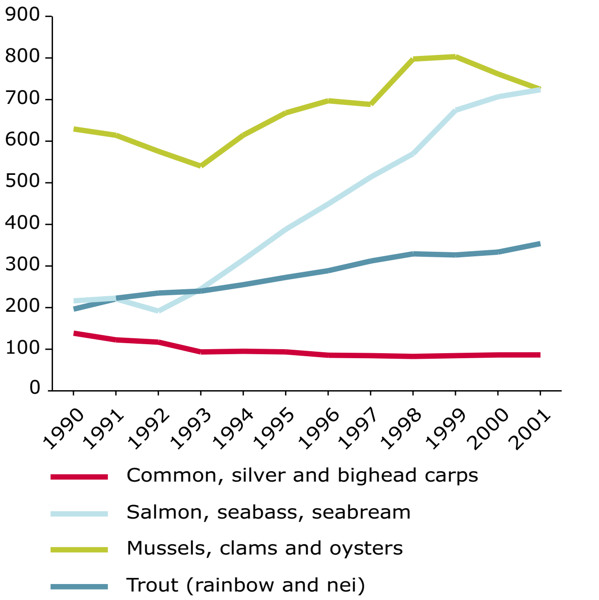
Note: Aquaculture production includes all environments, i.e. marine, brackish and freshwater.

EU and EFTA: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, the United Kingdom, Iceland, Norway and Switzerland;
EU accession countries and Balkans: Albania, Bulgaria, Czech Republic, Croatia, Estonia, FYR Macedonia, Hungary, Latvia, Lithuania, Poland, Romania, Yugoslavia, Slovak Republic, Slovenia, Cyprus, Malta and Turkey.

Luxembourg, Liechtenstein and Bosnia-Herzegovina are not included due to either no aquaculture production or lack of data.

Data source: UN Food and Agriculture Organization (FAO) Fishstat Plus (Ref: www.eea.eu.int/coreset).

Figure 2 **Annual production of major commercial aquaculture species groups, 1990–2001**



Note: Includes all countries and production environments for which data are available.

nei = not elsewhere indicated; trout (rainbow and nei) includes all species of trout.

Data source: FAO Fishstat Plus (Ref: www.eea.eu.int/coreset).

of nutrients relative to the total discharges of nutrients into coastal zones.

Production is measured in thousand tonnes, while marine aquaculture production relative to coastline length is given in tonnes/km.

Indicator rationale

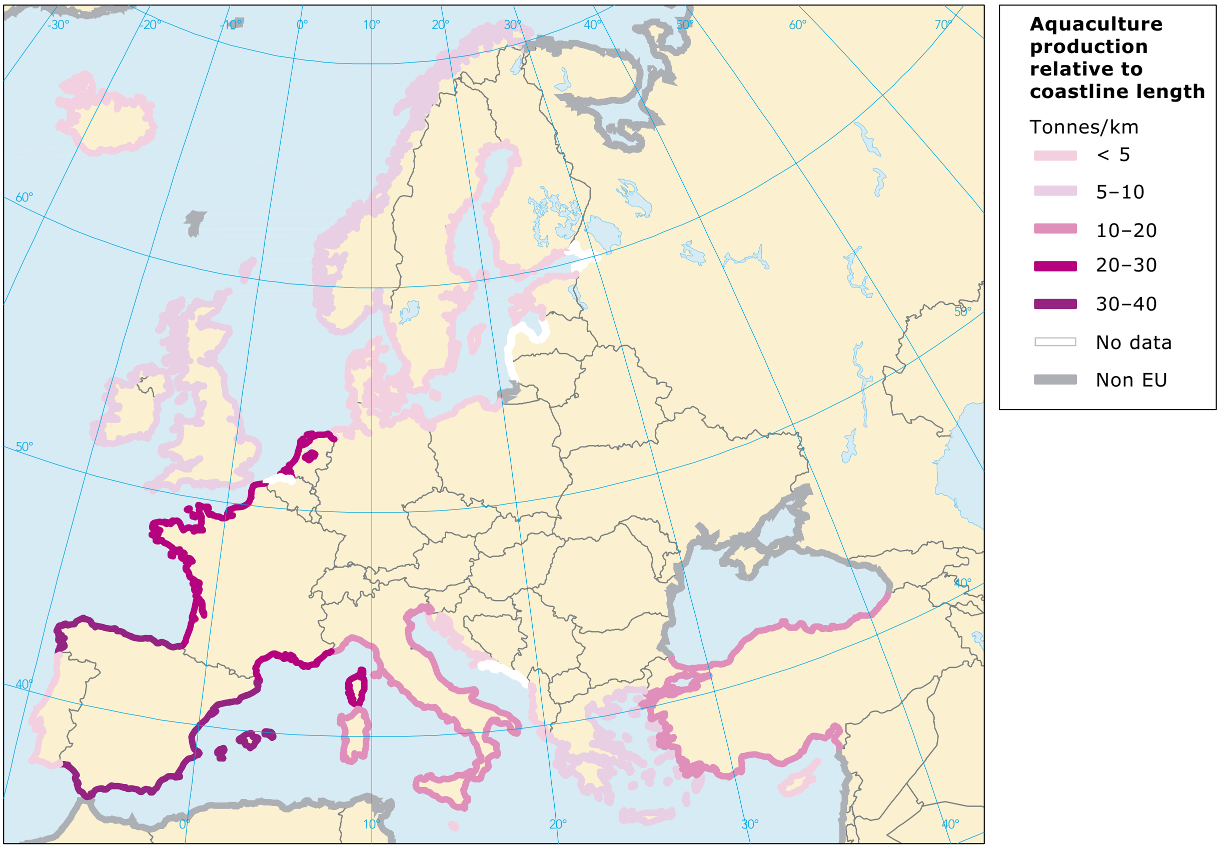
The indicator tracks aquaculture production and nutrient discharges and thereby provides a measure of the pressures of aquaculture on the marine environment. It is a simple and readily-available indicator but, as a stand-alone indicator, its meaning and relevance are limited because of widely varying production practices and local conditions. It needs to be integrated with other indicators related to production practices (such as total nutrient production or total chemical discharge) to generate a more specific indicator of pressure. Coupled with information on the assimilative capacity of different habitats, such an indicator would allow estimation of impact and ultimately the proportion of the carrying capacity of the surrounding environment used and the limits to expansion.

Policy context

Until recently there was no general policy for European aquaculture, although the Environmental Impact Assessment (EIA) Directive (85/337/EEC and amendment 97/11/EEC) requires specific farms to undergo EIA and the water framework directive requires all farms to meet environmental objectives for good ecological and chemical status of surface waters by 2015. There are few national policies specifically addressing the diffuse and cumulative impacts of the sector as a whole on aquatic systems, or the need to limit total production in line with the assimilative capacity of the environment. However, limits on feed inputs in some countries, such as Finland, effectively limit production.

The new reformed common fisheries policy (CFP) aims to improve the management of the sector. In September 2002, the Commission presented a communication on 'a strategy for the sustainable development of European aquaculture' to the Council and to the European Parliament. The main aim of the strategy is the maintenance of competitiveness, productivity and sustainability of the European aquaculture sector. The strategy has three main objectives: 1) to create secure employment; 2) to provide safe and good quality fisheries products and promote animal health and welfare standards; and 3) to ensure an environmentally sound industry.

Map 1 **Marine aquaculture production relative to coastline length**



Note: Only marine and brackish waters production.

Average production density values for countries with a coastline and with coastline data available. Based on latest year for which there are data, i.e. 2001 for all countries except Bulgaria (2000), Estonia (1995) and Poland (1993).

Data source: FAO Fishstat Plus and World Resources Institute (Ref: www.eea.eu.int/coreset).

Indicator uncertainty

The weakness of the indicator relates to the validity of the relationship between production and pressure. Production acts as a useful, coarse indicator of pressure but variations in culture species, production systems and management approaches mean that the relationship between production and pressure is non-uniform.

34 Fishing fleet capacity

Key policy question

Is the size and capacity of the European fishing fleet being reduced?

Key message

The size of the EU fishing fleet is following a downward trend, with reductions of 19 % in power and 11 % in tonnage in the period 1989–2003, and 15 % in numbers in the period 1989–2002. Similarly, the combined fleet of Estonia, Cyprus, Lithuania, Latvia, Malta, Poland and Slovenia decreased its tonnage by 50 % over the period 1992–1995. However, the EFTA fleet increased in terms of power (by 12 %; 1997–2002) and tonnage (by 34 %; 1989–2003) despite a drop in numbers by 40 % (1989–2002).

Indicator assessment

Power and tonnage are the main factors that determine the capacity of a fleet and thus approximate to the pressure on the fish stocks. Excess power is considered to be one of the major factors that lead to over-fishing.

Currently, the total power of the fishing fleet amounts to 7 122 145 kW in the EU-15 (2003) and 2 503 580 kW in EFTA (2002). Data for Estonia, Cyprus, Lithuania, Latvia, Malta, Poland, Slovenia, Bulgaria and Romania are not available. Over the past 15 years the EU fleet capacity in terms of power has been gradually decreasing, but the power of the EFTA fleet increased at a considerable rate of almost 13 % over the period 1997–2002. Norway, Italy, Spain, France and the United Kingdom retain the largest power in their fleets, which accounted for almost 70 % of the total fleet in 2003.

In 2003, the fishing fleet tonnage (GRT) consisted of 1 922 912 tonnes in the EU-15 and 579 097 tonnes in the EFTA countries. The last recorded census for Estonia, Cyprus, Lithuania, Latvia, Malta, Poland and Slovenia, in 1995, reported 543 631 tonnes. In the period 1989–2003, the EU fleet was gradually reduced in tonnage by approximately 10 %; at the same time the EFTA fleet experienced an almost 30 % increase (Figure 3). The fleets of Estonia, Cyprus, Lithuania, Latvia, Malta, Poland and Slovenia faced a dramatic decrease of 50 %, and those of Bulgaria and Romania 70 %, due to the restructuring of the economies of the new EEA member countries; there are no data available on fleet tonnage in these countries beyond 1995. Currently, Spain, Norway,

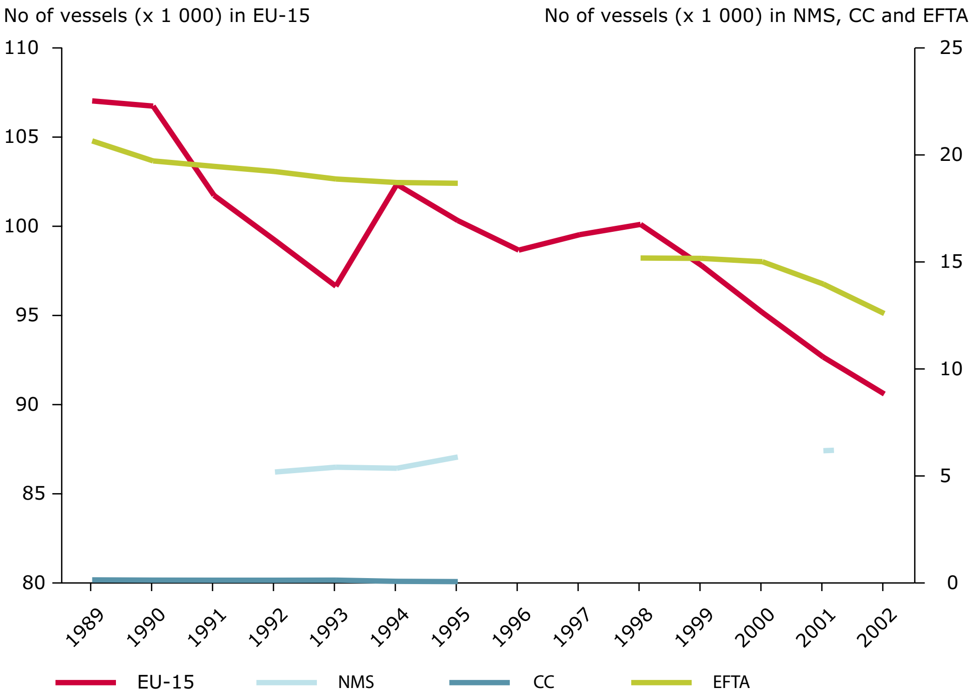
Figure 1 Changes in European fishing fleet capacity: 1989–2003

Note: Power changes refer to 1989–2003 for the EU-15 and 1997–2002 for EFTA.
Tonnage changes refer to 1989–2003 for the EU and EFTA; 1992–1995 for NMS and CC countries (see legend).
Number changes refer to 1989–2002 for the EU and EFTA; 1992–2001 for NMS; and 1992–1995 for CC countries.

Legend: Countries have been grouped into the following categories:
EU-15 (Austria, Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Finland, Sweden, the United Kingdom);
EFTA (Iceland and Norway);
New Member States (Estonia, Cyprus, Lithuania, Latvia, Malta, Poland and Slovenia);
Candidate countries (Bulgaria and Romania).

Data source: DG Fisheries, Eurostat, UN Food and Agriculture Organization (FAO) .

Figure 2 **European fishing fleet capacity: number of vessels**



Note: Data availability: Number of vessels 1989–2002 for EU-15; 1989–1992 and 1998–2002 for EFTA; 1989–1995 and 2001 for NMS (see legend); 1992–1995 and 2001 for Bulgaria and Romania.

Legend: Countries have been grouped into the categories as in Figure 1.

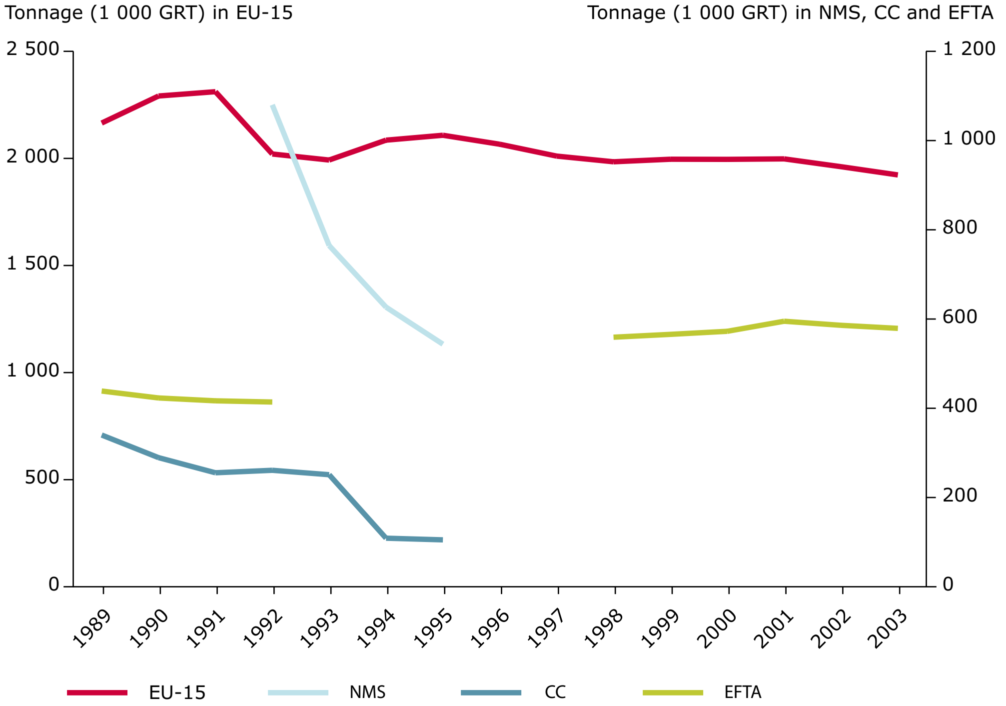
Data source: DG Fisheries, Eurostat, FAO (Ref: www.eea.eu.int/coreset).

the United Kingdom, France, Italy and the Netherlands retain the fleets of largest tonnage, accounting for almost 70 % of the total fleet in 2003.

In 2002 there were 90 595 fishing vessels in the EU-15 and 12 589 in the EFTA countries. According to DG Fisheries, the fleets of Estonia, Cyprus, Lithuania, Latvia, Malta, Poland and Slovenia amounted to approximately 6 200 vessels in 2001. Both EU and EFTA fleets have been gradually reduced in size over the past 15 years, whereas the fleet of Estonia, Cyprus, Lithuania, Latvia, Malta, Poland and Slovenia has increased gradually over the past 10 years (Figure 2). It is noteworthy that the peak value observed in 1994 was due to the introduction of new countries, namely Finland and Sweden, into the registry. Greece, Italy, Spain, Norway and Portugal retain the largest number of vessels, accounting for almost 70 % of the total fleet in 2003. In the case of Greece and Portugal, a comparison of the number of vessels with the fleet capacity indicates that these two fleets consist mainly of small vessels.

Despite the overall drop in size and capacity (power and tonnage) experienced by the EU fleet in the past 15 years, no visible improvement in the condition of the fish stocks has been observed. According to DG Fisheries *One of the most fundamental and enduring problems of the common fisheries policy has been the chronic overcapacity of the EU fleet. Conservation measures have persistently been undermined by fishing activities at levels well beyond the level of pressure that the available fish stocks*

Figure 3 **European fishing fleet capacity: tonnage**



Note: Data availability: 1989–2003 for EU-15; 1989–1992 and 1998–2003 for EFTA; 1992–1995 for NMS (see legend); 1989–1995 for CC countries.

Legend: Countries have been grouped into the categories as in Figure 1.

Data source: DG Fisheries, Eurostat, FAO (Ref: www.eea.eu.int/coreset).

could safely withstand. As new technology makes fishing vessels ever more efficient, the capacity of the fleet should be reduced to maintain a balance between fishing capacity and the quantities of fish that can safely be taken out of the sea by fishing. The multiannual guidance plans (MAGPs) have proved inadequate and have been replaced by a simpler scheme in the reformed common fisheries policy (January 2003).

Indicator definition

The indicator is a measure of the size and capacity of the fishing fleet, which in turn is assumed to approximate to the pressure on marine fish resources and the environment.

The size of the European fishing fleet is presented as the number of vessels, the capacity as the total engine power in kW, and the total tonnage in tonnes.

Indicator rationale

Fishing capacity, defined in terms of tonnage and engine power and sometimes number of vessels, is one of the key factors that determine the fishing mortality caused by the fleet. In simple terms, excess capacity leads to over-fishing and increased environmental pressure which undermines the principle of sustainable use. As new technology makes fishing vessels ever more efficient, the size and capacity of the fleet should be reduced to maintain a balance between fishing pressure and the quantities of fish available. Four multiannual guidance plans (MAGPs) were established to achieve sustainability by setting, for each coastal Member State, maximum levels of fishing capacity by types of vessel. However, MAGPs failed to meet expectations and proved cumbersome to manage. MAGP IV, which ended in December 2002, has therefore been replaced by a simpler scheme. Under the new scheme the fleet capacity will be reduced gradually, i.e. the introduction of new capacity into the fleet without public aid must be compensated by the withdrawal of at least an equivalent capacity, also without public aid.

Policy context

EU policies aim to achieve sustainable fishing over a long period within a sound ecosystem through appropriate management of fisheries, while offering stable economic and social conditions for all those involved in the fishing activity.

Sustainable exploitation of the fish stocks is ensured through the EU Common Fishery Policy (OJ C 158 27.06.1980).

Within the four MAGPs, an effort has been made to achieve a sustainable balance between the fleet and available resources. Commission Regulation (EC) No 2091/98 of 30 September 1998 dealt with the segmentation of the Community fishing fleet and fishing effort in relation to the multiannual guidance programmes, and Council regulation (EC) 2792/1999 laid down the detailed rules and arrangements regarding Community structural assistance in the fisheries sector, mainly through the structural funds and the financial instrument for fisheries such as the financial instrument for fisheries guidance (FIFG).

According to the reformed common fisheries policy, MAGPs failed to meet expectations and proved cumbersome to manage. Subsidies for construction/modernisation and running costs have undermined the efforts made, also with public aid, to eliminate overcapacity by helping the introduction of new vessels into the fleet. MAGP IV, which ended in December 2002, has been replaced by a simpler scheme under the reform of the CFP (Council Regulation (EC) No 2371/2002 on the Conservation and Sustainable Exploitation of Fisheries Resources under the common fisheries policy).

Targets

No specific target exists. However, the aim under the reformed CFP is to reduce the size and capacity of the fishing fleet to achieve sustainable fishing.

Indicator uncertainty

Data sets are fragmented both temporally and spatially. Data for Estonia, Cyprus, Lithuania, Latvia, Malta, Poland, Slovenia, Bulgaria and Romania are only covered by FAO, apart from a not very accurate assessment of the number of vessels reported by DG Fisheries for 2001. Data for EFTA are covered by Eurostat. Data for the EU-15 come from Eurostat and DG Fisheries. Data on power for Estonia, Cyprus, Lithuania, Latvia, Malta, Poland, Slovenia, Bulgaria and Romania are lacking, and in the case of tonnage and number of vessels they exist for the majority of these countries but only for a limited period, 1992–1995.

Restructuring the fleet and reducing its capacity do not necessarily lead to reduction in fishing pressure as advances in technology and design allow new vessels to exert more fishing pressure than older vessels of equivalent tonnage and power.

35 Passenger transport demand

Key policy question

Is passenger transport demand being decoupled from economic growth?

Key message

Growth in the volume of passenger transport has nearly paralleled that in GDP. Transport growth was marginally lower than GDP growth between 1997 and 2001, but once again exceeded it in 2002. Decoupling between transport demand and GDP over the period has been less than 0.5 % per year compared with transport growth of 2.1 % per year, and decoupling has not been achieved each year.

Indicator assessment

Over the past decade, passenger transport demand has grown steadily in the EEA countries as a whole, thereby making it increasingly difficult to stabilise or reduce the environmental impacts of transport. Most countries saw growth every year, but there are a few exceptions, notably Germany, where demand has remained almost stable since 1999. Transport demand per capita has also grown, and by 2002 had reached more than 10 000 km in the countries for which data are available.

The main underlying factor is the growth in incomes coupled with a tendency to spend more or less the same share of disposable income on transport. Additional income therefore means additional travel budget, which allows more frequent, faster, farther and more luxurious travelling. The average daily distance travelled by EU-15 citizens increased from 32 km in 1991 to 37 km in 1999, the fastest-growing modes of transport being private car and aviation.

Overall growth in passenger transport demand has been very similar to that of GDP. Transport growth was marginally lower than GDP growth between 1997 and 2001, but once again exceeded it in 2002. From 1997, decoupling between transport demand and GDP growth was less than 0.5 % per year compared with transport growth of 2.1 % per year.

One explanatory factor for the slight decoupling is a greater instability in fuel prices from 1997 onwards, which may have reduced the tendency to invest in additional cars. The 'fuel price protests' in 2000, albeit primarily by hauliers, illustrated the reaction of road users to higher prices. This is also consistent with the higher growth in 2002, because fuel prices by then had once again come down. But increasing congestion in some cities has also been put forward as an explanatory factor.

EU-wide data on travel purposes are not available. However, based on national mobility surveys, 40 % of passenger transport demand in the 1990s was for leisure. Tourism is an important travel motive, and most of the trips attributed to tourism are long-distance ones. The importance of tourism for air traffic is highlighted by the presence of the tourist destinations Palma de Mallorca, Tenerife and Malaga in the top 20 airports that handle most passengers.

The stated objective of the common transport policy of maintaining the 1998 modal shares is not currently being met. The share of car transport is stable at around 72 % while air transport is growing and bus plus rail is declining steadily. In absolute numbers, bus and rail are roughly maintaining their respective markets, while all growth is in road and in particular air transport.

Increasing wealth among citizens give more people the option to buy a car and use the added flexibility that it provides. Only in dense urban centres and for longer distances can public transport compete in terms of travel time.

Aviation saw a small drop in market share following the 11 September 2001 terrorist attacks on the World Trade Centre and the Pentagon, the subsequent wars and the SARS epidemic. This led to increased consolidation of the airline industry but also provided opportunities for low-cost airlines, which are rapidly gaining market share. Thus the relative cost of air travel has dropped, further fuelling the recent growth in air travel.

Indicator definition

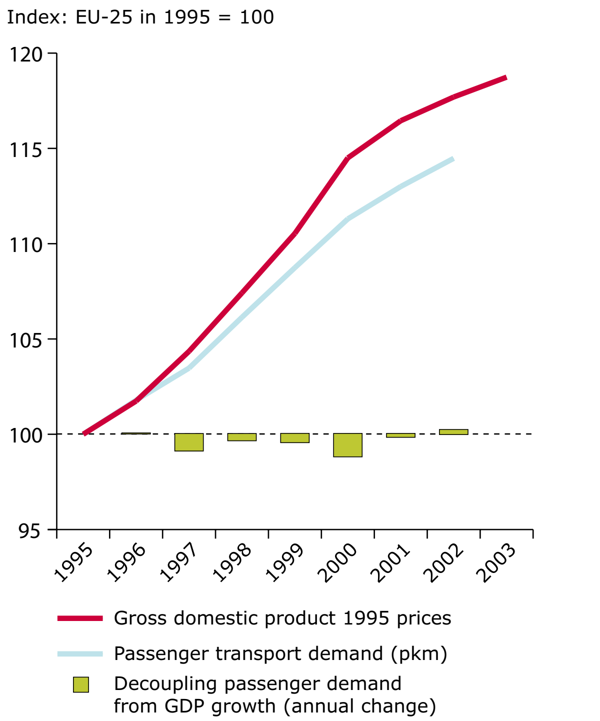
To measure decoupling of passenger demand from economic growth, the volume of passenger transport relative to GDP (i.e. the intensity) is calculated. Separate trends for the two components of intensity are shown for the EU-25. Relative decoupling occurs when passenger transport demand grows at a rate below that of GDP. Absolute decoupling occurs when passenger transport demand falls while GDP rises or remains constant.

The unit is the passenger-kilometre (passenger-km), which represents one passenger travelling a distance of one kilometre. It is based on passenger transport by car, bus, coach and train. Estimates of passenger transport by air are, where available (EU-15), included in total inland passenger transport. All data are based on movements within the national territory, regardless of the nationality of the vehicle.

Passenger transport demand and real GDP are shown as an index (1995 = 100). The ratio of the former to the latter is indexed on the previous year (i.e. annual decoupling/intensity changes) in order to be able to observe changes in the annual intensity of passenger transport demand relative to economic growth.

The indicator can also be presented as the share of transport by passenger car in total inland transport (i.e. modal split share for passenger transport). Eurostat is currently working on methods for the calculation and territorial attribution of performance data for air transport which, if included, would have a significant impact on the passenger modal shares. When Eurostat's results become available, the core set indicator will be reviewed and the modal split shares shown.

Figure 1 Trend in passenger transport demand and GDP



Note: If the decoupling indicator (vertical bars) is above 100 transport demand is outpacing GDP growth (i.e. positive bar = no decoupling) whereas a value below 100 is means transport demand growing less rapidly than GDP (i.e. negative bar = decoupling). The EU-25 index for passenger transport demand does not include Malta, Cyprus, Estonia, Latvia, and Lithuania because of lack of a complete time series in these countries. Decoupling for passenger demand also excludes the GDP of these 5 countries, together representing about 0.3–0.4 % of EU-25 GDP. See also indicator definition.

Data source: Eurostat and DG Energy and Transport, European Commission (Ref: www.eea.eu.int/coreset).

Indicator rationale

Transport is one of the main sources of greenhouse gases and also gives rise to significant air pollution, which can seriously damage human health and ecosystems. The indicator helps to understand developments in the passenger transport sector (transport's 'magnitude'), which in turn explains observed trends in the impact of transport on the environment.

The relevance of the modal split policy to the environmental impact of passenger transport arises from differences in the environmental performance

Table 1 Trend in the annual intensity of passenger transport demand

Trends in passenger transport demand (passenger/km for car, train and buses/coaches); Index 1995 = 100								
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
EEA	100	102	103	106	108	110	112	113
EU-25	100	102	103	106	108	110	112	113
EU-15 pre-2004	100	102	103	105	108	110	112	113
EU-10	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium	100	101	102	105	108	108	110	112
Denmark	100	103	105	107	110	110	109	111
Germany	100	100	100	101	104	102	104	105
Greece	100	104	108	113	119	125	131	137
Spain	100	104	107	112	118	121	124	133
France	100	102	104	107	110	110	114	115
Ireland	100	107	115	120	129	138	144	152
Italy	100	102	104	107	107	116	115	115
Luxembourg	100	102	104	105	105	107	109	111
Netherlands	100	101	104	105	107	108	108	110
Austria	100	100	99	101	102	103	103	104
Portugal	100	105	112	118	126	131	134	140
Finland	100	101	103	105	108	109	111	113
Sweden	100	101	101	102	105	106	108	111
United Kingdom	100	102	103	104	104	105	106	108
Cyprus	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Czech Republic	100	102	102	102	105	108	109	110
Estonia	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Hungary	100	100	101	102	104	106	106	108
Latvia	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	100	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	123
Malta	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Poland	100	102	108	114	115	120	123	127
Slovenia	100	108	104	95	92	92	90	85
Slovakia	100	98	95	94	97	106	105	108
Island	100	105	111	118	122	124	125	127
Norway	100	104	104	106	107	108	110	112
Bulgaria	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Romania	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Turkey	100	107	n.a.	n.a.	121	n.a.	n.a.	n.a.

Note: Total passenger transport demand data including air are not available for all countries and years. To guarantee a fairer comparison of trends, the index shown in the table does not include air transport demand. The aggregate EU-25 excludes Cyprus, Estonia, Latvia, Lithuania, Malta, because of lack of available passenger demand data since 1995.

Data source: Passenger demand data used in the structural indicators (February 2005), Eurostat (Ref: www.eea.eu.int/coreset).

(resource consumption, emissions of greenhouse gases, pollutants and noise, land consumption, accidents, etc.) of different transport modes. These differences are becoming smaller on a passenger-km basis, which makes it increasingly difficult to determine the direct and future overall environmental effects of modal shifts. The total environmental effect of modal shifts can in fact only be determined on a case-by-case basis, where local circumstances and specific local environmental effects can be taken into account (e.g. transport in urban areas or over long distances).

Policy context

The objective of decoupling was first defined in the transport and environment integration strategy that was adopted by the Council of Ministers in Helsinki (1999). The objective of decoupling is also mentioned in the sustainable development strategy, adopted by the European Council in Gothenburg, in order to reduce congestion and other negative side-effects of transport. The Council reaffirmed the objective of decoupling in the review of the integration strategy in 2001 and 2002.

Decoupling of economic growth and transport demand is mentioned in the sixth environment action programme as a key action in order to deal with climate change and alleviate the health impacts of transport in urban areas.

Shifting transport from road to rail is an important strategic element in the EU transport policy. The objective was first formulated in the sustainable development strategy (SDS). In the review of the transport and environment integration strategy in 2001 and 2002, the Council states that the modal split should remain stable for at least the next ten years, even with further traffic growth.

Modal shift is central and the Commission proposes measures aimed at modal shift in the white paper on the common transport policy (CTP) 'European Transport Policy for 2010: Time to Decide'. The target is to decouple transport growth significantly from growth in GDP in order to reduce congestion and other negative side effects of transport. Another target is to bring about a shift in transport use from road to rail, water and public passenger transport so that the share of road transport in 2010 is no greater than in 1998.

Indicator uncertainty

All data should be based on movements within the national territory, regardless of the nationality of the vehicle. However, data collection methodology is not harmonised at the EU level and the coverage is incomplete.

In relation to air transport, Eurostat does not currently collect data on transport performance within the national territory of the countries where this performance takes place, as would be required by the 'national territory principle'. Eurostat is working on methods for the calculation and territorial attribution of performance data for air transport. Until such data become available, the EU-25 aggregate for the core set indicator will include estimates of air transport demand from the European Commission's DG for Energy and Transport. The same estimates are not available for individual countries and for the same years.

Loading of the vehicle is a factor which plays a key role in assessing whether or not there is decoupling of passenger transport demand from GDP growth. Load factors for car passenger transport (i.e. the average number of passengers per car) are not mandatory variables in the data on passenger transport performance collected through the Eurostat/ECMT/UNECE common questionnaire on transport statistics. Since load factors are not always available, a sound assessment of passenger transport trends becomes very difficult. One could not, for instance, properly determine what share of the observed passenger-km trend results from changes in the average number of passengers per vehicle. For a complete picture of transport demand and the related environmental problems it would therefore be valuable to complement the data on the number of passenger-km with data on vehicle-km.

36 Freight transport demand

Key policy question

Is freight transport demand being decoupled from economic growth?

Key message

Freight transport volume has grown rapidly and has generally been strongly coupled with growth in GDP. Consequently the objective of decoupling GDP and transport growth has not been achieved. Closer inspection reveals great regional differences, with growth faster than GDP in the EU-15 and slower than GDP in the EU-10 Member States. This is mainly a result of the economic restructuring in the EU-10 Member States over the past decade.

Indicator assessment

Freight transport demand has grown significantly since 1992, thereby making it increasingly difficult to limit the environmental impacts of transport. But underlying the almost parallel growth with GDP is a more complex picture. Freight transport demand has grown significantly faster than GDP in the EU-15 whereas the picture for the EU-10 is the opposite.

For the EU-15, the main explanation is that the internal market is leading to some relocation of production processes, causing additional growth in transport demand over and above the steady growth in GDP. For the EU-10, the main reason is the large shift in production away from traditional relatively heavy low-value industry towards higher-value production and services. This, coupled with strong economic growth, means that freight transport growth is not keeping up with GDP growth. Both effects are temporary, but the data do not contain any indication that real decoupling is taking place.

The share of alternative modes (rail and inland waterways) in freight transport has declined during the past decade. As a result, the objective outlined in the common transport policy (CTP) of stabilising the shares of rail, inland waterways, short-sea shipping and oil pipelines, and shifting the balance from 2010 onwards, will not be achieved unless there is a strong reversal of the current trend.

This development can be explained by looking at the type of goods transported. This plays an important role in choice of mode. Perishable and high-value goods require fast and reliable transportation — road transport is often the fastest and most reliable form available, providing much flexibility with pickup and delivery points. Agricultural products and manufactured goods are some of the most important goods transported throughout Europe. Their shares in tonne-km are also rising.

Because the transport system allows it, modern production prefers 'just-in-time' delivery of goods. Transport speed and flexibility are therefore of great importance. Despite congestion, road transport is often faster and more flexible than rail or water transport. In addition, as a result of spatial planning and infrastructure development, many destinations can only be reached by road, and combined transport is used only to a limited extent. Furthermore, the road sector is liberalised to a great extent, while the inland waterway and rail sectors have only relatively recently been opened up to broad competition. Finally the average tonne of goods carried by road travels about 110 km, a distance over which rail or inland waterways are less efficient because road transport is needed to and from the points of loading. Moreover, in using multi-modal transport for such short distances, valuable time is lost due to lack of standardisation of loading units and convenient and fast connections between inland waterways and rail. For short-sea shipping, the average tonne of goods is carried more than 1 430 km. Here, time is less of an issue. The low price of shipping is probably of overriding importance.

Indicator definition

To measure decoupling of freight transport demand from economic growth, the volume of freight transport relative to GDP (i.e. the intensity) is calculated. Separate trends for its two components are shown for the EU-25. Relative decoupling occurs when freight transport demand grows at a rate below that of GDP. Absolute decoupling occurs when freight transport demand falls and GDP continues to rise or remains constant. If demand and GDP both fall, they remain coupled.

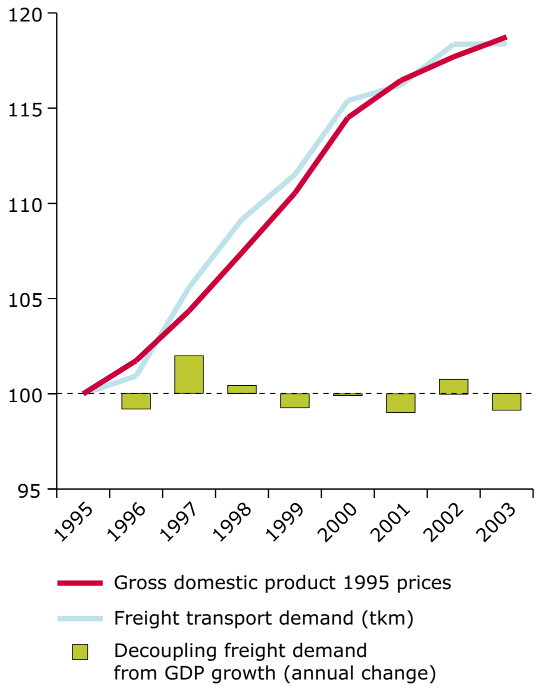
The unit is the tonne-kilometre (tonne-km), which represents the movement of one tonne over a distance of one kilometre. It includes transport by road, rail and inland waterways. Rail and inland waterways transport are based on movements within national territory, regardless of the nationality of the vehicle or vessel. Road transport is based on all movements of vehicles registered in the reporting country.

Freight transport demand and GDP are shown as an index (1995=100). The ratio of the former to the latter is indexed on the previous year (i.e. annual decoupling/intensity changes) in order to be able to observe changes in the annual intensity of freight transport demand relative to economic growth.

The indicator can also be presented as the share of road in total inland transport (i.e. modal split for freight transport). Eurostat is currently working on methods regarding the calculation and territorial attribution of performance data for maritime transport which, if included, would have a significant impact on the modal shares. When Eurostat's results become available, the core set indicator will be reviewed and the modal shares shown.

Figure 1 Trends in freight transport demand and GDP

Index: EU-25 in 1995 = 100



Note: The decoupling indicator is calculated as the ratio of freight transport demand to GDP measured in 1995 market prices. The bars depict the intensity of transport demand in the current year in relation to the intensity in the previous year. An index above 100 results from transport demand outpacing GDP growth (i.e. positive bar = no decoupling) whereas an index below 100 is explained by transport demand growing less rapidly than GDP (i.e. negative bar = decoupling). See also indicator definition.

Data source: Eurostat (Ref: www.eea.eu.int/coreset).

Indicator rationale

Transport is one of the main sources of greenhouse gas emissions and also gives rise to significant air pollution, which can seriously damage human health and ecosystems. Reducing demand would therefore reduce the environmental burden of freight transport. Decoupling freight transport from GDP growth is only indirectly linked to environmental impact.

The relevance of the modal split policy for the environmental impact of freight transport arises from the differences in environmental performance (resource consumption, greenhouse gas emissions, pollutant and noise emissions, land consumption, accidents etc.) of different transport modes. These differences are becoming smaller on a tonne-km basis, which makes

Table 1 Trends in the annual intensity of freight transport demand

Trends in freight transport demand (tonne/km for road, rail and inland waterways); index 1995 = 100									
	1995	1996	1997	1998	1999	2000	2001	2002	2003
EEA	100	102	106	109	111	114	115	117	118
EU-25	100	101	106	109	112	115	116	118	118
EU-15 pre-2004	100	102	105	110	113	117	118	120	119
EU-10	100	98	106	106	104	106	105	109	115
Belgium	100	93	97	93	87	112	115	116	112
Denmark	100	95	96	96	103	107	99	100	103
Germany	100	99	103	106	111	114	115	114	115
Greece	100	120	136	155	161	162	162	163	164
Spain	100	100	108	121	129	142	153	174	181
France	100	101	104	108	114	115	114	113	111
Ireland	100	113	123	142	176	209	211	241	263
Italy	100	106	106	112	108	112	113	115	105
Luxembourg	100	69	84	93	115	136	152	157	164
Netherlands	100	102	109	116	122	119	118	116	109
Austria	100	104	107	113	123	130	136	140	141
Portugal	100	120	130	131	136	139	154	153	144
Finland	100	100	105	113	117	125	119	123	121
Sweden	100	102	106	103	102	109	105	109	111
United Kingdom	100	104	106	108	106	105	105	105	106
Cyprus	100	103	105	108	110	114	118	122	130
Czech Republic	100	97	114	97	99	101	103	110	115
Estonia	100	113	146	183	209	223	245	261	298
Hungary	100	99	103	120	115	119	116	119	118
Latvia	100	126	149	148	141	156	169	183	214
Lithuania	100	99	111	112	126	135	129	165	185
Malta	100	103	106	109	113	116	116	116	116
Poland	100	104	110	109	105	106	103	103	107
Slovenia	100	95	106	104	110	128	131	121	125
Slovakia	100	71	70	74	72	65	62	62	66
Island	100	103	109	112	121	127	130	132	139
Norway	100	123	138	143	144	147	146	147	156
Bulgaria	100	88	86	73	61	31	33	35	38
Romania	100	102	102	78	66	73	81	94	104
Turkey	100	120	123	133	132	142	131	131	133

Note: Data source: Freight demand data used in the structural indicators (February 2005), Eurostat (Ref: www.eea.eu.int/coreset).

it increasingly difficult to determine the direct and future overall environmental effects of modal shifts. The differences in performance within specific modes can also be substantial, for example old versus new trains. The total environmental effects of modal shifts can only be determined on a case-by-case basis, where local circumstances and specific local environmental effects can be taken into account (e.g. transport in urban areas or through sensitive areas). The magnitude of the environmental effects of modal shifts may be limited, since modal shift is only an option for small market segments. Opportunities for modal shift depend, for example, on the type of goods carried — e.g. perishable goods or bulk goods — and the specific transport requirements of these goods.

Policy context

The EU has set itself the objective of reducing the link between economic growth and freight transport demand ('decoupling') in order to achieve more sustainable transport. Reducing the link between transport growth and GDP is a central theme in EU transport policy for reducing the negative impacts of transport.

The objective of decoupling freight transport demand from GDP was first mentioned in the transport and environment integration strategy adopted by the Council of Ministers in Helsinki (1999). This named the expected growth in transport demand as an area where urgent action was needed. In the sustainable development strategy adopted by the European Council in Gothenburg, the objective of decoupling is set in order to reduce congestion and other negative side-effects of transport. In the review of the integration strategy in 2001 and 2002, the Council reaffirmed the objective of reducing the link between the growth of transport and GDP.

In the sixth environment action programme, decoupling of economic growth and transport demand is named as one of the key objectives in order to deal with climate change and alleviate the health impacts of transport in urban areas.

Shifting freight from road to water and rail is an important strategic element in the EU transport policy. The objective was first formulated in the sustainable development strategy (SDS). In the review of the transport and environment integration strategy in 2001 and 2002, the Council stated that the modal split should remain stable for at least the next ten years, even with further traffic growth.

In the white paper on the common transport policy (CTP) 'European Transport Policy for 2010: Time to Decide', the Commission proposes a number of measures aimed at modal shift. The target is to decouple transport growth significantly from growth in GDP in order to reduce congestion and the other negative side effects of transport. A second target is to stabilise the shares of rail, inland waterways, shortsea-shipping and oil pipelines at 1998 level and bring about a shift in transport use from road to rail, water and public passenger transport from 2010 onwards.

Indicator uncertainty

Total inland freight transport demand excludes maritime transport because of methodological problems related to the allocation of international maritime transport to specific countries. Thus, the effect of globalisation (production being moved from Europe, for example to China) does not have a measurable impact on the indicator in spite of having large real consequences for total freight transport demand.

Load factors for road freight transport are not mandatory and are collected only in the framework of Council Regulation (EC) No 1172/98. Even for the countries that measure such variables, data have been reported to Eurostat only since 1999. Assessment of the loading of vehicles was not foreseen by the Regulation. Loading is a factor which plays a key role in assessing whether or not there is decoupling of freight transport demand from economic activity.

37 Use of cleaner and alternative fuels

Key policy question

Is the EU making satisfactory progress towards using cleaner and alternative fuels?

Key message

- Many Member States have introduced incentives to promote the use of low and zero-sulphur fuels ahead of the mandatory deadlines (a maximum of 50 ppm 'low' in 2005 and a maximum of 10 ppm 'zero' in 2009). The combined penetration increased from around 20 to almost 50 % between 2002 and 2003, but this is still some way off the 2005 target of 100 %.

- The penetration of biofuels and other alternative fuels is low. The share of biofuels in the EU-25 is less than 0.4 %, still far off the 2 % target set for 2005. However, following the adoption of the Biofuels Directive in 2003, national initiatives are rapidly changing the situation.

Indicator assessment

A reduction in the sulphur content of petrol and diesel fuels is expected to have a significant impact on exhaust emissions as it will enable the introduction of more sophisticated after-treatment systems. In view of the 2005 (50 ppm) and 2009 (10 ppm) mandates, many Member States have introduced incentives to promote these fuels. However, the capacity of refineries to supply the fuels affects the time it takes for them to penetrate the market.

In 2003, the combined share of low and zero-sulphur petrol and diesel in the EU-15 was 49 % and 45 % respectively, with a nearly equal split between low and zero-sulphur fuels. Compared with the 2002 figures of around 20 %, these fuels have seen significant growth. If this continues at the same pace, both the 2005 and the 2009 targets are within reach. Many countries have abandoned the sale of regular (350 ppm sulphur) petrol and diesel fuel. In particular, Germany leads the way by being the only country offering only zero-sulphur fuel. At the other end of the scale, four countries (France, Italy, Portugal and Spain) do not yet offer low or zero-sulphur fuels in their markets.

Assessment of the market penetration of biofuels is hampered by incomplete data sets, as not all countries have yet set up reporting for this. Based on the available data, the share of biofuels in the EU-25 in 2002 was still low, accounting for 0.34 % of all petrol and diesel sold for transport purposes (reported biofuels consumption as a percentage of total gasoline and diesel consumption). This share has more than doubled over the past eight years; however more effort is needed to reach the 2 % and 5.75 % objectives by the end of 2005 and 2010 respectively. France and Germany have the highest shares of biofuels sold in their markets.

Indicator definition

The use of cleaner and alternative fuels is measured using two different indicators:

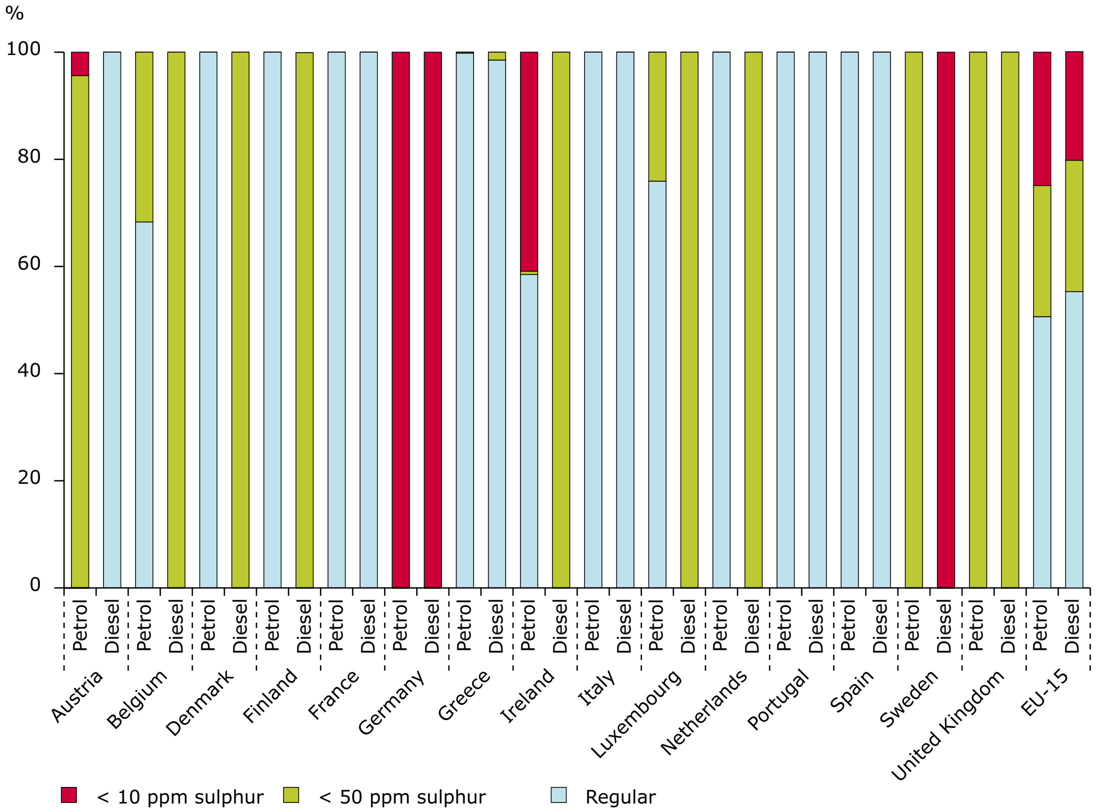
1) The share of regular, low and zero-sulphur fuels in total fuel consumption for road transport. Fuels with less than 50 parts of sulphur per million (ppm) are often referred to as low-sulphur and those with less than 10 ppm as zero-sulphur.

2) The percentage of final energy consumption of biofuels for transport in the total combined final energy consumption of gasoline, diesel and biofuels for transport.

Petrol and diesel fuels are measured in millions of litres and presented as shares of regular, < 50 ppm sulphur and < 10 ppm sulphur.

Final energy consumption of biofuels, diesel and gasoline for transport are measured in Terajoules of net calorific value (NCV) and the share of biofuels is presented as a percentage of the sum of all three fuels.

Figure 1 Low and zero-sulphur fuel use (%), EU-15



Note: Data source: European Commission, 2005. Quality of petrol and diesel fuel used for road transport in the European Union: Second annual report (reporting year 2003). Report from the European Commission (COM (2005) 69 final) (Ref: www.eea.eu.int/coreset).

Indicator rationale

EU legislation has set requirements for the sulphur content of road transport fuels and the minimum share of biofuels in total road transport fuel consumption. The indicator has been selected to follow these policy requirements by monitoring the progress achieved.

The promotion of low and zero-sulphur fuels will enable a further decrease in emissions of pollutants from road vehicles, while the promotion of biofuels is essential for reducing greenhouse gas and especially CO_2 emissions.

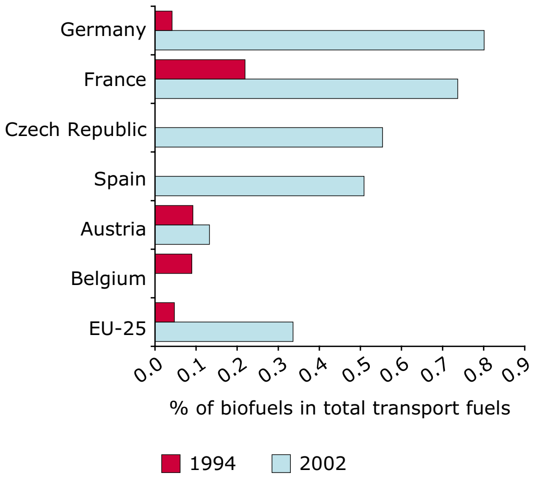
Policy context

EU legislation requires a reduction of the sulphur content of road transport fuels to 50 mg/kg (low-sulphur) by 2005 and a further reduction to below 10 mg/kg (zero-sulphur) by 2009. It also suggests that EU road transport fuel consumption should have a 2 % share of biofuels by 2005 and 5.75 % by 2010.

Indicator uncertainty

The data are collected on an annual basis by the European Commission and can thus be considered reliable and accurate. The requirement for data

Figure 2 **Share of biofuels in transport fuels (%)**



Note: The biofuels directive aims at promoting the use of biofuels for transport to replace diesel or petrol. The primary objective is to increase the consumption of biofuels, as opposed to its production, which may or not be exported to other countries. The share of biofuels should reach 2 % by 2005 and 5.75 % by 2010. The denominator includes all EU-25 countries with consumption of diesel and gasoline. The numerator refers to the final energy consumption of biofuels in the transport sector. By 2002, only a few EU countries had consumption of biofuels or were reporting consumption of biofuels to Eurostat. A progressively larger number of EU countries are expected to report biofuels consumption to Eurostat when data become available for 2003, the year of entry into force of the directive.

Data source: Eurostat (Ref: www.eea.eu.int/coreset).

collection for low and zero-sulphur fuels and biofuels is mandatory and thus the results are harmonised at the EU level.

Data on the share of low and zero-sulphur fuels are currently available only for the EU-15 and for three years (2001, 2002 and 2003), resulting from their reporting obligations. Data on biofuels are currently available for eight of the EU-25 countries (data for Italy and Denmark available, but reported as zero); however it is very likely that these countries represent the vast majority of biofuel consumption for transport purposes in the time-frame indicated.

Table 1 Final energy consumption in the transport sector

	1994						**2002**					
	Final energy consumption in terajoules (net calorific value)			**Fuel shares in final energy consumption (%)**			**Final energy consumption in terajoules (net calorific value)**			**Fuel shares in final energy consumption (%)**		
	Motor spirit (gasoline)	Gas/diesel oil	Biofuels	Motor spirit (gasoline)	Gas/diesel oil	Biofuels	Motor spirit (gasoline)	Gas/diesel oil	Biofuels	Motor spirit (gasoline)	Gas/diesel oil	Biofuels
EU-25	5 541 712	4 864 585	4 896	53.2	46.7	0.05	5 242 160	6 635 686	40 052	44.0	55.7	0.34
EU-15	5 105 540	4 574 576	4 896	52.7	47.2	0.05	4 791 160	6 192 212	38 964	43.5	56.2	0.35
EU-10	436 172	290 009	0	60.1	39.9	0.0	451 000	443 473	1 088	50.4	49.5	0.12
Belgium	125 004	178 591	272	41.1	58.8	0.09	91 960	244 452	0	27.3	72.7	0.00
Czech Republic	69 256	50 591	0	57.8	42.2	0.0	84 876	110 445	1 088	43.2	56.2	0.55
Denmark	81 048	71 995	0	53.0	47.0	0.0	84 216	78 509	0	51.8	48.2	0.0
Germany	1 301 344	983 687	952	56.9	43.0	0.04	1 187 516	1 127 380	18 700	50.9	48.3	0.80
Estonia	12 540	6 683		65.2	34.8	0.0	13 464	13 790		49.4	50.6	0.0
Greece	116 424	83 669		58.2	41.8	0.0	153 692	97 079		61.3	38.7	0.0
Spain	403 040	511 830	0	44.1	55.9	0.0	361 636	881 363	6 358	28.9	70.5	0.51
France	660 352	934 576	3 502	41.3	58.5	0.22	570 196	1 256 818	13 566	31.0	68.3	0.74
Ireland	43 340	34 940		55.4	44.6	0.0	69 784	80 074		46.6	53.4	0.0
Italy	721 952	622 487	0	53.7	46.3	0.0	703 692	831 237	0	45.8	54.2	0.0
Cyprus	7 920	11 040		41.8	58.2	0.0	10 076	14 382		41.2	58.8	0.0
Latvia	18 700	11 125		62.7	37.3	0.0	14 960	18 950		44.1	55.9	0.0
Lithuania	18 568	14 678		55.9	44.1	0.0	15 796	25 676		38.1	61.9	0.0
Luxembourg	23 980	24 746		49.2	50.8	0.0	24 464	48 307		33.6	66.4	0.0
Hungary	63 492	33 502		65.5	34.5	0.0	58 740	74 617		44.0	56.0	0.0
Malta	3 740	4 484		45.5	54.5	0.0	2 244	4 991		31.0	69.0	0.0
Netherlands	172 128	187 178		47.9	52.1	0.0	183 656	256 507		41.7	58.3	0.0
Austria	101 684	82 612	170	55.1	44.8	0.09	91 036	165 393	340	35.5	64.4	0.13
Poland	187 044	111 926		62.6	37.4	0.0	185 548	119 117		60.9	39.1	0.0
Portugal	81 532	88 196		48.0	52.0	0.0	91 036	173 642		34.4	65.6	0.0
Slovenia	33 704	14 890		69.4	30.6	0.0	33 792	22 631		59.9	40.1	0.0
Slovakia	21 208	31 091		40.6	59.4	0.0	31 504	38 874		44.8	55.2	0.0
Finland	84 128	69 457		54.8	45.2	0.0	80 520	84 938		48.7	51.3	0.0
Sweden	183 216	88 365		67.5	32.5	0.0	180 048	110 826		61.9	38.1	0.0
United Kingdom	1 006 368	612 250		62.2	37.8	0.0	917 708	755 690		54.8	45.2	0.0
Iceland	6 072	2 496		70.9	29.1	0.0	6 424	2 242		74.1	25.9	0.0
Norway	73 744	72 798		50.3	49.7	0.0	72 336	87 011		45.4	54.6	0.0
Bulgaria	43 428	21 573		66.8	33.2	0.0	26 884	35 955		42.8	57.2	0.0
Romania	51 568	66 538		43.7	56.3	0.0	76 648	89 845		46.0	54.0	0.0
Turkey	174 856	228 293		43.4	56.6	0.0	137 280	262 514		34.3	65.7	0.0

Note: By 2002, only a few EU countries had consumption of biofuels or were reporting consumption of biofuels to Eurostat. A progressively larger number of EU countries are expected to report biofuels consumption to Eurostat when data become available for 2003, the year of entry into force of the directive.

Data source: Eurostat (Ref: www.eea.eu.int/coreset).