Environmental signals 2001

European Environment Agency
regular indicator report

European Environment Agency

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Foreword

The European Environment Agency has prepared this, the second edition of its *Environmental signals* indicator report, for the Gothenburg meeting of the European Council in June 2001. This report confirms some of the findings of last year's first report, such as increasing waste generation and greenhouse gas emissions, a reduction in emissions of acidifying substances and the continued development of organic farming. It also provides some new insights into major environmental trends in the EU, such as the considerable environmental cost of transport, increasing sales of eco-labelled products and improving water quality.

Our objective with this report is to support the more efficient framework for action that has emerged over recent years and that has made possible the continuous review of policies in a timely and consistent way.

The 1998 Cardiff initiative on integrating environmental protection into sectoral policies, which was broadened at the 1999 Helsinki summit and is now being taken forward to Gothenburg, is a shining example of integrated thinking in policy development. This is now taken further by the conclusion of the March 2001 European Council in Stockholm identifying the need to add an environmental dimension to the so-called Lisbon process, which integrated employment, economic reform and social cohesion. The sustainable development strategy to be adopted at the Gothenburg Council will be the overall umbrella and each annual Spring Council will review all dimensions of sustainable development in a single report.

The integration of the Cardiff and Lisbon processes will lead to some 'joined up thinking' on all aspects of sustainable development. Additionally, also individual policy processes (economic and social integration, sectoral integration, and the 6th Environmental action programme) will need to be supported by indicators and reporting mechanisms to enable regular evaluation of their progress and ensure transparency and accountability.

Indicators are important because we can manage only what we can measure. And while critics may argue that indicators and targets are a far too simplistic response to complex issues, the reality is that they appear to work! At the EEA we face a constant challenge to prevent overload of information on the environment and sustainability, and indicators are a key tool for us in this regard since they distil data into a clear and accessible form.

Let me summarise where we stand in our work on indicators:

The EU's sectoral integration strategies, which are intended to lead to sectoral sustainability, need to be monitored using indicators on the integration of environment and sectoral policies.

The Transport and Environment Reporting Mechanism (TERM) developed by the EEA with the support of Eurostat and the other European Commission services is a good example of such monitoring. Together with its partners, the EEA is now developing similar indicator-based reports on energy and on agriculture. Good coordination between the sectoral reporting mechanisms is essential and to this end we are preparing a common reporting framework.

The 6th Environment Action Programme ('Environment 2010: Our Future, Our Choice') and the Thematic Strategies to achieve environmental sustainability that will flesh it out need to be monitored using sets of selected issue indicators. In this respect the *Environmental signals* series is developing into the main indicator report on the environmental sustainability of the EU.

The Commission, together with the EEA and the Member States, will shortly publish the first report on environmental headline indicators. This will comprise a very limited set of 10 indicators on the EU's main environmental problems.

Indicators should not be mere presentations of statistics but should form part of an analysis of progress made. This means that as far as possible indicators should be developed as:

- Performance indicators, linked to an agreed target
- Efficiency indicators, which show the relationship to production and other economic variables
- Policy effectiveness indicators, which show the effect of policy measures and structural developments.

Now that the headline indicators have been identified, the next step is for policymakers to link these to quantitative targets. Just as the convergence criteria for economic and monetary union (EMU) succeeded in moving EU Member States rapidly towards 'Euroland', or the single currency, the headline sustainability targets should be able to move societies towards a general improvement in their sustainability. What we need now are sustainability convergence criteria.

The business sector, which is quite advanced in incorporating environment as a production factor in decision-making processes, is already busy formulating its own sustainability convergence criteria to give it clear targets against which to benchmark itself and monitor progress. National governments and the EU need to develop their sustainability strategies in a similarly clear and transparent process.

We should not be afraid to develop bold targets and bold measures to accompany them. There are clear precedents. Examples include the Kyoto Protocol targets for reducing greenhouse gas emissions and the objective of avoiding any exceedance of critical deposition loads that has been used in negotiations under the Convention on Long Range Transboundary Air Pollution.

Domingo Jiménez-Beltrán
Executive Director

1. Introduction

This is the second in the series of 'Environmental signals' reports produced by the European Environment Agency for high-level policy-makers in EEA member countries and the European Union. Chapters 1-7 focus on economic sectors and chapters 8-15 on major environmental issues.

The main aim is to present key environmental indicators in order to report, on a regular and consistent basis, on progress in a number of policy areas at the European level. The report highlights selected issues; each report in the series is not intended to be comprehensive. For comprehensive background information on European environmental problems, readers should refer to other EEA products such as state-of-the-environment reports or thematic monographs, all available on the EEA web site (http://www.eea.eu.int). That site also provides a gateway to detailed environmental information at European, EU and national levels. Its data service gives access to many of the statistics on which the indicators in this report are based.

The nature and format of the Environmental signals series allows each edition to address an appropriate selection of environmental problems, based on their particular relevance and timeliness to the policy debate and the need to update issues at different intervals, some yearly (e.g. greenhouse gas emissions), others every few year (e.g. water quality) (EEA, 2000a).

A review of the first report in the series, *Environmental signals 2000*, made a number of recommendations, as many as possible of which have been implemented in this report. These included shortening or omitting background technical descriptions, placing more emphasis on the indicators themselves, producing a summary and web site versions, and showing more clearly the interlinkages between the economic sectors and environmental issues. The reports will continue to be improved by including, for example, figures showing outlooks – some are included in the transport, climate change and air pollution chapters – as commonly used in economic indicator reports.

1.1. Towards regular sets of indicators to meet the EU policy agenda

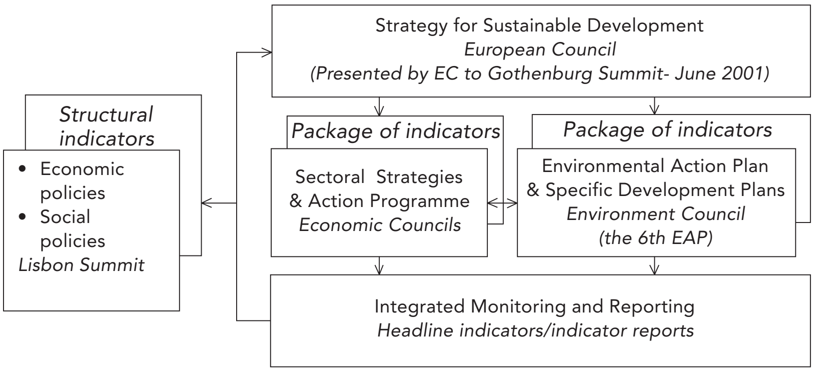
Sectoral integration and sustainable development

Over the past two years, the EU Council has paid considerable attention to the major policy goals underlined in the Amsterdam Treaty: the need for integration of environmental and sectoral policies and sustainable development. The Council, at recent meetings (Helsinki, December 1999; Lisbon, June 2000), proposed a strategy for achieving these objectives. In particular, it agreed that:

'The completion of sectoral strategies should be followed by their immediate implementation. Regular evaluation, follow-up and monitoring must be undertaken so that the strategies can be adjusted and deepened. The Commission and the Council are urged to develop adequate instruments and applicable data for these purposes'.

A main component of this approach is the process related to environmental sustainability (towards the 6th Environmental Action Plan) and sectoral integration, topped by a sustainable development strategy to be adopted in the

Figure 1.1. **EU policy developments and indicators**



Source: EEA

Gothenburg Council, June 2001. This process includes the development of a monitoring and benchmarking system using indicators (Figure 1.1). Two indicator sets have been worked out to date: 'headline' environmental indicators that match the structure of the 6th Environment Action Programme ('Environment 2010: Our Future, Our Choice' – 6th EAP) and sectoral and structural indicators that deal with socio-economic aspects. The first sectoral indicator report, on transport (Transport and Environment Reporting Mechanism –TERM - EEA, 2000b), has provided a model for presenting and discussing indicators for policy evaluation and strategic development.

Towards a consistent set of environmental indicators

Policy progress and prospects are assessed at different levels; this requires a differentiated but interconnected reporting and information system and a hierarchy of indicators, including prospective analyses. Thus, sectoral indicators plot progress of the individual integration strategies (see Chapter 2) and headline environmental indicators plot progress at the overall strategic level (see Chapter 8). As the environment pillar of the Community's sustainable development strategy, the indicators and information from the 6th EAP and the Thematic Strategies that will flesh it out will need to contribute to the monitoring programme proposed for the EU sustainability strategy.

In particular this means linking with the key environmental themes of the strategy (climate change and clean energy, depletion of natural resources, mobility and land use, environment and health – development of thematic strategies) to provide the same or consistent indicators.

The indicators in this edition of *Environmental signals* are not yet that consistent. However, those published in this series are a starting point which over following editions aim to build up and converge with those required to monitor the 6th EAP thematic strategies. Developing separate thematic reporting mechanisms for the main themes of the 6th EAP may help this.

For relevant socio-economic themes, for example employment and innovation, indicators and information used in the 6th EAP for measuring integration should be consistent with the Commission's structural indicators (COM(2000)594 final).

Current parallel indicator developments

In recent years, environmental indicators have expanded from describing changes in the state of the environment to an interrelated family of indicator sets, as discussed above, in line with the broadening of environmental policy towards integration of environmental issues in other policy fields. Demand for reports dealing with the implementation and effectiveness of sectoral instruments is also emerging (e.g. the Environmental Taxes report – EEA, 2000c).

Within the EU, working groups have been set up to develop indicator sets and progress reports to present to the sectoral Councils. This work has reached various stages and a common framework for sectoral reporting is under development, which addresses the various aspects of indicator-based monitoring systems: the selection of indicators and other evaluation criteria, the assessment process, and the institutional organisation.

The four priority sectors for which indicator-based reporting is in proceeding or proposed are:

Transport. Following TERM-2000, the Transport Council invited the Commission and the EEA to continue this work on a regular basis:

- TERM 2001 for the EU: publication in autumn 2001; some outlook indicators to be included;
- TERM-Accession: covering the accession countries; work in hand, publication expected early 2002.
- TERM-2003/2004 (to be decided): covering EU and Accession countries, and including outlook indicators.

Energy. Eurostat will continue to produce its energy indicator pocketbook; EEA support will include the provision of atmospheric emission data. EEA is also applying the TERM model to the energy sector. A zero version 'Energy and Environment Reporting Mechanism' report, similar to TERM 2000, will be finalised by end 2001.

Agriculture. The main activity in this area is the continuous improvement of the agriculture indicators for the Environmental signals report. This will set a pattern for the development of agri-environment indicators. Depending on progress in the inter-service group with DG Agriculture, the first agri-environmental report that would be fully integrated in the policy process could be developed in 2002, and published in 2003.

Tourism. A EU Working Group was set up in 2000 to produce key policy recommendations by summer 2001. Although tourism has not been identified so far as a key area in the Cardiff process, EEA aims to lay the foundations for a 'Tourism and Environment Reporting Mechanism' report at the European level for publication in 2002.

Country groupings used in this report:

EU: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the UK

EEA: EU + Iceland, Liechtenstein and Norway

Nordic countries: Denmark, Finland, Iceland, Norway and Sweden

Central Europe: Austria, Belgium, Denmark, Germany, Ireland, Liechtenstein, Luxembourg, the Netherlands and the UK

Southern Europe: France, Greece, Italy, Portugal and Spain

1.2. Presentation of the indicators

Indicator framework and types

The assessment in this report is based on indicators that cover the most important aspects of the socio-economic and environment framework (Driving forces, Pressures, State of the environment, Impacts, and societal Responses – the so-called DPSIR assessment framework), including eco-efficiency indicators. Analysis of the indicators can be found in detailed fact sheets on EEA's website. The key indicators presented in this report illustrate the most important trends in each policy domain. 'Smiley faces' indicate progress overall, or lack of progress, for each indicator.

Within this framework, indicators are presented in a standard format, at an international level and showing totals for EU Member States or EEA member countries. This is particularly relevant where there are international agreements on action to tackle continental or global problems (e.g. greenhouse gas emissions). Where possible and relevant, national breakdowns are provided for benchmarking national environmental performance, with some discussion of the differences between countries.

The smiley faces in the boxes next to each indicator aim to give a concise assessment of the indicator:

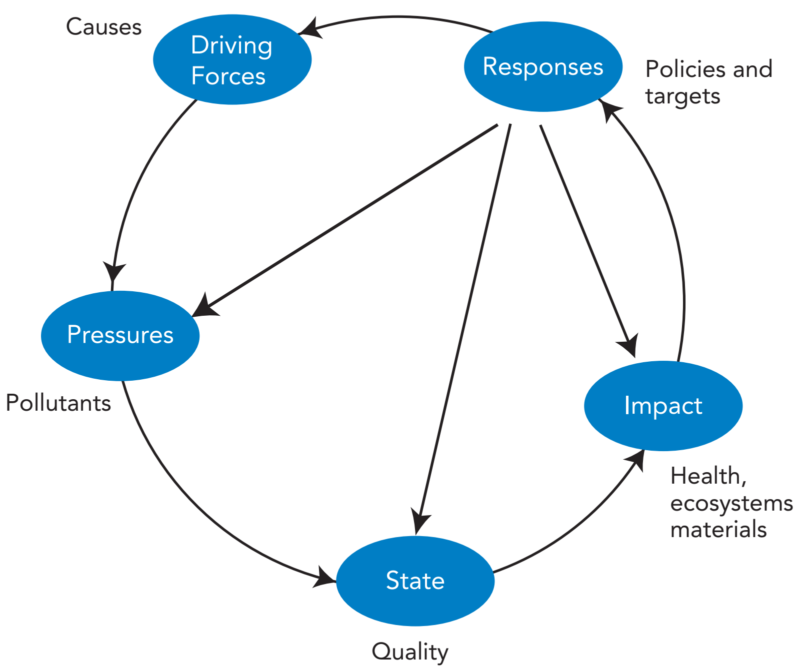
☺ positive trend, moving towards target

😐 some positive development, but either insufficient to reach target or mixed trends within the indicator

☹ unfavourable trend

Unless explicitly stated, the assessment is based on the whole period covered by the indicator.

Figure 1.2. DPSIR assessment framework



Source: EEA

This report includes several different types of indicators (see EEA, 1999). Performance indicators include or are linked to targets, providing a precise assessment of progress towards the targets. Descriptive indicators illustrate trends, but are not linked to a definite policy target. Qualitative targets for such indicators ('to increase…', 'to stabilise…') may, however, be included in environmental policies. The sectoral chapters include eco-efficiency indicators that provide insight on the efficiency of products and processes in terms of resources used, emissions and waste generated per unit of desired output; and, policy effectiveness indicators (see Chapter 5) to visualise the effects of policy responses to trends in emissions.

Interlinkages between indicators

The major interlinkages between indicators and chapters are highlighted in three ways:

Figure 1.3. Cross-reference matrix (numbers refer to chapters or sections)

	Resource use				Air emissions					Water			Hazardous substances		
	Land/ soil	Water use	**14. Waste generation**	**6. Energy use**	**9. Climate change**	Ozone layer	**10. Acidification**	**10. Troph. ozone**	**10. Urban air quality**	**11. River WQ**	Eutrophication	**12. Marine WQ**	Chemicals	**13. Soils: contaminated sites**	**15. Biodiversity**
3. Households		3.7	14, 3.2	6, 3.6	9, 3.2					11.6	11.6	12			
Fisheries															
4. Tourism															
5.Transport				5.2	9, 5.2		10.6, 5.2	10.4, 5.2, 5.5	10.5						
6. Energy		6.3	14, 6.3, 6.7		9, 6.3		10.6, 6.2	10.4, 6.3	10.5			6.9			
7. Agriculture	7.4	7.2		7.2	9, 7.2		10.6, 7.2	10.4, 7.2	10.5	11.3	11.3, 7.2, 7.5	12	7.2		7.3, 15
Industry			14		9		10.6	10.4	10.5	11.6	11.6	12	12.2	13	
Tertiary sect.															
Military														13	

- a simple cross-referencing between chapters (Figure 1.3) enables identification of those sectors that require priority action because of the wide influence they have across many fields and problems;
- a similar approach (Figure 1.4.) can help define the multiple sectoral contributions to particular environmental problems and thus help in the design of better strategies to tackle them across sectors;
- the descriptions of environmental issues in each chapter help to identify important interlinkages and indicate combinations of circumstances and actions that may enable both causes and effects to be addressed.

1.3. The next report in the series

The EEA's mission statement highlights the provision of timely, targeted and reliable information. One of the practical consequences of the concept of 'targeted information' is the co-ordination of major EEA reports with policy events such as ministerial conferences, drafting of white papers and strategic planning processes. This report was prepared just before the European Council held in Gothenburg in June 2001 with the aim of drawing together the threads of EU sectoral reporting mechanisms on integration and their co-ordination with environmental issue indicators.

The next report in the series will be a special pan-European edition, in connection with the next pan-European environmental ministers' conference in the Environmental Programme for Europe process, to be held in Kiev in spring 2003. Work on this next report is also expected to provide spin-off information and input to the Rio+10 Conference in autumn 2002.

Multiple sectoral contributions to environmental issues Figure 1.4.

	Resource use				Air emissions					Water			Hazardous substances		
	Land/ soil	Water use	**14. Waste generation**	**6. Energy use**	**9. Climate change**	Ozone layer	**10. Acidification**	**10. Trop. ozone**	**10. Urban air quality**	**11. River WQ**	Eutrophication	**12. Marine WQ**	Chemicals	**13. Soils: contaminated sites**	**15.Biodiversity**
3. Households	●↗	●↘	●↗	●●↗	●→		●↘			●●●↘	●●●↘	●→	●●→		●
Fisheries															
4. Tourism	●↗	●↗	●↗	●↗	●↗		●→	●→	●→		●→	●→			●→
5.Transport	●↗		●↗	●●↗	●●↗		●●↘	●●●↘	●●●↘		●↘	●↘		●	●↗
6. Energy		●↘	●	●●→	●●↘		●●↘	●↘	●↘	●	●↘	●↘			
7. Agriculture	●●●↘	●●●↗	●	●→	●→		●●→	●↘	●↘	●●●↘	●●●→		●●●↘		●●●↗
Industry		●↘	●●	●●→	●●↘	●●●↘	●↘	●↘	●↘	●↘	●↘	●●↘	●●●	●●●	
Tertiary sect.															
Military														●●●→	

●●● Significant pressure (~>40% of total pressure)
●● Large pressure (~20-40% of total pressure)
● Small pressure (~<20% of total pressure)

↗ Increasing pressure
↘ Decreasing pressure
→ Stable pressure

1.4. References and further reading

EEA (1999). *Environmental indicators: typology and overview.* Technical report no 25. European Environment Agency, Copenhagen.

EEA (2000a). *Environmental signals 2000.* Environmental assessment report no 6. European Environment Agency, Copenhagen.

EEA (2000b). *Are we moving in the right direction? Indicators on transport and environment integration in the EU.* Environmental issues series no 12. European Environment Agency, Copenhagen.

EEA (2000c). *Recent developments in the use of eco-taxes in the EU.* Environmental issues series no 18. European Environment Agency, Copenhagen.

2. Integration of environment and sector policies

The integration of environmental considerations into sectoral policies is slowly progressing as a result of both the number of instruments being used and their widening scope. Eco-efficiency is improving in transport, energy supply and agriculture, but such improvements are outweighed by the growth of these sectors, resulting in an increasing burden on the environment.

Economic production and consumption, and resulting increases in prosperity and welfare, have environmental and social consequences. Sustainable development requires air, water and soil conditions to be good, as well as natural areas that contribute to well-being. Environmental and nature conservation policies are in place to protect these assets. A new policy approach, based on the Amsterdam Treaty and launched at the Cardiff summit in 1998, aims at better integration of environmental objectives into the policies of the economic sectors that are the main driving forces of economic development. This new approach strengthens existing policies such as the Integrated Pollution Prevention and Control and Integrated Product Policy.

Policy integration strategies are under development for such sectors as transport, agriculture, energy, and industry (see Chapter 1). The Gothenburg Council in June 2001 will take stock of progress, on the basis of the regular indicator-based evaluations requested by the Council in 1999 (the 'Cardiff process'), so that the strategies can be modified and strengthened where necessary.

Whereas environmental policy is aimed primarily at the environmental impacts of economic activities, integration policy aims at the sectors where these activities take place. Integration policy is primarily aimed at the 'driving forces' behind environmental degradation and takes into account the interactions between these forces. For example, tourism generates transport that uses energy; industry processes products from agriculture. Integration policy also addresses the economic factors that drive these activities (see Figure 2.1).

What are the key determinants and interactions - the 'wheels within wheels'? Economic growth and demographic development may be fundamental societal drivers but are usually not the direct determinants of the development of economic sectors. Economic growth and demography do not explain why some activities increase rapidly, others develop more slowly, and some stagnate or even decline. Neither do these factors explain why some sectors change their production processes. The main determinants of change are other economic parameters directly linked to sectoral activities, such as prices (of energy or transport), disposable household income, financial support to sectors and technological innovation. Integrating environmental policies into sectoral policies means subjecting these determinants to policy measures which directly influence the main drivers of environmental deterioration.

One of the main determinants in a market economy is the price of goods and services. Correct price signals require full internalisation of external costs, confronting those who cause environmental damage with the correct bill. A common way of internalisation is through environmental taxation (EEA, 2000).

Integration policy points of action Figure 2.1.

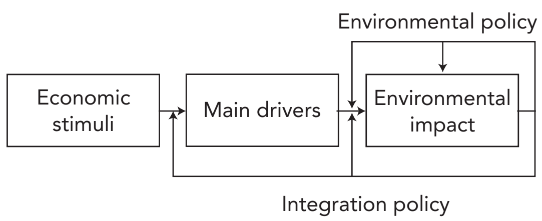
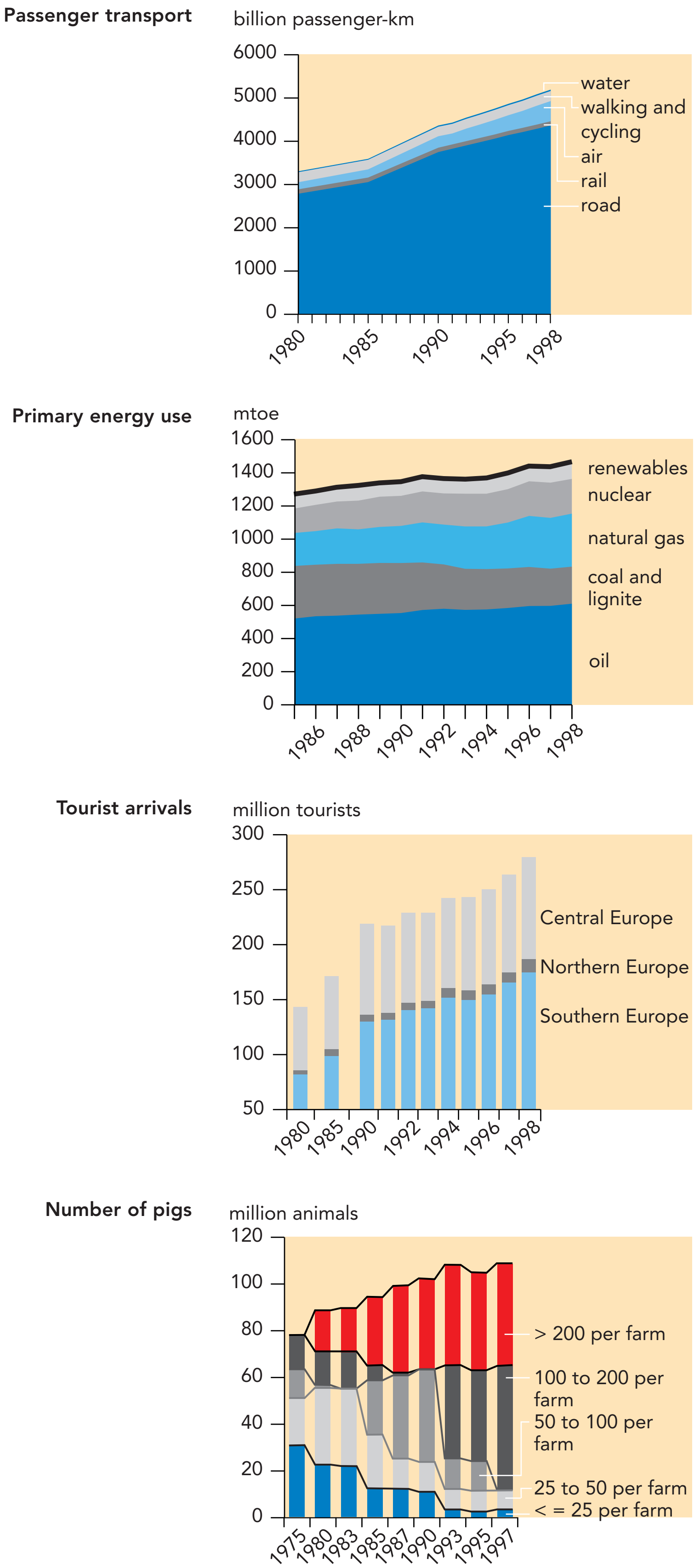


Figure 2.2. **Major developments in transport, energy, tourism and agriculture**



2.1. Main drivers in the transport, energy, tourism and agriculture sectors

Transport is constantly increasing, in particular those modes that are least sustainable (road and air). The shares of more sustainable modes such as cycling, walking, rail and inland water transport are falling.

Transport is a core activity of the tourist sector, which is rapidly growing into one of the most important sectors in the European economy. The number of international tourist arrivals, the overwhelming majority using air or road transport, grew by almost 4 % per year between 1980 and 1998.

Related to these developments, the demand for transport fuels is growing faster than overall energy demand. Transport energy demand in the EU grew by an average of 2.5 % per year between 1980 and 1998, against 1.3 % for total energy demand in the same period.

The agricultural sector is not expanding significantly, but is changing its production processes. In particular it is becoming more dependent on non-farm resources such as pesticides, fertilisers and fuel, and it is using more water and a smaller area of land per unit of production. With a decreasing number of farms and an increasing number of cattle and pigs, meat production is becoming more intensive. In 1997, 9 out of 10 pigs were raised in farms with more than 50 pigs, compared with 4 out of 10 in 1990.

2.2. Key determinants

Determinants of the demand for transport, and of modal choice (for example, public or private transport) include disposable household income and the price of the various modes, but also increasing home-to-work distances due to the dispersion of economic activities, and smaller households resulting in higher car ownership and lower car occupancy. Data for Denmark and the United Kingdom indicate that bus and rail fares have increased more steeply than the costs of driving a private car.

Among the factors that determine the cost of transport is the price of motor fuels which, in turn, is related to the development of the price for crude oil and the level of fuel taxation. Fuel prices fell in the mid-1980s and only returned to the 1980 level in 2000. In combination with constantly increasing incomes, private transport, and hence also tourist trips, have become relatively cheaper, which in a market economy means boosting the demand. The tax on diesel fuel has increased considerably, keeping the selling price from dropping even further; the tax on petrol has increased more slowly. However, full internalisation has not been achieved in most instances, so price signals in the transport market remain incorrect.

Agriculture is a sector for which government intervention is particularly important and decisive. The Common Agricultural Policy (CAP) has greatly influenced the development of the EU agricultural market. The 1992 CAP reforms began to alter the structure of the financial support, moving away from direct support of product prices and towards income support, as well as spending an increasing part of the budget on rural development and accompanying measures. Market support fell from 61 % of CAP subsidies in 1993 to 32 % in 1998 and, according to Agenda 2000, rural support should increase to 10 % of the budget. A fair price system in agriculture should also include full internalisation of external costs.

Prices, subsidies and expenditures — Figure 2.3.

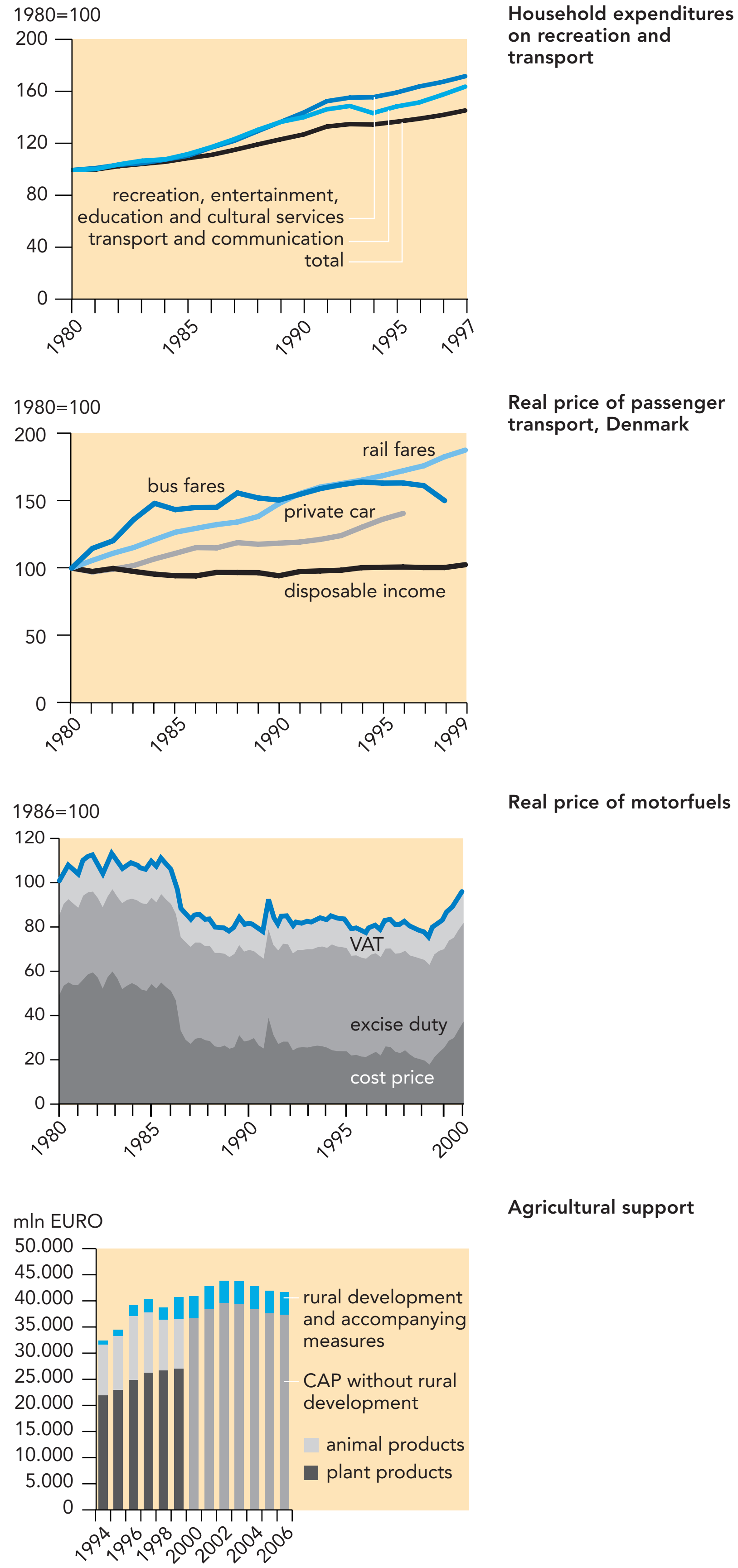
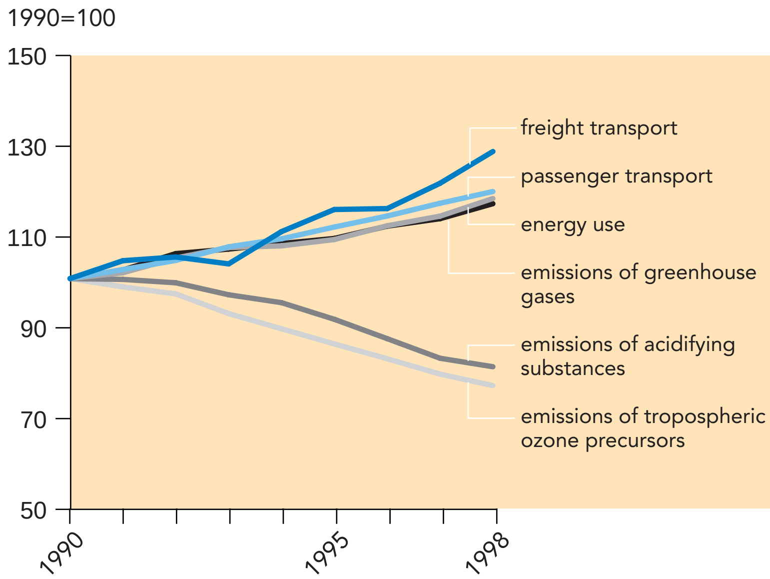
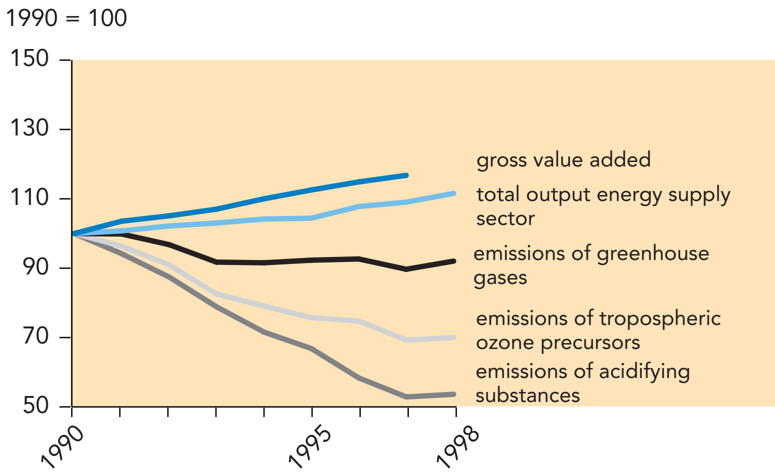


Figure 2.4. Indicators for eco-efficiency

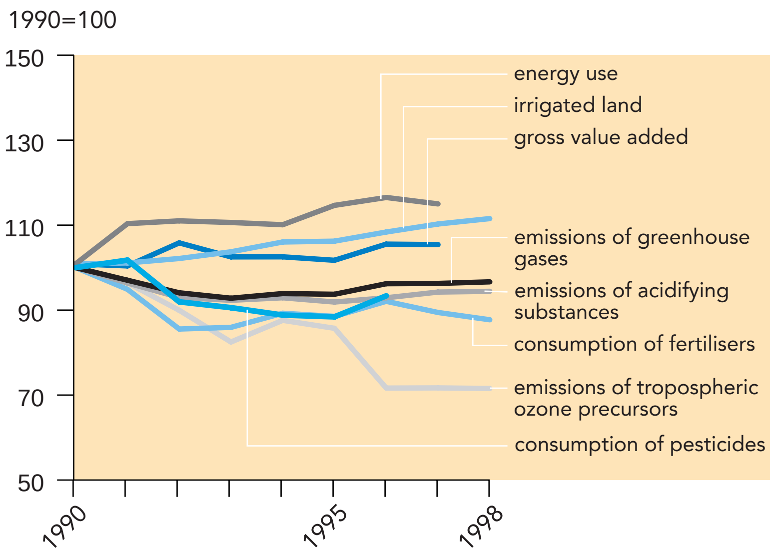
Transport



Energy supply



Agriculture



2.3. Eco-efficiency

Eco-efficiency is the amount of 'environment' used per unit of 'economic activity'. A major goal of sustainable development policy is to decouple the environmental impact of an economic activity from its growth in volume. Eco-efficiency must be improved. Decoupling is relative if the growth of the environmental impact is less than the growth of the activity, and absolute if the impact decreases even if the activity continues to grow.

Between 1990 and 1998, the eco-efficiency of transport, the energy supply sector and agriculture increased, resulting in absolute decoupling, as far as acidifying substances and ozone precursors are concerned. There was also improvement in eco-efficiency for energy use and related greenhouse gas emissions in the energy supply and agriculture sector, but not in the transport sector. The number of inbound tourist visitors grew faster than total passenger transport. The output of the agricultural sector, measured as gross value added (or income generated), has been fairly constant over the past 10 years, as have use of energy, water and irrigated land, fertilisers and pesticides.

2.4. Conclusion: integration policy instruments

Expanding sustainable development governance by bringing environmental objectives into sectoral policies requires the penetration of environmental policy tools into the very heart of economic activity. The history of environmental policy provides some evidence of the performance of such tools when applied in practice. Of the three types of policy instruments, regulatory instruments were the first to be fully explored (from the 1960s onwards). Since the 1970s market-based instruments have supplemented these, and the 1990s brought forward communication instruments such as voluntary agreements.

Signs of expanding sustainable development policy are visible: environmental regulation is evolving into integrated regulation, for example with Integrated Pollution Prevention and Control and Integrated Product Policy. The application of environmental taxes is developing into a broader ecological tax reform (EEA, 2000). Agreements with economic entities as regards their environmental behaviour are growing into contracts that encompass the full economic process, as with management contracts in agriculture.

What about the performance of these tools? Analysis of past developments in the Netherlands (RIVM, 2000) shows that regulatory instruments are effective when large reductions of environmental impact or abolition of polluting products are required. Sometimes sectoral polices are already effective even without explicit inclusion of environmental considerations. For example, in the Netherlands, the milk quota system appears to have had a larger impact on reduction of manure and ammonia emissions than environmental policy.

Integration policy implies a more dedicated search for such synergies. International agreements appear to be effective, but in general work only slowly. Market-based instruments are sometimes effective as stand-alone, but also often act supportively by reinforcing other instruments and providing sources of financial support for environmental innovation. In many instances taxes and economic incentives are not strong enough, resulting in incomplete internalisation of external costs and too much leeway for economic activities. Also, environmental taxes become less effective if the income (of a firm or a household) grows faster than the tax rate. Communication instruments such as voluntary agreements are generally seen as important for their 'soft effects' in terms of increasing the support and acceptance of other tools and improving conditions for effective application of environmental and integration policy. In a few cases legally binding voluntary agreements have proved to be environmentally effective.

2.5. References and further reading

EEA, 2000. *Environmental taxation: recent developments in tools for integration*. European Environment Agency, Copenhagen.

RIVM, 2000. *Milieubalans 2000 - Het milieu nader verklaard.* Alphen a/d Rijn. pp. 27-33. Bilthoven.

Integration of environment and other policies in the Netherlands

Tax-free returns for green investors

Green investment funds are becoming very popular. The Dutch government has made such schemes more attractive by removing the tax on the returns.

Major environmental projects can be difficult to finance, and may not produce the high returns expected by the market. Ensuring that the returns on such projects are untaxed enables them to compete for regular market funds. The aim of the Dutch scheme is to promote investment in environmentally-oriented projects that could not be financed in a commercial way.

The Dutch central bank establishes criteria defining 'green projects' for such investment funds, into which 70 % of the fund must be invested. There is a wide range of approved projects, with a strong focus on renewable energy, energy saving, organic farming, nature conservation projects and green mortgages supporting investments in green housing. In 1995, EUR 45 million were invested in approved green projects, rising to EUR 272 million in 1997. The funding of research and development projects on renewable energy has doubled since this tax legislation was introduced.

Source: Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer

http://www.iea.org/pubs/studies/files/renenp2/ren/27-ren.htm

3. Households and consumption patterns

policy issue	indicator	assessment
level and intensity of consumption	household number and size	☹
consumption of harmful products and services	household expenditure categories	😐
energy intensity policy	household energy consumption	☹
eco-labelling and market prices	penetration of environment-friendly products	😐

The household sector is a major source of pressure on resources and the environment. Improvements in the efficiency of energy and resource use have been overwhelmed by growth in the number of households and changes in consumer demand and expenditure patterns.

Households, as final consumers, are a major driving force in the economy. Household expenditure is nearly twice what it was in 1980. This growth reflects aspirations for higher living standards and increased welfare which threaten the integrity of the environment. In particular, the sector contributes, directly or indirectly, to emissions of greenhouse gases, acidifying substances, tropospheric ozone precursors, nitrogen, phosphorus and other pollutants; to energy and water use; and to waste.

There is a growing array of policy instruments, at the EU and national level, that aim to influence consumer behaviour and reduce the impacts of the household sector, but few include specific targets.

The Fifth Environmental Action Programme addresses the role of members of the public as direct producers of pollution and waste, but does not set explicit goals and targets in this respect. The proposed Sixth Environmental Action Programme emphasises the need to help individuals and households to make environmentally informed choices, particularly purchasing decisions.

Energy consumption in the domestic sector has been addressed at the EU level through voluntary agreements with manufacturers that set minimum standards for the energy efficiency of domestic appliances. There is no general EU policy on water consumption, either in general or for households. However, implementation of the proposed Framework Water Directive should result in a legal requirement to manage water use. There are several national action plans on water resources that cover household water use and water savings.

Most countries have introduced some form of environmental taxes or charges which fall on households. Several policies are directed towards providing more information on the environmental impact of products, for example, eco-labelling and energy labelling of appliances.

	Resource use				Air emissions					Water			Hazardous substances		Biodiversity
	Land / soil	Water use	**Waste generation**	**Energy use**	**Climate change**	Ozone layer	**Acidification**	**Trop. ozone**	**Urban air quality**	**River WQ**	Eutrophication	**Marine WQ**	Chemicals	**Soils: contaminated sites**	
Households	●↗	●↘	●↗	●●↗	●→		●↘			●●●↘	●●●↘	●→	●●→		●
contribution	2-17%	14%	8-18%	29%	12%						phosphor 45%	heavy metals	use of chem.		

3.1. Household numbers and size

Between 1980 and 1995 the population in the EEA area increased by 5 % but the number of households increased by 19 %, bringing average household size down to 2.5 persons. Average household size in most countries fell by 10 to 15 %, but in Iceland, Luxembourg, Sweden and the United Kingdom it remained nearly constant.

The trend towards smaller households seems set to continue, for example the percentage of single-person households in the EU is expected to increase from the present 30 % to 36 % in 2015. There has not been a corresponding decrease in the average size of dwellings; indeed, this increased from 83 m^3 in 1985 to 87 m^3 in 1997.

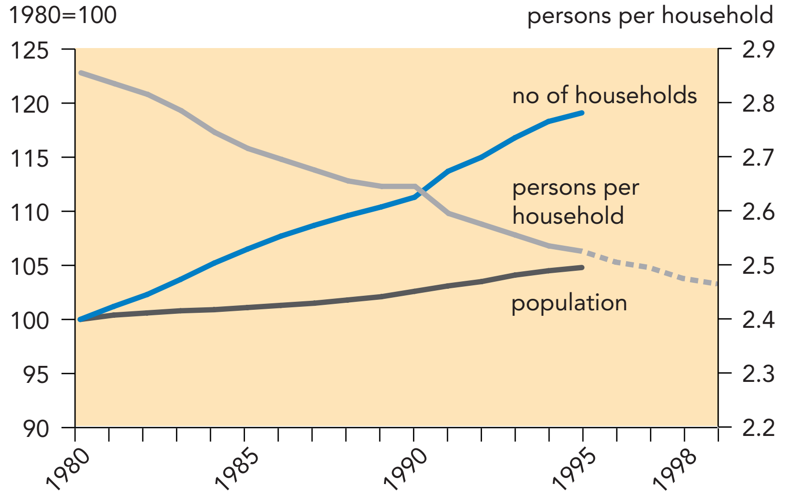
3.2. Some elements of household eco-efficiency

Energy use has risen more or less in line with the increase in household numbers and expenditure, somewhat more rapidly in the early 1990s and more slowly in recent years.

Carbon dioxide emissions from the household sector in 1997 were close to the 1990 level, with the increase in the number of households roughly balanced by improvements in energy efficiency and switching from coal and oil to gas. However, the emission of carbon dioxide from fossil fuel use by households is a low estimate of total greenhouse gas emissions from households.

Energy and water use per household depend on lifestyle factors such as desirable room temperature, washing-habits and number of appliances, as well as on efficiency of use. It is difficult, therefore, to judge the effectiveness of instruments aimed at improving efficiency from these data alone. Energy use and water consumption are further discussed below.

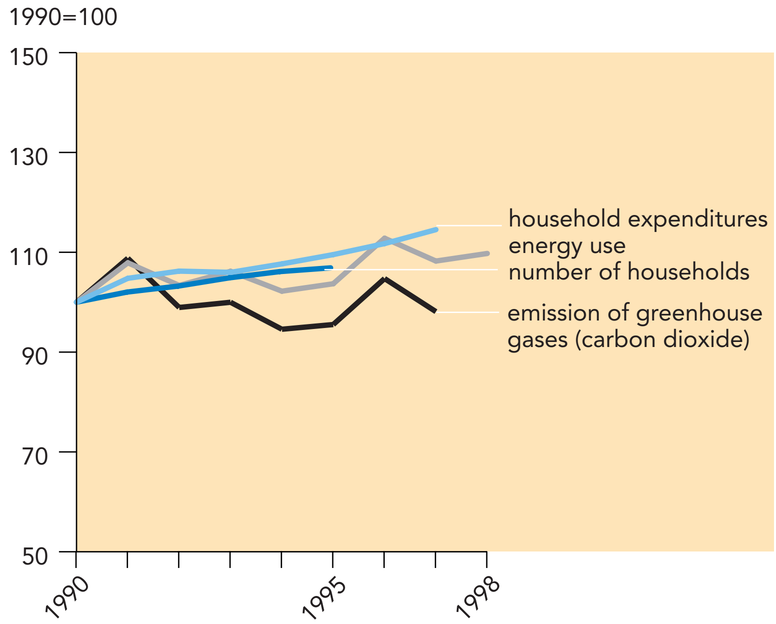
Development in the number of households and population and the average size of households in the EEA area — Figure 3.1.



Source: Eurostat

☹ From 1980 to 1995 the population in the EEA area increased by 5 per cent while the number of households increased by 19 per cent; the average household size consequently decreased. Small households consume more per capita than large ones.

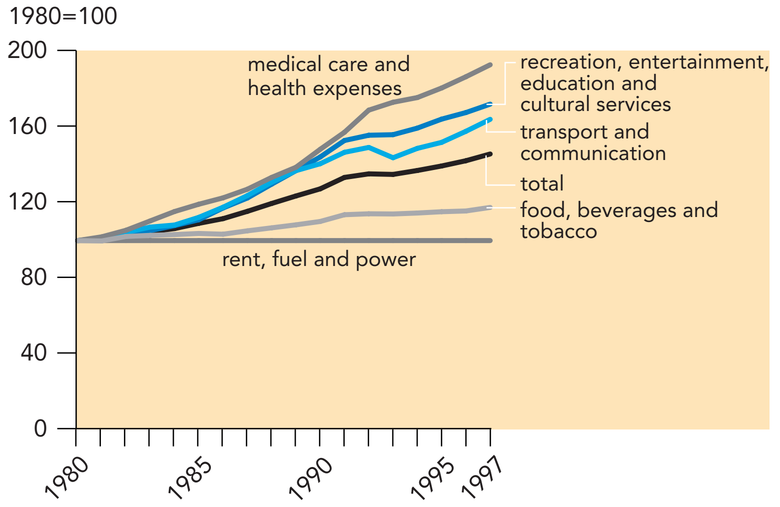
Some indicators of eco-efficiency of the household sector — Figure 3.2.



Source: EEA-ETC/AE, Eurostat, Euromonitor

☹ Energy use by the household sector increased between 1990 and 1998, in line with increases in household numbers and expenditure.

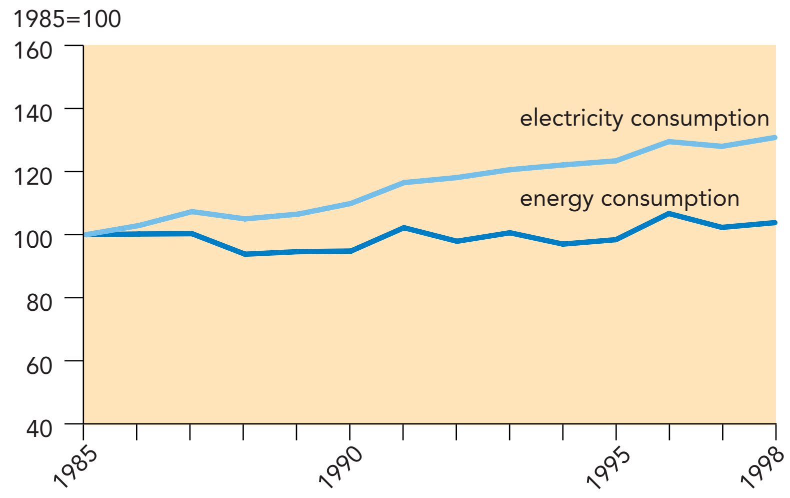
Figure 3.3. **Household consumption expenditure, EU15**



Note: constant 1990 prices
Source: Eurostat New Cronos

Consumer spending per capita has increased by 46 % since 1980, shifting from basic needs (food, housing) towards less basic needs (transport, fuel, recreation).

Figure 3.4. **Final energy consumption and electricity consumption by households, EEA countries**



Source: Eurostat

Higher energy standards for houses and the introduction of more efficient electrical appliances and heating installations have not led to a decrease in total energy and electricity consumption by households.

3.3. Household expenditure and consumption

Household expenditure

The make-up of household expenditure has shifted gradually from basic to less basic needs - from food, clothing and housing towards transport, fuel and recreation. Between 1980 and 1997, expenditure on food and clothing increased by 20 %, on housing by 47 %, on transport by 65 % and on recreation by 73 %. The steepest growth was in spending on health, to nearly twice the 1980 figure, probably partly reflecting the increasing age of the population.

In 1997 the average EU citizen spent EUR 9 400, nearly twice the 1980 figure in real terms. About half the total went on food and housing and a quarter on transport and recreation.

As part of the 'new consumerism', a marked increase in expenditure on recreation includes the growth in private car use (see chapter 5) and tourism (see chapter 4). The increase in second homes for holidays, often in environmentally sensitive areas such as lakesides, seashores and mountains, can add significantly to the environmental impact of a household.

Household energy consumption

The household sector is one of the largest users of energy in the EEA - 29 % (excluding energy used for transport) of final energy consumption. Consumption by the sector increased by 4 % between 1985 and 1998, with energy used for space heating falling slightly and electricity consumption rising by about 31 %. The overall increase was due to the increase in number of households, with consumption per household remaining nearly constant.

Consumption per dwelling is falling slightly in northern countries; rising in southern Europe, Austria and Ireland; and steady in other countries. Most consumption is for space heating (69 %), followed by water heating (15 %), and electrical appliances and lighting (11 %). Consumption per household for space heating has fallen slightly since 1990, with more energy-efficient dwellings and appliances more than making up for larger and warmer houses. New dwellings need 22 % less energy for space heating than those built in 1985.

Electricity consumption per household continues to grow, but more slowly than in the past (2.1 % per year between 1985 and 1990; 0.9 % per year between 1990 and 1997). Appliances are becoming more efficient, but households have more of them, their characteristics have changed (refrigerator/freezers instead of refrigerators, colour instead of black and white televisions), and they are used more often (especially washing machines and televisions). A further factor has been the steady fall in domestic electricity prices - about 1 % per year in real terms between 1985 and 1996.

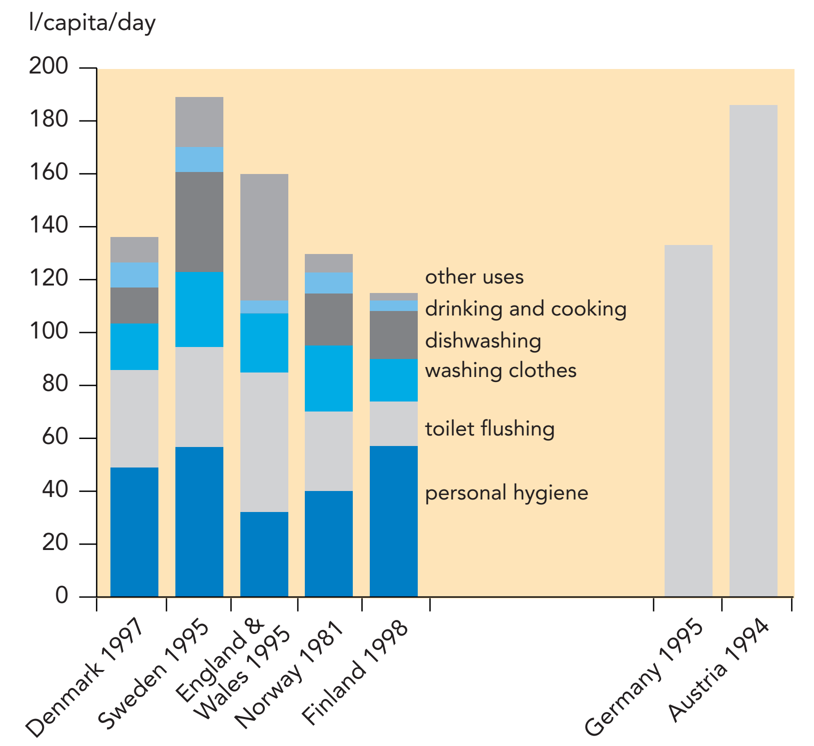
Household water consumption

Households account for about 10 % of total water consumption in the whole of the EU. The figure may be significantly higher in urban areas and areas with poor water resources.

Few data exist for water consumption per household. The data used in this indicator are for consumption per capita, for all household purposes and for particular uses such as washing clothes or flushing toilets.

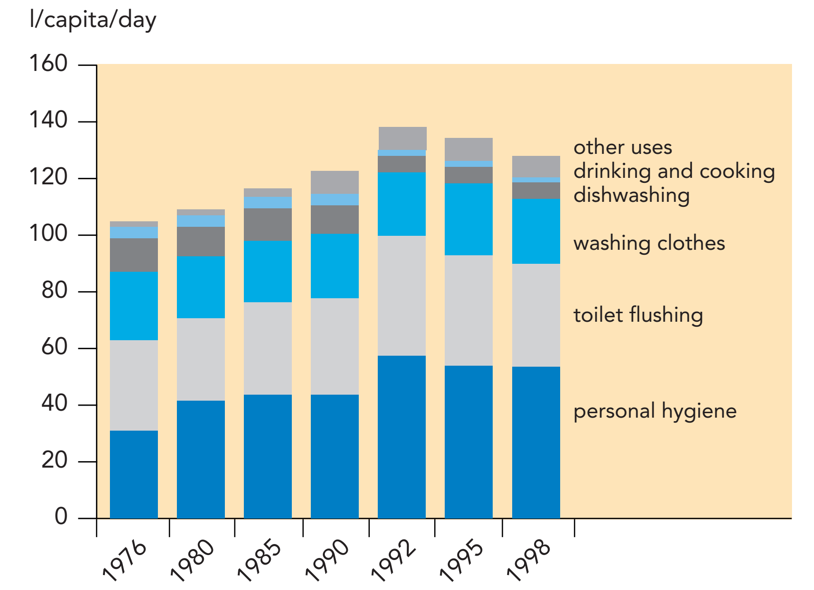
Average consumption for all household purposes in the EEA is about 150 litres per capita. On the basis of information from four countries, about one third of this is for personal hygiene, one third for washing clothes and dishwashing, 25 to 30 % for flushing toilets and only about 5 % for drinking and cooking.

Household water consumption by type of use Figure 3.5a.



Source: National State of the Environment Reports

Trend in household water consumption by type of use in the Netherlands Figure 3.5b.



Source: based on information from RIVM, Milieucompendium 1999

Household water consumption generally increased during the 1980s, reflecting increases in number of households, more household appliances and changing lifestyles. The increase slowed and in some countries was even reversed during the 1990s.

Per capita consumption generally increased during the 1980s, reflecting increases in the number of appliances, particularly washing machines and dishwashers, changes in lifestyle and the reductions in average household size. This trend was arrested and in some countries even reversed during the 1990s. In the Netherlands, for example, consumption increased from 105 litres/capita/day in the mid-1970s to a maximum of 138 in 1992 before falling to 128 in 1998. The more favourable trend may be the result of the use of showers rather than baths and growing penetration of low-flush toilets. Another factor may be steep increases in the price of water (including wastewater treatment). In France, for example, prices rose from EUR 1.37 per m3 in 1990 to EUR 2.29 in 1997, and in Denmark from EUR 1.47 in 1988 to EUR 4.02 today.

Table 3.1. **The European food market for organically produced products, 1997**

region/country	% of total food market	yearly growth (%)
Europe	Ca. 1.5	
Austria	2.0	10-15
Denmark	2.5	30-40
Finland*	1.0	
France	0.5	20
Germany	1.2	5-10
Italy	0.6	20
Netherlands	1.0	10-15
Sweden	0.6	30-40
Switzerland	2.0	20-30
United Kingdom		25-30

Source: ITC, 1999

*Finland: 1999 data

☺ Sales of eco-labelled products are on the increase.

😐 In many countries the market for organic products is still small; it is, however, growing everywhere.

3.4. Penetration of environmentally friendly products

Some indicators suggest that, in a limited number of areas, consumer behaviour is shifting towards the use of more environmentally sound products. A possible reason for this is the growth in eco-labelling and environmental product declarations.

The market for organically produced food (see also chapter 7) is small, about 1.5 % of total food sales in the EU, but growing rapidly. Consumption is highest in Germany, followed by Italy, France and the United Kingdom. In southern and eastern Europe, consumption of organic products is relatively low, and most production is for export to northern and western Europe.

In 1998 each Swede bought eco-labelled products to the value of about EUR 300, about 10 times more than in 1995. The number of eco-labelled products in Sweden increased from 1 852 in 1995 to 4 059 in 1998.

The EU Energy Labelling scheme requires manufacturers and retailers to display energy-efficiency ratings (class A for best, G for worst) for certain household appliances, including refrigerators and washing machines.

For refrigerators, the market share of class A and B appliances increased from 15 % in 1994 to 20 % in 1996, but class A refrigerators still only represented 3 % of sales in 1996 (compared with 1 % in 1994). Similar changes were not seen in the market for freezers because of an increase in some countries (United Kingdom, France, Spain) in the sales of chest freezers, whose efficiency is generally low. In Sweden, between 1996 and 1999, the market share of class A and B refrigerators increased from 2 % to 16 %, and of freezers from 29 % to 63 %. The market share of class A washing machines increased from zero in 1997 to 33 % in 2000.

Refrigerators and freezers have to meet minimum energy-efficiency standards from 1999 and all models of lower energy-efficiency (classes D to G) will be removed from the market.

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Electricity consumption by households in the EEA area. Table 3.2.

	1985	1990	1995	1996	1997	1998	98/85
	million tonnes of oil equivalent						%
Austria	0.88	0.96	1.09	1.14	1.11	1.12	1.27
Belgium	1.16	1.58	1.90	2.00	1.97	2.01	1.74
Denmark	0.73	0.78	0.90	0.94	0.89	0.88	1.21
France	7.38	8.33	9.36	10.36	10.24	10.59	1.44
Finland	1.05	1.26	1.40	1.48	1.50	1.56	1.49
Germany, Federal Republic of (incl. ex-GDR from 1991)	9.67	10.07	11.05	11.51	11.25	11.25	1.16
Greece	0.68	0.78	0.99	1.05	1.07	1.10	1.63
Ireland	0.34	0.39	0.47	0.49	0.46	0.47	1.40
Italy	3.83	4.53	4.92	4.98	5.03	5.10	1.33
Luxembourg	0.05	0.06	0.06	0.06	0.07	0.06	1.30
Netherlands	1.38	1.42	1.69	1.72	1.75	1.79	1.30
Portugal	0.37	0.51	0.68	0.73	0.72	0.76	2.01
Spain	2.00	2.60	3.09	3.23	3.45	3.59	1.79
Sweden	3.42	3.28	3.65	3.72	3.66	3.64	1.07
United Kingdom	7.59	8.06	8.79	9.24	8.98	9.42	1.24
EU15	40.5	44.6	50.0	52.7	52.1	53.3	1.32
Iceland	0.04	0.05	0.05	:	:	:	:
Norway	2.49	2.61	2.98	3.03	2.92	2.96	1.19
Liechtenstein	:	:	:	:	:	:	:
EEA	43.0	47.3	53.1	55.7	55.1	56.3	1.31

Source: Eurostat

Households in Germany without parking spaces

Conventional planning legislation often assumes that everyone with a residence also has a car. Provision of parking spaces is obligatory for most housing developments. This encourages car-dependent living, occupies valuable urban land and drives up the cost of houses and apartments.

In Vauban, an area of the German city of Freiburg, a group of people wanted to develop a housing area without providing parking spaces. Originally, this was prevented by the planning regulations. After some effort, the city was persuaded to allow the building of 350 car-free housing units, although some parking was to be provided outside the area.

The viability of the housing project depended on the acceptance of car-free living. With the normal number of parking spaces, the cost of the project would have been significantly higher.

The car-free area will constitute only a small part of the new urban district of Vauban. However, the whole area is intended to be a model community for sustainable living. The project is supported by the European Union through the Life Programme.

Source: http://cities21.com/egpis/egpc-151.html

4. Tourism

policy issue	indicator	assessment
modal split in tourism transport	travel by transport modes	☹
reflecting environmental costs in tourism prices	household expenditure for tourism and recreation	☹
carrying capacity of destinations	tourism intensity	☹
reducing energy use	energy use	☹
reducing environmental impacts	eco-labelling	😐

Tourism is a rapidly growing source of pressure on natural resources and the environment. Europe has long been the world's favourite tourist destination and the World Tourism Organisation forecasts a doubling of the number of arrivals to around 720 million per year by 2020. Vacationing patterns are changing with more holidays per year, shorter stays, longer travelling distances and more second homes with low occupancy rates. The lack of an EU policy on tourism makes developing a coherent framework to tackle these problems more difficult.

Tourism, which contributes to well-being and recreation, is receiving increasing attention as an economic sector in need of more sustainable management. The sector was identified as an area of concern in the Fifth Environmental Action Programme.

Employment is a top Community priority and tourism, which already provides some 9 million jobs, is expected to provide between 2.2 and 3.3 million more by 2010. Tourism is expected soon to be the largest service industry in the EU. There are tourism activities in all Member States, involving about 2 million businesses (mostly small and medium-sized enterprises) currently generating up to 12 % of GDP (directly or indirectly), 6 % of employment and 30 % of external trade. There are large regional differences in European countries, tourism being the main activity in some places, for example 70 % of GDP in Mallorca (Spain) and 40 % in Malta. All these figures are expected to increase as tourism demand grows by almost 50 % and capital investment in the sector (as a percentage of GDP) doubles by 2010.

For the whole of the EU, tourism now accounts for 50 % of passenger transport energy use, and holiday travel accounts for 70 % of air transport. Travel to and from destinations is responsible for 90 % of the energy use of the sector.

There is no specific policy at the EU level for tourism-related travel. Some countries, however, levy taxes and/or duties on tourism-related transport, earmarked for environmental protection.

	Resource use				Air emissions					Water			Hazardous substances		Biodiversity
	Land / soil	Water use	**Waste generation**	**Energy use**	**Climate change**	Ozone layer	**Acidification**	**Trop. ozone**	**Urban air quality**	**River WQ**	Eutrophication	**Marine WQ**	Chemicals	**Soils: contaminated sites**	
Tourism	●↗	●↗	●↗	●↗	●↗		●→	●→	●→		●→	●→			

4.1. Major tourism patterns

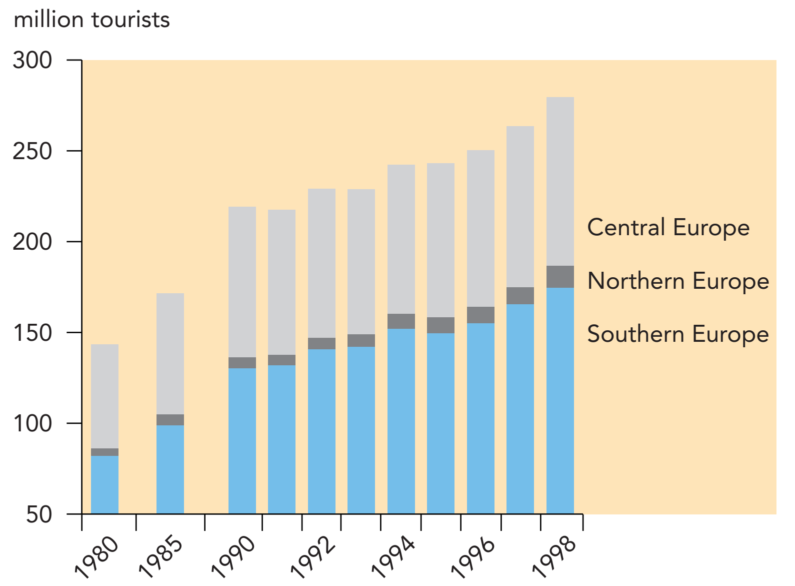
Tourism demand
For years, European countries have been the primary destination for tourists, taking 60 % of all international arrivals. France, Spain, Italy, the United Kingdom and Austria are among the top ten world destinations. But 80–90 % of tourism trips are within the country of origin, and domestic tourism is not growing as rapidly as international tourism. Most holiday trips are to the sea (63 %), mountains and cities (25 % each) and the countryside (23 %) – some trips cover several of these types of destination.

The Mediterranean is the biggest tourism region in the world, accounting for 30 % of international arrivals and 25 % of receipts from international tourism. The number of tourists in Mediterranean countries is expected to increase from 260 million in 1990 (with 135 million to the coastal region) to 440 to 655 million in 2025 (with 235 to 355 million to the coastal region). The Alps have the second highest tourism intensity in Europe, with 59.8 million arrivals and a total of 370 million bed nights per year.

The number of tourist arrivals in the 15 EU and 4 EFTA countries increased steadily during the 1980s, levelled off in the early 1990s and increased by 18 % between 1993 and 1998. There are expected to be about 720 million international tourism arrivals in 2020, representing an annual growth rate of about 3 % over the period 1995 to 2020.

Tourist travel
In 1996, travel for tourism (the definition includes business travel, which constitutes 25–30 % of passenger km) was almost 9 % of total passenger travel. The average EU citizen makes 0.8 tourist trips a year with an average round-trip distance of about 1 800 km. The country-to-country range is from 765 km in Portugal to 3 000 km in the United Kingdom. Reflecting world tourism patterns, Europeans will be taking trips more often and will travel further from home.

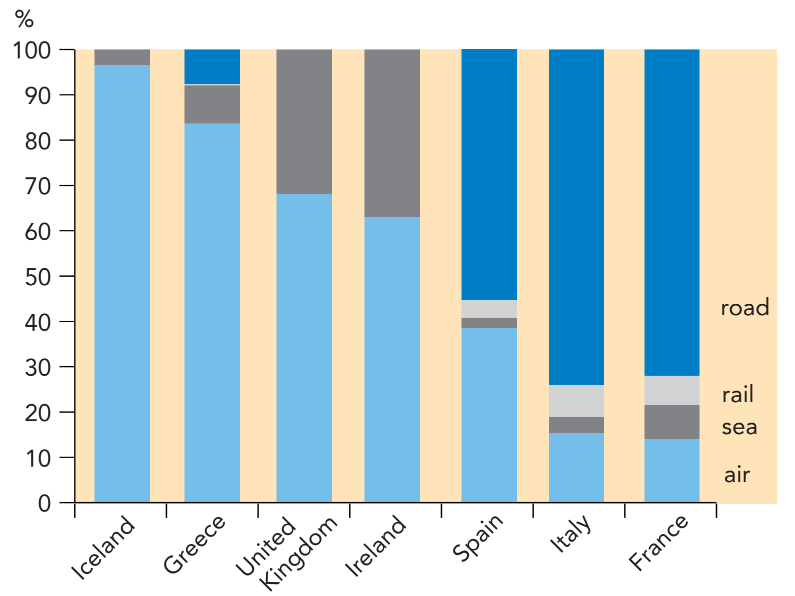
Total international inbound tourism in Europe — Figure 4.1.



Source: World Tourism Organisation

The number of tourist arrivals in Europe increased steadily during the 1980s and increased by 18 % between 1993 and 1998. International arrivals in Europe are expected to increase by about 3 % per year between 1995 and 2020.

International tourism by mode for selected countries, 1995 — Figure 4.2a.



Note: The lack of time series is a weakness for analysing this data. Furthermore, the definition of tourism related travelling varies widely between countries, resulting in a weak data set. Data based on distance travelled per tourist.

Source: OECD

Figure 4.2b. **Trends in number of stays by mode of transport, France**

Source: Insee; Direction du Tourisme; Sofres – cited in IFEN, 2000

	1986 –1994	1994 –1998
	% change	
Car	+ 17.0	– 9.5
Aeroplane	+ 70.4	+ 25.8
Train	– 6.3	– 3.9
Bus	+ 9.3	– 19.5
Other	– 42.0	+ 21.5

☹ The average EU citizen travels 0.8 times per year for tourism purposes, travelling a distance of around 900 km away from home. Most tourists in Europe (61 %) travel by road.

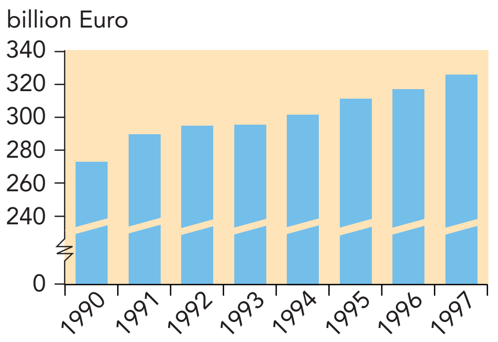
Most tourist movements in Europe are by road (61 %), with 21 % by air, 15 % by train and 3 % by ship. A major factor in the recent growth in air transport is the large increase in the availability of packaged holidays which include cheap air fares.

In 1995, road travel accounted for 39 % of all international trips (as much as air and nearly six times as much as train).

Figure 4.3. **Household consumption expenditures on recreation, EU15**

Note: Includes expenditures on entertainment, educational and cultural services. In constant 1990 prices.

Source: Eurostat



☺ Household expenditure on tourism in Europe increased by 16 % between 1990 and 1997. Tourism prices are continually decreasing, resulting in deals more attractive to the customer.

Car travel for tourism has advantages such as lower costs and a high degree of freedom. In contrast, public transport is expensive, particularly for families, and does not provide door-to-door service, a particular problem with respect to baggage handling. The attractiveness of public transport for tourism travelling is further reduced by inadequate access, especially to remote and tourist areas, and insufficiently frequent operation, especially during peak tourist seasons.

Tourism and leisure expenditure

As people become more affluent and have more leisure time, and as the relative costs of travel and holidays fall, tourism is taking a larger and larger share (currently about 9 %) of household expenditure. The retired population in the EU will increase by about 17 million over the next 20 years which could contribute significantly to the growth of tourism. Household expenditure on recreational, entertainment, educational and cultural services, which includes tourism, increased by 16 % between 1990 and 1997, the largest increases being in Belgium, Denmark, Ireland and the United Kingdom.

As working hours have fallen and holiday periods have increased, time spent on vacations is becoming longer and more people are taking them. For example, vacation time in Denmark increased from 5 to 5.5 weeks during the 1990s. In the Netherlands 40.8 % of people took vacations in 1966 and 72.2 % in 1997, with the average number of vacations per person increasing from 1.24 to 1.71 over that period. Also in the Netherlands, between 1988 and 1997 the percentage of people taking short vacations increased by about twice as much as the percentage taking long vacations. In France the average number of trips per person increased from 3.1 in 1975 to 4.8 in 1994, with the average duration of each holiday falling from 18 to 13 days. About one third of holidays taken in France are during July and August; spreading holidays over a longer period would help to reduce congestion and some of the related environmental problems.

4.2. Tourism and environment

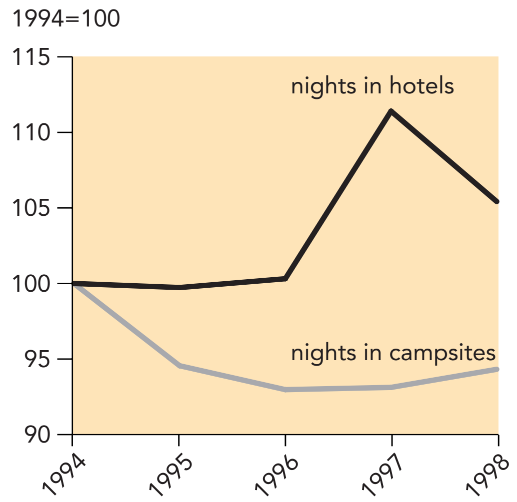
Tourism is responsible for a large share of air and road traffic, and consumption of energy by tourist infrastructure adds further to emissions of greenhouse gases and acidifying substances. In France for example, 5–7 % of greenhouse gas emissions are due to tourism, mainly because 80 % of domestic tourist travel is by private car.

Hotels appear to be the most ecologically acceptable form of accommodation. However, energy consumption per m^2 per year in a one star hotel is 157 kWh, in a two star hotel 230 kWh and in a four star hotel 380 kWh. Campsites have the advantage of being a reversible form of land use, but problems (such as waste water collection and treatment or waste) can arise during temporary overcrowding.

Hotels, swimming pools and golf courses can put critical pressure on water resources, particularly in regions such as the Mediterranean where resources are scarce. Tourists typically consume around 300 litres (luxury tourism 880 litres) and generate 180 litres of wastewater per day. Tourism contributes about 7 % of pollution in the Mediterranean. Annual waste generation per capita at coastal holiday resorts in France is 100 kg higher than the national average.

Although rural areas can benefit from tourism in many ways, this may come at high cost because of the need for infrastructure such as roads and water supplies, waste disposal problems, and damage to environmentally sensitive areas.

Stays in tourism establishments Figure 4.4.



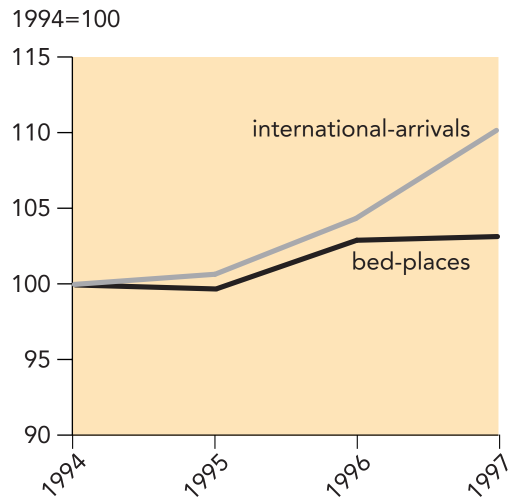
Note: EU15 excluding Greece and Ireland.

Source: Eurostat

☺ Of all nights spent by tourists (both residents and non-residents) 58 % are spent in hotels.

☹ The number of second homes has increased dramatically since the beginning of the 1990s. In France second homes represent 73 % of the total number of establishments in 2000.

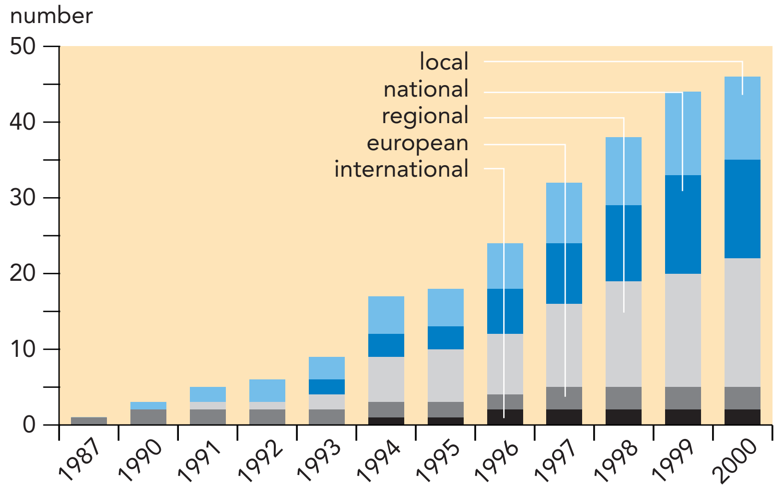
Number of beds and international arrivals, EU15 Figure 4.5.



Source: Eurostat

☹ Tourism intensity in terms of number of beds per international arrivals in the EU15 countries increased by 3 % between 1994 and 1997, leading in some areas to overloading the accommodation capacities of the destinations.

Figure 4.6. **Current eco-labels for accommodation in Europe**



Source: ECOTRANS-ECO-TIP database: www.eco.tip.org

There has been a significant increase since 1990 in the use of eco-labelling at the national and sub-regional level but national case studies show that implementation remains marginal.

Managing mass tourism in Spain

What do you do when your guests take over your house? Almost 11 million people arrive at the Balearic Islands in Spain each year. This is an impressive number considering that the permanent population of the three islands of Mallorca, Menorca and Ibiza is only 760 000.The tourists contribute significantly to the local economy, but there are also social and environmental costs. For some years, the local people have tried to cope with the environmental pressures resulting from mass tourism, with the city of Calvia at the forefront. In 1997, Calvia was awarded the European Prize for Sustainable Cities for its efforts. Under the umbrella of a Local Agenda 21 plan, the city demolished worn-out tourist resorts, rehabilitated others and placed restrictions on new construction. In parallel, the city focused on preserving natural areas and reducing the overall environmental impacts from the inhabitants as well as the tourists.

The regional government of the Balearic Islands is trying to manage the impacts of tourism. It has proposed an eco-tax on hotel stays, expected to be implemented in 2001. The tax will be earmarked for environmental regeneration and the establishment of nature conservation areas.

Source: http://www.caib.es

An important characteristic of tourism is its concentration in particular areas. In France, for example, the most visited country in the world, 4.5 % of municipalities, most of which are in coastal and mountain areas, receive about half of the total number of tourists. Some coastal areas, particularly around the Mediterranean, are under extreme pressure from such large numbers, but there is little detailed information on which analysis of the impacts on the coastal and marine environments can be based. One study, however, suggests that three quarters of the sand dunes between Spain and Sicily have disappeared as a result of urbanisation linked to tourism development.

In mountain regions, too, tourism can bring economic benefits to otherwise poor communities, but at significant environmental cost. Walking and mountain biking can lead to erosion and wear and tear of paths. The building of cable cars and ski lifts, and in particular the laying out of new ski runs, has resulted in extensive clearing of forests. Most visitors to ski resorts are day trippers arriving by car, leading to traffic congestion, overcrowding and litter problems.

The increase in tourism is not being matched by a similar increase in available accommodation, leading to demand for more building, overcrowding, especially at peak holiday times, and more pressure on resources and the environment. Of all nights spent by tourists, 58 % are spent in hotels, 18 % in camp or caravan sites, 12 % in furnished accommodation and the rest with family and friends or in second or mobile homes. The growth in the number of second homes is causing concern since the land area of such a home, per person, is estimated to be 40 times that required by a flat and 160 times that required by an 80-bed hotel (20 times when garden areas are excluded). In Austrian ski resorts, 30 m^2 of land are needed for one bed in a hotel and 200 m^2 for one bed in a second home. In France, more than 4 % of the land used for new buildings between 1982 and 1998 was for second homes.

4.3. Instruments: eco-labelling

Eco-labelling has some potential as an indicator for tourism and the environment, but there is no common EU framework for a tourism-related eco-label policy.

There has been a five-fold increase since 1990 in the use of eco-labels for accommodation, but total numbers remain small (for example only 0.12 % of companies providing accommodation in Austria), and the lack of data on targeted accommodation establishments precludes any evaluation of their penetration.

Similarly, there has been some increase in the number of European Blue Flag awards to beaches, but the aim of these is not to judge the cleanliness of beaches in general but to concentrate tourism at specific areas that meet water quality and also provide facilities such as services and information, rather than at rural beaches without such facilities. Information on beaches that failed to get a Blue Flag is not available to the public.

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Number of Blue Flag European beaches — Table 4.1.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Belgium		24	4	21		3	7	5	9	9	9	12
Denmark	42	89	128	173	168	125	139	169	171	185	185	176
Finland				0	0	0	0	0	3	3	5	3
France	106	125	93	104	248	193	302	291	271	338	299	399
Germany	13	14	30	22	11	0	0	0	3	12	18	26
Greece	7	6	85	178	232	237	287	282	311	311	326	318
Ireland	19	36	48	66	54	61	55	66	59	70	78	70
Italy	5	17	27	55	29	215	221	192	219	289	342	99
Netherlands	8	7	21	30	14	19	12	13	0	19	19	20
Portugal	69	107	101	96	50	102	95	111	114	122	116	115
Spain	106	120	137	170	206	229	306	307	329	363	369	390
Sweden								1	1	15	37	40
United Kingdom	17	22	29	35	17	20	17	18	31	31	44	41
Total EU13	392	567	703	950	1030	1204	1441	1455	1521	1767	1847	1709

Source: http://www.blueflag.org

5. Transport

policy issue	indicator	assessment
reduce use of resources and outputs that damage the environment	transport eco-efficiency	😐
decouple transport growth from economic growth	freight and passenger transport volumes	☹
manage demand for travel	travel distance per capita	☹
progress towards more environment-friendly modes	freight and passenger modal split	☹
stimulate fuel efficiency	average prices of motor fuel	☹
fair and efficient pricing	internalisation of external costs	😐

Transport is the fastest-growing source of anthropogenic carbon dioxide emissions. The main cause of this is the continuing growth in road transport, but emissions from aviation are also growing rapidly. Emissions of ozone precursors and particulate matter from transport are beginning to come under control, partly as a result of the introduction of catalytic converters and improvements in fuel quality. However, nearly all EU urban citizens are still exposed to air pollution levels that exceed proposed EU air quality standards. The environmental costs of transport are estimated at about 5.5 % of GDP, accident costs 2.3 % of GDP and congestion costs 0.5 % of GDP. Road transport is responsible for more than 95 % of these external costs. Little progress is being made in internalising these costs in transport prices.

As well as being a major contributor to climate change and air pollution, the transport sector is increasingly contributing to a number of other environmental and human-health problems, such as noise, land take, fragmentation and disturbance of nature conservation areas, as well as an unending toll of accidental deaths (typically 44 000 a year in the EU), injuries and material damage.

Past efforts to reduce these environmental impacts have focused mainly on technological improvements, but the benefits of these have been partly offset by transport growth, which remains strongly coupled to economic growth. In seeking to meet EU environmental standards, transport policies increasingly recognise the need to tackle growing transport demand and the deterioration of modal split as the shares of more environment-friendly modes – rail, cycling and walking – continue to fall.

Little progress is being made in internalising the external environmental and other costs of transport: the more environmentally harmful modes are often still the cheapest and the most attractive in terms of quality and flexibility. In particular, current price structures continue to favour private over public transport.

	Resource use				Air emissions					Water			Hazardous substances		Biodiversity
	Land / soil	Water use	Waste generation	Energy use	Climate change	Ozone layer	Acidification	Trop. ozone	Urban air quality	River WQ	Eutrophication	Marine WQ	Chemicals	Soils: contaminated sites	
Transport	●↗		●↗	●●↗	●●↗		●●↘	●●● ↘	●●● ↘		●↘	●↘		●	●●↗
contribution	land use		scrapped cars	32%	20%		24%	54%			atm. dep.	oil spill TBT		petrol stations	land use

5.1. Transport eco-efficiency

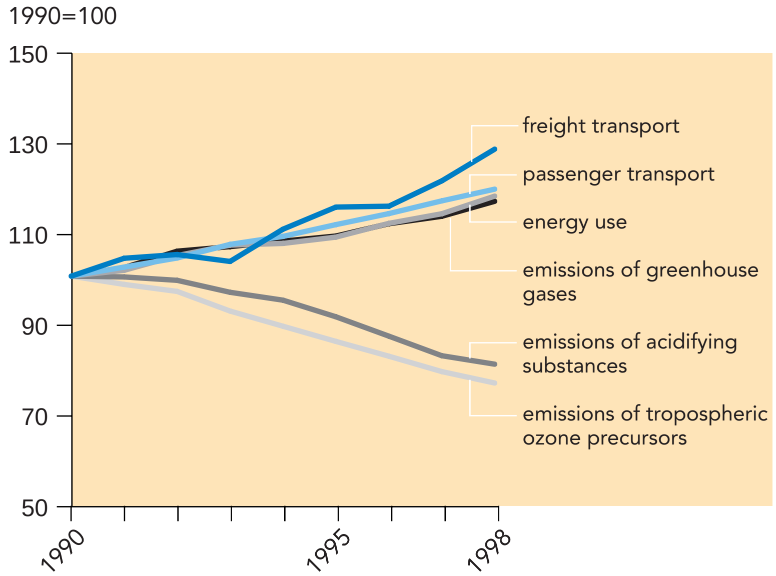
Energy and carbon dioxide efficiency

Passenger and freight transport, and the associated energy use and emissions of greenhouse gases, have all continued to grow since 1990. The energy efficiency of passenger transport (and thus its specific carbon dioxide emissions) has improved only slightly, following technological improvements which have been further enhanced by the voluntary agreement with the car industry to reduce carbon dioxide emissions from new cars. There have been no improvements in the energy efficiency of freight transport. The discrepancy between improvements in technology and actual energy efficiency is partly the result of the use of heavier and more powerful vehicles and low occupancy rates and load factors.

Transport is the fastest-growing energy consumer in the EU: energy use since 1985 increased by 47 %, compared with 4.4 % for the remaining economic sectors. More than 30 % of final energy in the EU is now used by transport.

In 1998, road transport contributed 20 % of total carbon dioxide emissions. The voluntary agreement of the Commission with the car industry on the reduction of carbon dioxide emissions of new cars has led to a reduction of almost 6 % in emissions from new cars between 1995 and 1999. However, all three cooperating car manufacturing associations (Europe, Japan, Korea) will have to increase their efforts if the final target of the agreement for 2010 is to be met. Without this agreement, carbon dioxide emissions from road passenger transport by 2010 are projected to be 29 % higher than those in 1990, compared with only 11 % higher if the agreement is fully implemented (European Commission, 2000a).

Some indicators of eco-efficiency of transport, EU15 — Figure 5.1.



Note: Passenger transport includes travel by motorbike, car, bus, tram / metro, rail, water and air. Freight transport includes freight by road, rail, inland waterways, short sea shipping, oil pipelines and air.

Source: EEA, Eurostat

Emissions of acidifying substances and ozone precursors have decoupled from growth in transport of passengers and goods, but the use of energy and the emissions of greenhouse gases (in particular from road transport and aviation) continue to rise.

Road transport is also a small but growing source of nitrous oxide emissions, a side-effect of the fitting of catalysts to passenger cars. Nitrous oxide emissions from transport almost doubled between 1990 and 1998 to 7 % of total emissions. A substantial further rise is expected by 2010. However, since transport is not a large source of nitrous oxide, this will not have a major impact on the overall trend of greenhouse gas emissions.

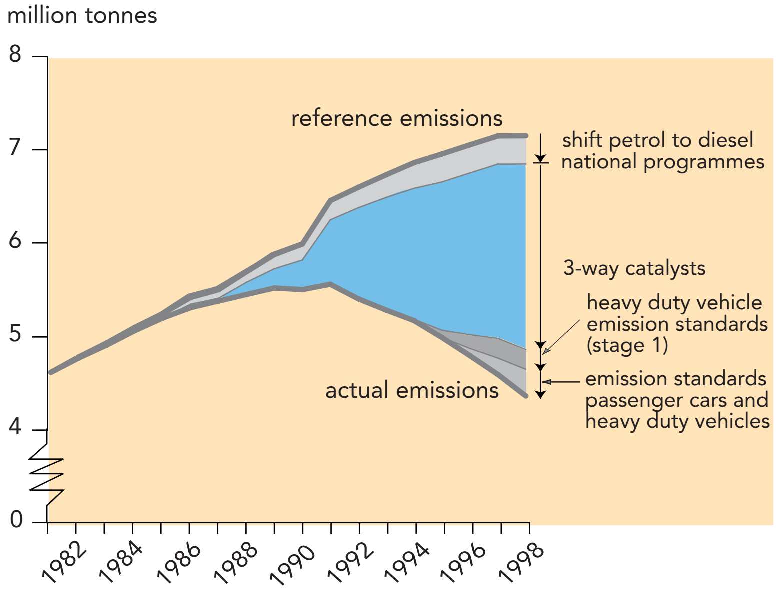
Between 1990 and 1998, EU greenhouse gas emissions from international transport (based on fuel sold in the EU to ships and aircrafts engaged in international transport) increased by 33 % to reach 5 % of total EU emissions. These emissions are not addressed under the Kyoto Protocol, but the International Civil Aviation Organisation and the International Maritime Organisation are currently examining reduction options.

Emissions of ozone precursors, acidifying gases and particulate matter
Transport is responsible for more than half of emissions of tropospheric ozone precursors and more than 20 % of emissions of acidifying substances.

There were significant reductions in emissions of tropospheric ozone precursors (by 25 %) and acidifying substances (by 20 %) from the sector between 1990 and 1998, due primarily to the introduction of catalysts in new petrol-engine cars and stricter regulations on emissions from diesel vehicles. Without these measures, nitrogen oxides emissions from traffic in the EU would have been 50 % higher in 1998.

This reduction in pollutant emissions from transport has contributed to a significant improvement of urban air quality. It is expected that this trend will continue with the implementation of the recent EU Directives, following the Auto Oil II agreements (European Commission, 2000b). However, large numbers of people, particularly in urban areas, are still exposed to high pollution levels, and predictions for 2010 show that some 70 % of the EU urban population are still likely to be exposed to PM10 levels exceeding the limit values, some 20 % to nitrogen dioxide exceedances, and some 15 % to benzene exceedances (Chapter 10). WHO studies show that this results in a significant amount of premature deaths, new cases of chronic bronchitis (adults and children) and asthma attacks (Kunzli, N. et al., 2000).

Figure 5.2. **Reduction of nitrogen oxide emissions from road traffic**



Notes: Emission estimates of the ForeMove/COPERTIII model (see references for further detail).

Source: EEA

☺ Three-way catalysts have been the most important measure to counter the increase in nitrogen oxide emissions from the growth of road traffic

Emissions from international shipping are currently not included in national inventories, but it is estimated that shipping in European waters contributed 24 % of total sulphur dioxide emissions and 22 % of total nitrogen oxide emissions from EU15 countries in 1998.

Land take and impacts on biodiversity
Land is under continuous pressure for new transport infrastructure: between 1990 and 1998 some 33 000 ha, about 10 ha of land every day, were taken for motorway construction in the EU. Other modes are less land-intensive. For example, land take per passenger-km by rail is about 3.5 times less than for cars, and bicycles need 10 to 12 times less space than cars.

Most areas in the EU are highly fragmented by transport infrastructure. The average size of contiguous land units that are not cut through by major transport infrastructure ranges from about 20 km^2 in Belgium to nearly 600 km^2 in Finland, with an EU average of about 130 km^2.

Noise
Model results show that more than 30 % of the total population is exposed to road traffic noise levels above 55 Ldn dB, a level at which people are 'seriously annoyed'. Ten percent of the EU population is exposed to rail noise above 55 Ldn dB and probably a similar percentage is highly annoyed by air transport noise.

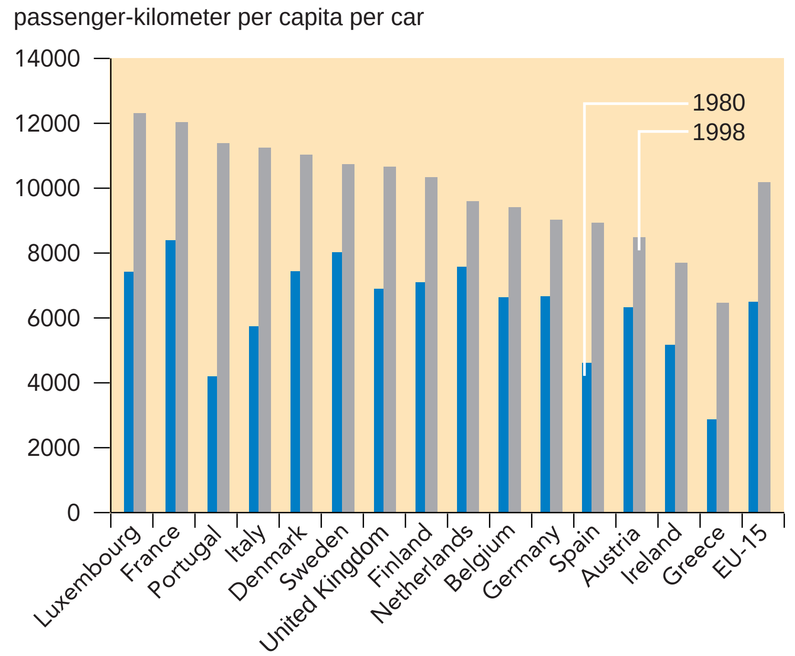
5.2. Short and long distance passenger transport

Passenger transport has increased by around 55 % over the past 20 years, with the strongest growth in air and road (particularly motorway) transport. Leisure, commuting and shopping account for the vast majority of all trips (European Commission, 2000c). Tourism is the fastest-growing reason for travel (Chapter 4).

A major component of the growth of passenger traffic is increasing travel distances to destinations like work, shops, schools and leisure activities. These distances are increasing because origins and destinations (residential areas, industrial areas, shops, hospitals and schools) are being located further apart and often primarily linked with roads ('urban sprawl').

Long distance passenger travel is growing, as rising private incomes boost tourism travel (mainly by road and air).

Annual average travel distance per capita, EU15 — Figure 5.3.



Source: Eurostat

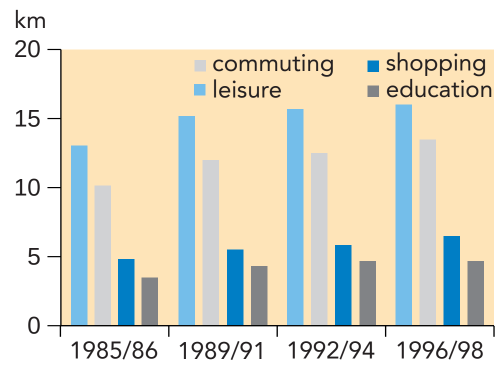
☹ The average growth rate of total passenger-kilometres in the period 1980 to 1998 was 2.8 % per year, slightly higher than that of GDP (2.2 % per year). Only a slight decoupling from economic growth is expected by 2010.

5.3. Mobility versus accessibility

In 1996, 10.5 % of EU households did not have a car because they could not afford it and 16.2 % because they did not want one. Providing this important group of citizens with accessibility is a major challenge for transport policy makers. National surveys show that transport developments do not always result in an increase in accessibility of basic services and activities (shopping, work, leisure and education). In the United Kingdom, for example, households without a car find it more and more difficult to reach basic services.

Most EU urban and transport policies recognise the importance of physical planning (including car-restricted areas) to limit urban sprawl and promote public transport as effective alternatives to the car. Such policies generally only produce effects in the long term, but some results are already becoming apparent. In some cities, people are moving back into city centres partly because of the attraction of market processes which thrive in compact cities.

Average journey lengths by purpose (Great Britain) — Figure 5.4.

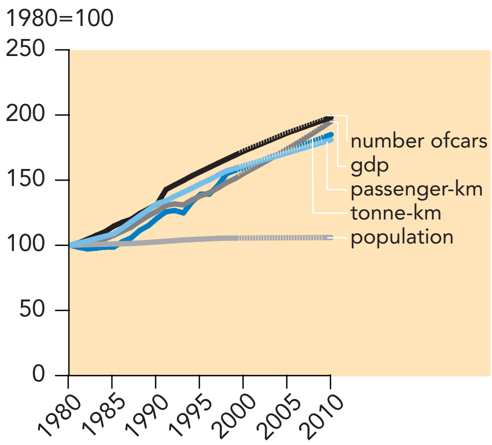


Source: Department of the Environment, Transport and the Regions (1999)

☹ The distances between origins and destinations that could be influenced by spatial policies are increasing. This results in more travel kilometres, in particular for commuting, shopping and day-trips to the countryside.

Figure 5.5. **Evolution of passenger and freight transport demand, car fleet, population and GDP, EU15**

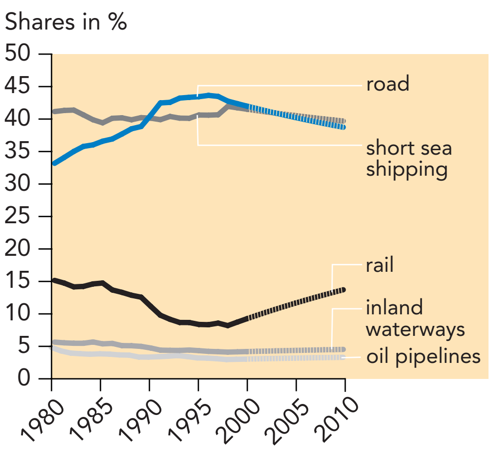
Source: Eurostat, CEC DG TREN, Auto-Oil II progamme, TRENDS



Between 1980 to 1999 freight transport demand grew by an average 2.5 % per year, outstripping GDP growth (2.2 % per year). No decoupling between freight transport and economic growth is expected by 2010.

Figure 5.6. **Evolution of modal split in freight transport, EU15**

Source: Eurostat, CEC DG TREN, Auto-Oil II progamme, TRENDS



The shares of rail and inland waterways fell by 7 % and 1.5 % respectively between 1980 and 1998. Trucking and short sea shipping have almost equal shares (43% and 42% respectively).

5.4. Freight transport

Freight transport increased by 55 % between 1980 and 1998, with the largest growth in road (3.9 % per year on average) and short-sea shipping (2.6 % per year). The spatial and economic patterns of production and consumption, for example in the food sector, are leading to increasing freight transport by road.

Trucking now accounts for 43 % of total tonne-km (33 % in 1980), and 80 % of total tonnes transported. On the road, each tonne of goods is transported on the average 110 km. Urban freight transport is also becoming more important. For longer distances, short sea shipping has become quite successful: in 1998 its share in tonne-km almost equalled that of road transport (42 %), transporting 6 % of total tonnes (over an average distance of 1 430 km per tonne) (European Commission, 2000c).

The shares of rail and inland waterways are declining. Unless prices take into account environmental externalities (Section 5.6) and unless the quality and flexibility of rail and inland waterways is improved, these trends are expected to continue.

5.5. Investment in infrastructure and services

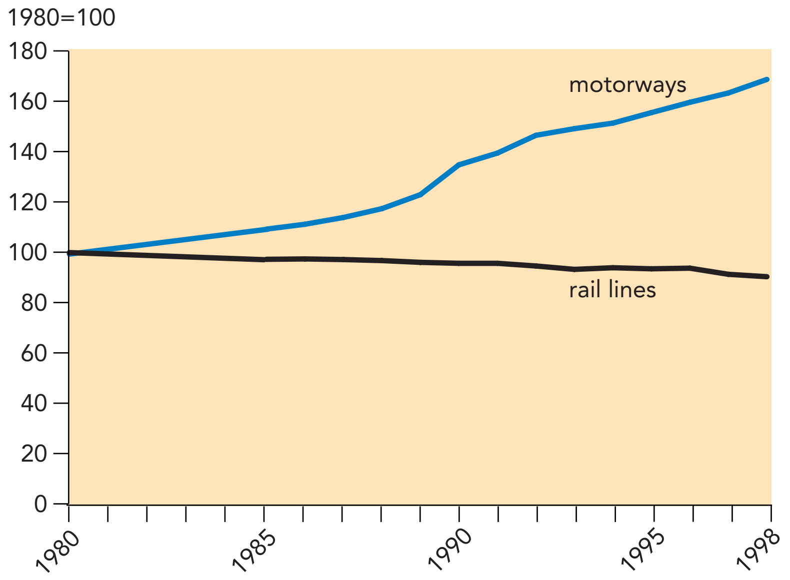
Until recently, the most common response to increasing transport demand was to build new infrastructure. The motorway network has grown by more than 50 % since 1970 while the conventional railway and inland waterways networks decreased by about 9 % (partly due to the closure of unprofitable small lines). The general level of infrastructure investment has been falling since 1993. In 1996, it was at the same level as in 1990. Since 1980 the shares of investment in transport modes have remained almost unchanged, dominated by road at 62 % and rail at 28 % in 1995.

Rail receives a larger share of total investment than its share of total demand, but this has not been enough to counter the gradual reduction in quality and reliability (and hence use) of railways. The Community is trying, for example through the development of the trans-European transport network (TEN), to redress investment patterns for major infrastructure projects. However, funding by the Community and international banks (such as the European Investment Bank) does not yet reflect the modal share originally envisaged for TEN investments (i.e. a 60 % rail to 30 % motorway split).

In line with the TEN plans, high-speed rail infrastructure is gradually being extended: the length of high-speed rail track almost tripled between 1990 and 1999 (now reaching more than 2 700 km, and expected to increase to 24 000 km by 2010).

In contrast, investment to promote quality regional network and alternative modes at the urban level is still low, though there are some positive signs. Between 1986 and 1994 for example, there was a relatively high investment in urban rail. More and more attention is also being paid to cycling tracks and public transport. For example, Italy has reserved a considerable national budget to stimulate the building of cycle tracks, and the German transport ministry envisages increasing investment in cycle tracks parallel to national roads.

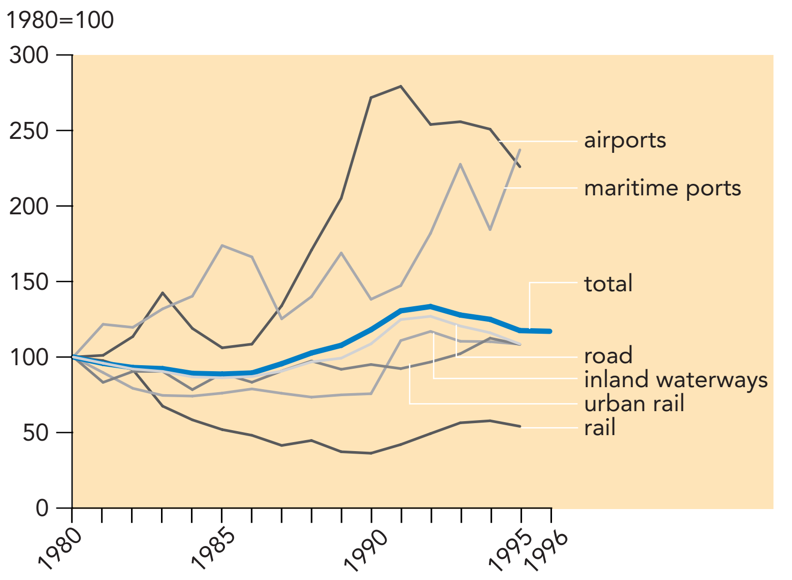
Length of motorways and railways, EU15 Figure 5.7.



Source: Eurostat

The fastest growth was in the motorway network – a 76 % increase 1980 and 1998. The length of the conventional railway network fell by some 9 %.

Investments in transport infrastructure, EU15 Figure 5.8.

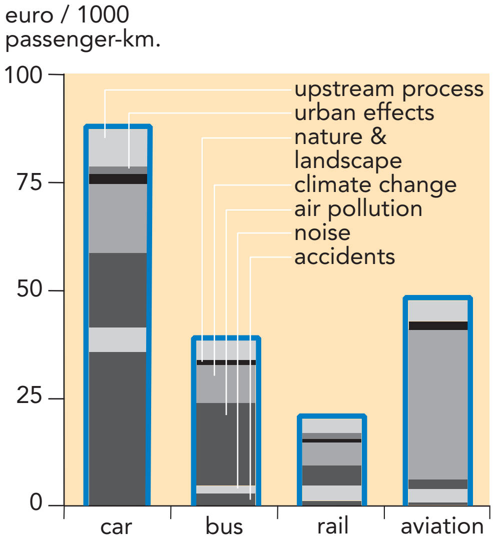


Source: CEC

EU transport infrastructure investment grew by 17 % between 1980 and 1996. After peaking in 1992, it has since fallen by 3 % per year. Since 1980 the overall modal investment shares have remained almost unchanged, dominated by road and rail.

Figure 5.9. **Average external costs of passenger transport in 1995 (EU15, Norway and Switzerland)**

Note: without congestion costs and uncovered parking costs
Source: INFRAS, IWW, 2000



Environmental costs are estimated to amount to about 5.5% of GDP, accident costs 2.3% and congestion costs 0.5%. Road transport is responsible for more than 95 % of these costs.

5.6. Internalisation of external costs

One way of influencing the behaviour and investment decisions of private actors is to internalise the environmental cost of transport: every transport user should pay the full costs of all the impacts of a transport movement, including costs such as congestion and parking. At the moment, this is not the case.

According to a recent estimate (INFRAS, IWW 2000) the aggregate external costs of transport in the EU are estimated to be at least 8 % of GDP. The main contributors are environmental costs (±5.5 % of GDP), accident costs (±2.3 %) and congestion (±0.5 %). Road transport is responsible for more than 95 % of these externalities, and the private car causes more than half of these. Cars have an estimated external cost per passenger-km more than four times higher than trains, and freight transport by trucks more than four times

Table 5.1. **Average external costs in 1995**

Source: Eurostat

	freight transport road	rail	aviation	water-borne	**passenger transport** car	bus	rail	aviation
	Euro/1000 tonne-km				Euro/1000 passenger-km			
Austria	44	11	234	15	104	19	10	46
Belgium	99	22	208	21	108	65	27	40
Denmark	60	20	191		75	32	51	43
Finland	66	15	238	14	85	40	20	51
France	128	10	193	16	78	34	8	48
Germany	96	28	199	20	113	38	25	48
Greece	64	23	196		68	38	26	49
Ireland	53	38	215		77	67	31	44
Italy	84	26	218	70	78	38	20	52
Luxembourg	84	27	117	25	102	48	33	23
Netherlands	64	10	262	24	92	35	23	51
Norway	136	15	199		73	55	16	58
Portugal	79	27	198		61	16	21	44
Spain	93	24	167		64	18	17	47
Sweden	89	6	212		72	40	8	51
Switzerland	160	13	205		96	41	15	43
United Kingdom	81	11	211	31	88	70	37	44
EU15 + NO +SW	88	19	205	17	87	38	20	48

higher than by train. The study also forecasts a 42 % increase in external costs by 2010, compared with projected GDP growth of 39 %.

In many countries transport prices are increasingly encouraging the use of the car, truck and airplane rather than bus, train and ship. In those countries car transport has become cheaper relative to bus and train transport than it was 20 years ago.

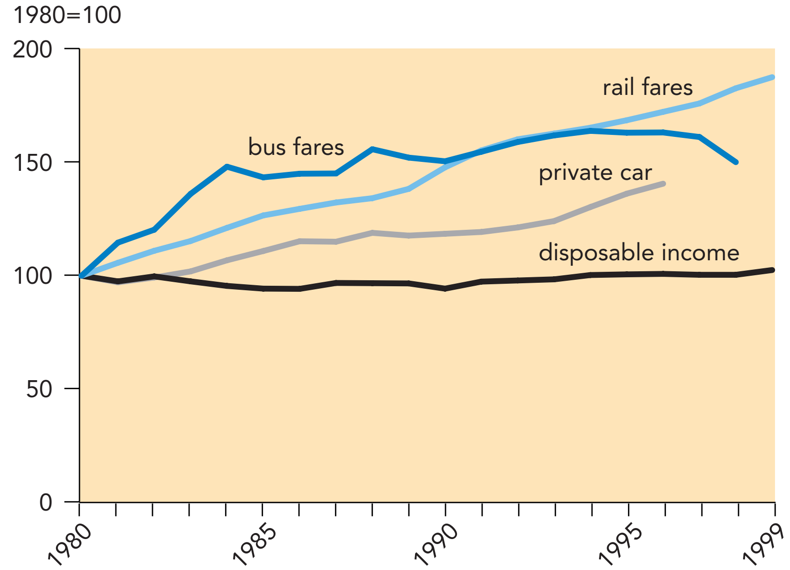
EU Member States are moving towards tax structures that differentiate between transport modes on the basis of environmental and congestion costs. Those internalisation measures are concentrated mainly on air pollution and noise. There have been almost no tax measures that aim to internalise the costs of congestion and carbon dioxide emissions.

The inflation-corrected EU average price of road fuel in October 2000 was lower than in the first half of the 1980s. Therefore fuel prices (and taxes) have not been such as to discourage consumption and therefore reduce carbon dioxide emissions over that period. The differentiation of prices has, however, largely contributed to the phase-out of leaded petrol.

Household expenditure on transport in EU Member States has increased at the same pace as general consumption over the past 20 years, with 14 % of household expenditure on total transport and 3 % on public transport. There has been no shift of expenditure towards public transport since the 1980s.

Overall, objective assessment of external costs remains critical and difficult, particularly when considering the 'value of a human life' or the risks of climate change. Moreover, public values may change over time. They should therefore be regularly monitored and widely communicated, to enhance support for higher transport prices. Polluters should know why they have to pay higher prices.

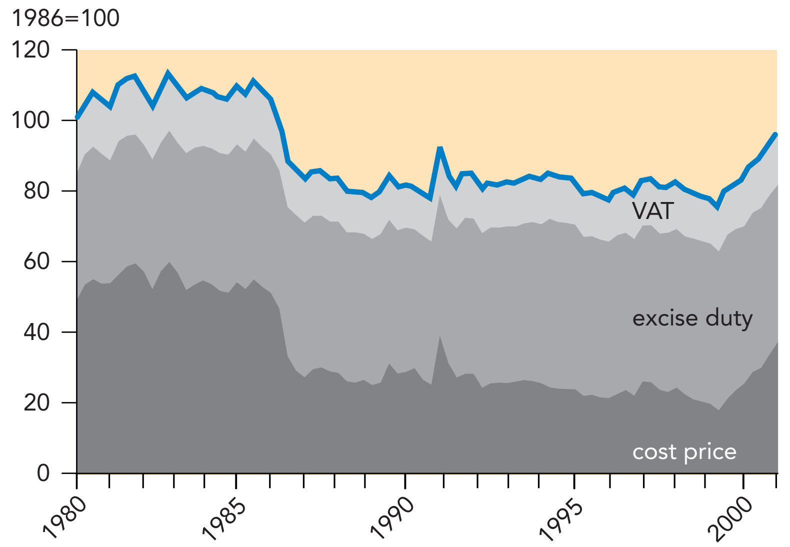
Real changes in the price of passenger transport, Denmark Figure 5.10.



Source: Statistics Denmark

☹ In some countries (Denmark, United Kingdom) car transport has become cheaper relative to bus and train transport than it was 20 years ago. Freight transport prices in The Netherlands have fallen while GDP has risen.

Real average EU prices for motor fuel Figure 5.11.



Source: EC Oil bulletin; Eurostat

☹ The inflation corrected EU average price of road fuel in October 2000 was lower than in the first half of the 1980's, in spite of regular small increases in excise duties. Fuel price and tax developments over that period have therefore not led to lower fuel consumption and carbon dioxide emissions.

Table 5.2. Integrated transport planning and environmental management

	Institutional coordination	Integrated transport strategies	National transport-environment monitoring systems	Implementation of strategic environmental assessment
Austria	✔	✔	✔	UD
Belgium	✔	UD		UD
Denmark	✔	✔	UD	✔
Finland	✔	✔	✔	✔
France	✔		✔	✔
Germany	✔	✔	✔	
Greece				
Ireland	✔	✔		UD
Italy	✔			UD
Luxembourg		UD		
Netherlands	✔	✔	✔	✔
Portugal				
Spain				UD
Sweden	✔	✔	✔	✔
United Kingdom	✔	✔	UD	✔

Note: UD = 'under development'
Source: EC

Minimising the use of private cars
There are a growing number of strategies for reducing car usage, the main cause of urban air pollution, and supporting a shift towards more environment-friendly modes of transport.

In the beginning of the 1990s, the French city of Strasbourg decided to do something about its urban centre. The city used a holistic approach, restricting car use and providing alternatives. Among the measures introduced was investment in a new light rail system and bike paths. At the same time, private cars were hindered from crossing the city centre. In five years, car use fell by 17 % and use of public transport increased by 30 %.

The city of Karlsruhe in Germany has enabled trams to use existing rail lines as well as tramway lines, thus benefiting from the large investments that the rail lines represent. Since its introduction in the mid 1980s the system has provided speed, flexibility and adequate capacity. It includes several routes where trams run on rail tracks in the surroundings of the city and tram tracks in the centre. On one of the main routes, traffic has increased fivefold since 1992.

However, making alternatives to the private car more attractive is seldom enough to change people's behaviour. Most households own a car and it is often cheaper to use it than to spend on public transport.

Car-share organisations have emerged in several European cities as an alternative for city-dwellers who do not need a car every day. Stattauto Car Sharing AG in Germany is one of the largest. Mainly owned by its members, it offers cars at more than 100 stations in Berlin, Hamburg, Rostock and Potsdam. In 1999, 8 500 customers shared more than 300 cars, a person/car ratio of almost 30:1. Stattauto uses the Internet extensively; its website provides information on costs, stations and available cars.

Sources: http://www.stattauto.de, http://cities21.com/egpis/egpc-047.html, Karlsruher Verkersverbund, http://www.karlsruhe.de/KVV/

5.7. Integration strategies, monitoring their progress and awareness-raising

The environmental effects of transport are a major and increasing public concern. Improvements in public transport and better facilities for pedestrians and cyclists are stated as priorities in public surveys. Pricing measures to restrain car use appear to receive little public support. The legitimacy of pricing measures, and other measures which aim at changing lifestyles, needs to be ascertained.

At the national level, most countries have some form of institutional coordination of transport and environmental issues, integration strategies, monitoring systems and strategic environmental assessments. There is a large variation in the details and effectiveness of these approaches to the integration of environmental objectives into the transport sector (Table 5.2.).

In response to the request of the Cardiff Summit, the Transport Council developed and approved (end 1999) an integration strategy for the EU transport sector. The Council has foreseen a regular review of the strategy on the basis of reports from the Commission; the first review is to take place by June 2001.

To support this review, a joint transport and environment country expert group produced a report, proposing ways and means for the further development of the strategy towards a sustainable transport system (Expert Group on Transport and Environment, 2000). The report highlights the need for a package containing economic incentives, demand management, land-use planning, information and education, technology, regulation and research. The setting of intermediate and long-term sectoral targets is strongly recommended to focus and facilitate the instruments for its implementation. Progress towards these targets should be monitored regularly through the indicator-based transport and environment reporting system (TERM).

5.8. References and further reading

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Annual harmonized consumer price indices — Table 5.3.

	All items				Transport			
	1995	1997	1998	1999	1995	1997	1998	1999
	1996=100							
Austria	:	101	102	103	:	101	101	102
Belgium	98	102	102	104	97	102	101	105
Denmark	98	102	103	105	97	102	103	107
Finland	99	101	103	104	97	101	102	105
France	:	101	102	103	:	101	101	102
Germany	99	102	102	103	98	102	102	104
Greece	93	105	110	113	95	105	108	107
Ireland	98	101	103	106	97	103	104	106
Italy	96	102	104	106	96	102	103	105
Luxembourg	99	101	102	103	99	101	100	102
Netherlands	99	102	104	106	99	101	101	104
Norway	97	102	104	106	96	104	107	110
Portugal	97	102	104	106	96	103	102	105
Spain	99	102	103	103	98	101	101	103
United Kingdom	:	102	103	105	:	105	107	11
EUR	:	102	103	104	:	102	102	104
EU-15	98	102	103	104	:	102	103	105

Source: Eurostat

6. Energy

policy issue	indicator	assessment
have emissions from the sector been decoupled from economic activity?	energy supply sector eco-efficiency	😐
progress in reducing emissions from fossil fuel based electricity generation?	carbon intensity of conventional thermal power plants	🙂
have acidification reduction policies aimed at power plants succeeded?	reduction of sulphur dioxide emissions from electricity generation	🙂
has overall energy efficiency been improved?	overall energy and carbon efficiency	😐
have total energy and fossil fuel use been reduced?	total energy consumption	☹️
have sectors used less energy?	final energy consumption by sector	☹️
is the electricity sector moving towards the proposed renewable and combined heath and power generation target?	renewable energy - combined heat and power share in electricity consumption	😐
have other environmental influences of the sector diminished?	generation of nuclear waste, oil spills	😐

Energy use in the EU grew relatively slowly in the early 1990s but is now increasing more rapidly. It remains linked to GDP and continues to be dominated by fossil fuels. The carbon intensity of electricity generation from fossil fuels has fallen, mainly because of switching to fossil fuels with a lower carbon content, leading to an important reduction in emissions. With the current growth in electricity consumption, significant improvements in energy efficiency and growth in carbon-free sources of energy are needed to secure further emission reductions from the electricity sector. It remains to be seen whether EU indicative targets for energy from renewable sources, for overall energy efficiency and for combined heat and power generation will be met.

Energy is vital for development. However it is a large user of resources, and is the basic driving force behind climate change and a number of air pollution problems, discussed in chapters 9 and 10.

The gradual opening up and reorganisation of energy markets might lead to the use of more efficient generating technologies, but is also likely to lead to reduced energy prices. This in turn might reduce the incentive for energy conservation.

There are, however, several EU policies that aim to reduce energy consumption, such as the European Commission's Action Plan to Improve Energy Efficiency in the European Union (COM(2000)247) which aims to integrate energy efficiency policy more fully into other policy areas.

Notwithstanding policy efforts, the domination of energy supply by fossil fuels is likely to persist for the foreseeable future.

	Resource use				Air emissions					Water			Hazardous substances		Biodiversity
	Land / soil	Water use	Waste generation	Energy use	Climate change	Ozone layer	Acidification	Trop. ozone	Urban air quality	Riwer WQ	Eutrophication	Marine WQ	Chemicals	Soils: contaminated sites	
Energy		●↘	●	●●→	●●↘		●●↘	●↘	●↘	●	●↘	●↘			
Contribution		abst.38% cons.5%	4% & nuclear waste	34%	27%		29%	8%		hydro-power cooling		Oil spill Off-shore			

6.1. Energy supply sector eco-efficiency

Emissions of all the major pollutants from the energy supply sector fell between 1990 and 1998 despite increases in total energy output and in gross value added. Much of the overall fall resulted from fuel switching in electricity generation, from oil and coal to natural gas. Flue gas desulphurisation and more use of low-sulphur fuels in electricity generation also contributed to reductions in emissions of sulphur dioxide, and abatement techniques in large combustion plant and refineries contributed to reductions in emissions of nitrogen oxides.

However, the reductions in emissions appear to have ceased in 1998. This was caused partly by an increase in electricity output, and partly by more use of coal and to a lesser extent of natural gas, while nuclear power generation fell marginally.

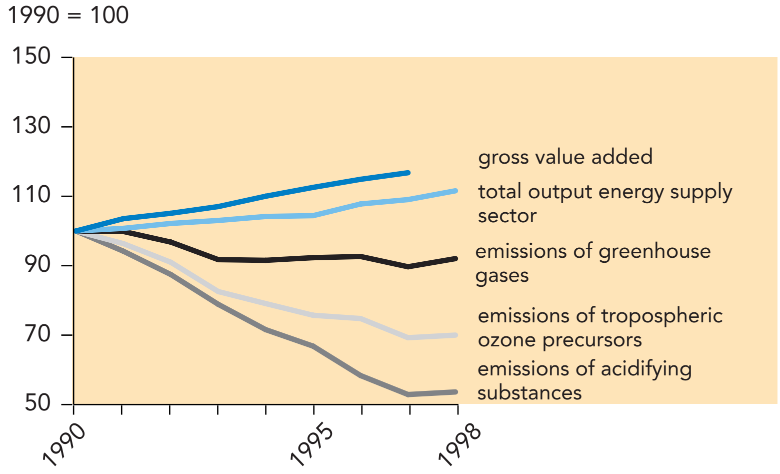
The most significant changes in the individual indicators of eco-efficiency of the energy sector are discussed in the following three sections.

6.2. Sulphur dioxide abatement in power plants

Sulphur dioxide emissions from electricity generation in the EU fell by more than 60 % between 1990 and 1998. The introduction of flue gas desulphurisation and the use of lower sulphur fuels were mainly due to implementation of the Large Combustion Plant Directive (88/609/EEC). About a quarter of the reduction resulted from the switch from coal and oil to natural gas. A reduction in the proportion of electricity generated from fossil fuels also contributed to the decrease.

However, large combustion plants in general are still the major source of sulphur dioxide emissions in the EU (65 % of the total in 1998) and they remain a large source (21 %) of nitrogen oxides (see chapter 10).

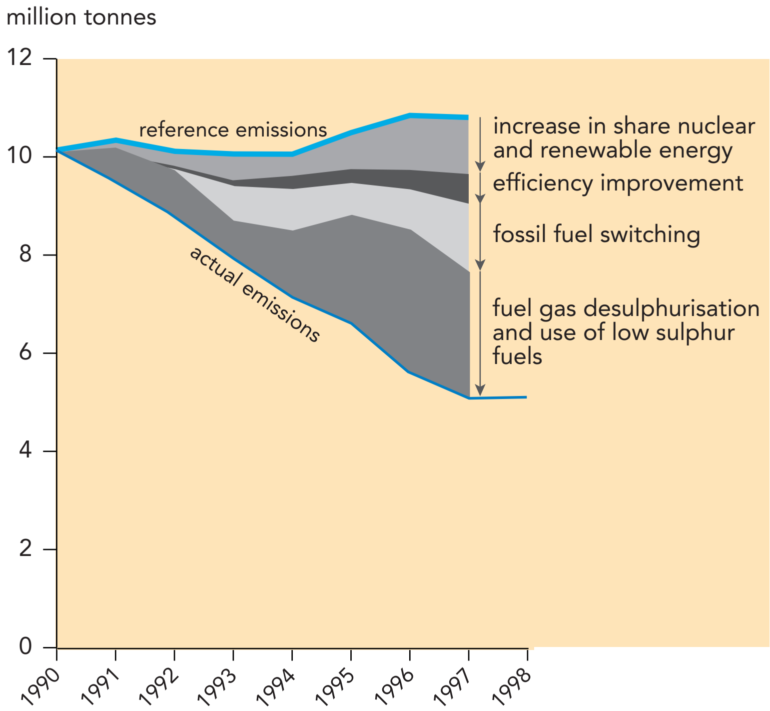
Indicators of eco-efficiency of the energy supply sector, EU15 — Figure 6.1.



Notes: The energy supply sector includes coal, oil and gas exploration and extraction, public electricity and heat production, refineries and other industries engaged in transforming primary energy into other energy products. Gross value added at market prices, constant 1990 prices; excluding Ireland; 1990 data for Germany do not include GDR. Total output refers to energy output. Emissions include emissions from fuel combustion and fugitive emissions.
Source: EEA, Eurostat

While the output of the sector has grown, emissions to the air have fallen. However, the decrease in emissions ceased in 1998.

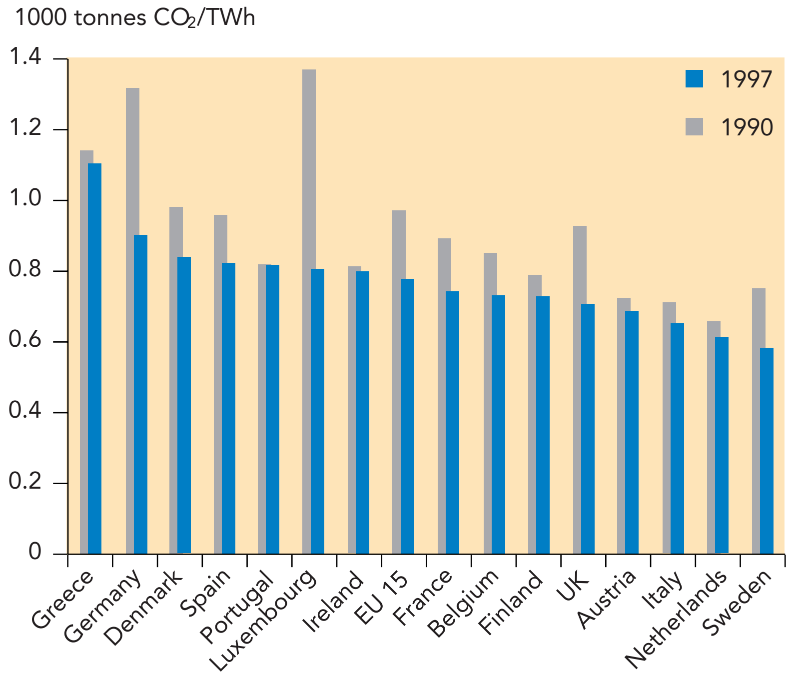
Reduction of sulphur dioxide emissions from electricity generation, EU15 — Figure 6.2.



Source: EEA

About half of the decrease in emissions of sulphur dioxide from power plants can be attributed to the introduction of flue gas desulphurisation and the use of lower sulphur coals and fuel oils in conventional thermal power plants.

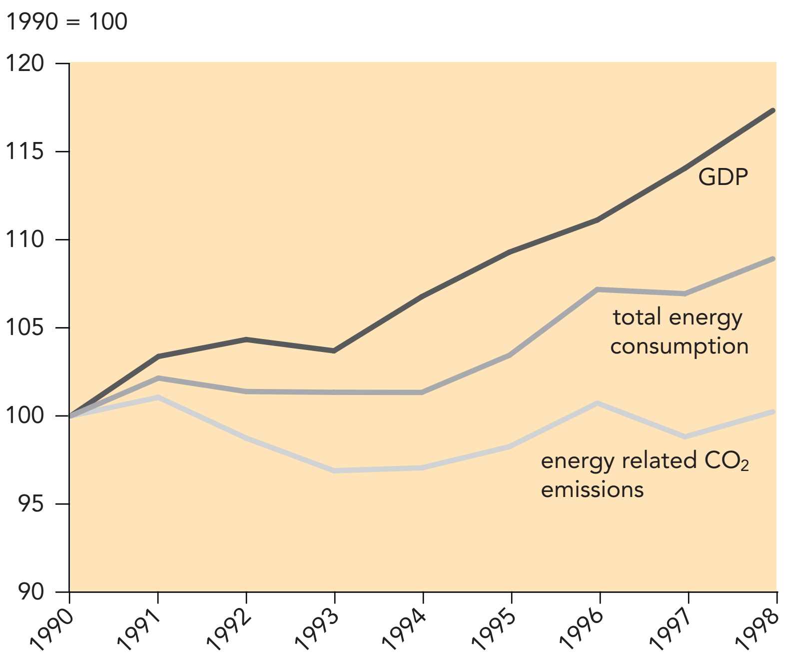
Figure 6.3. **Carbon dioxide intensity of conventional thermal electricity generation, EU15**



Note: Conventional thermal electricity generation includes plants fired with fossil fuel, biomass, waste and geothermal energy. Data shown here include public thermal power and auto-producers.
Source: Eurostat

☺ Carbon intensity of electricity generation from fossil fuels in the EU15 has decreased, however action is required to ensure further reduction in line with obligations under the Kyoto Protocol.

Figure 6.4. **Overall energy and carbon efficiency**



Note: Total energy consumption (or gross inland energy consumption) equals the domestic energy production plus energy imports, minus exports and plus net withdrawals from stocks.
Source: EEA and Eurostat

😐 Growth in the economy and population still requires additional energy use. Energy related carbon dioxide emissions have been decoupled partially.

6.3. Carbon intensity of conventional thermal electricity generation

In 1997, 51 % of the electricity in the EU was generated by conventional thermal power. Less than 5 % of conventional thermal electricity is generated from geothermal power, biomass and waste; the rest is from fossil fuels. The conventional thermal power sector contributes approximately 30 % of all energy-related carbon dioxide emissions and 85 % of carbon dioxide emissions of the energy supply sector.

The carbon dioxide intensity (carbon dioxide emissions per unit of electricity) of conventional thermal power generation in the EU dropped by 1.6 % per year between 1990 and 1997 leading to a 7 % decrease of carbon dioxide emissions. Reductions have been the result mainly of switching from coal to natural gas. Improvements in gas turbine technology have also contributed, although overall energy efficiency improvements have been slow. Large decreases happened in Germany and the United Kingdom, through fuel switching; and in Sweden, through increased use of biomass.

In the longer run, fossil fuel switching will be limited by supply and other technical and energy policy constraints. The rate of recent improvements in carbon intensity is unlikely to be sustained, therefore, unless more support is given for non-fossil energy sources and for energy efficiency improvements.

In the CEEC countries, conventional thermal power generation accounts for more than 70 % of electricity generation. The fuel mix is dominated (80 %) by solid fuels and carbon intensity fell moderately between 1990 and 1996.

6.4. Total energy consumption, GDP and carbon dioxide emissions

Between 1990 and 1998, total energy consumption in the EU increased at an average rate of 1.1 % per year, compared with GDP growth of 2.0 % per year.

Energy consumption per unit of GDP (energy intensity) fell by an average of 0.9 % per year. This decrease in energy intensity is even smaller than what the European Commission had forecast in its 'conventional wisdom' baseline scenario, namely 1.1 % per year over the 1990–2000 period. Much of the decrease has come from structural changes in the economy, especially the shift towards services; little is the result of proactive energy efficiency efforts.

The European Union has an indicative target for the 1998–2010 period of 1 % annual improvement in final energy intensity (the energy intensity of final energy consumers) above what would have otherwise been achieved (COM(1998)246 final). Given recent trends, much more will have to be done to reach this target. This is particularly true for the countries where energy intensity is still increasing (Belgium, Finland, Greece, Italy, Portugal and Spain).

The most striking feature of the data is the drop between 1990 and 1998 of almost 2 % per year in carbon intensity (carbon dioxide emissions per unit of GDP). These reductions, which occurred in all countries except Greece, Portugal and Spain, have been the result mainly of switching to fuels with lower carbon content in the energy supply sector and in industry. Germany and the United Kingdom have contributed significantly to the overall decrease in carbon intensity.

Electricity consumption per capita Table 6.1.

	1995	1996	1997	1998
	KWh per capita			
Austria	5.8	6.0	6.0	6.0
Belgium	6.8	6.9	7.1	7.3
Denmark	6.0	6.1	6.0	6.0
Germany	5.5	5.6	5.6	5.7
Finland	12.8	13.0	13.7	14.1
France	5.9	6.1	6.1	6.3
Greece	3.3	3.4	3.5	3.7
Iceland	15.9	-	-	-
Ireland	4.1	4.4	4.6	4.8
Italy	4.1	4.2	4.3	4.4
Luxembourg	12.3	11.9	12.3	12.5
Netherlands	5.4	5.6	5.7	5.9
Norway	23.9	23.6	23.6	24.6
Portugal	2.9	3.0	3.2	3.4
Spain	3.6	3.7	4.0	4.2
Sweden	14.1	14.3	13.9	14.0
United Kingdom	5.0	5.2	5.2	5.3
EU15	5.3	5.4	5.5	5.6
EEA (EU15				
+ Norway)	5.5	5.6	5.7	5.9

Note: Electricity consumption per capita has been calculated by dividing the electricity consumption of the final energy demand sectors (industry, residential, tertiary, transport and agriculture) by the population. It therefore does not include transmission and distribution losses.
Source: Eurostat

However, carbon intensity rose again between 1997 and 1998. This increase reflects increased consumption of fossil fuels for transport and electricity generation.

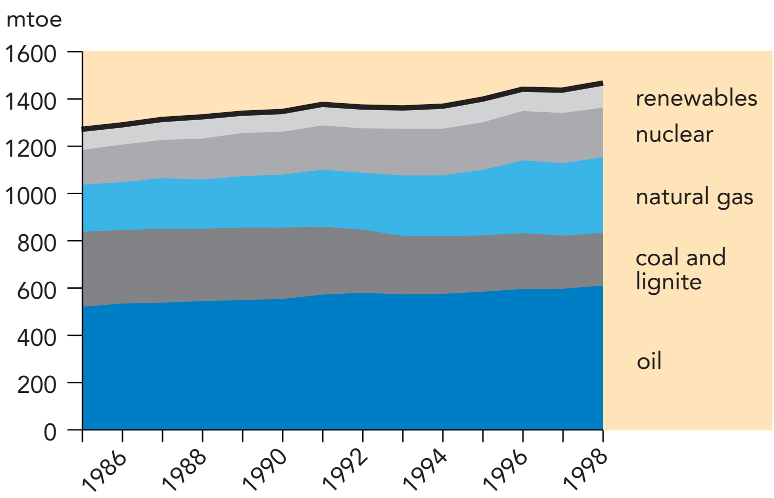
Electricity consumption per capita increased by an average of 2 % per year between 1995 and 1998. This is in line with the European Commission's forecast, in its most recent Primes baseline scenario, of a 1.9 % annual growth of electricity demand over the period 1995–2010. According to the same scenario, the carbon intensity of power and steam generation is set to decrease by only 1.4 % per year over the same period, which is not enough to offset the expected increase in emissions. Furthermore, increased electricity consumption entails increased overall transmission and distribution losses. These typically account for 7 % of electricity generated and are expected to decrease only marginally over the period. All these factors taken together suggest that, in the absence of significant policy shifts, the expected growth in electricity demand will contribute substantially to growth in emissions, particularly of carbon dioxide.

6.5. Energy consumption by fuel

Oil remains the main source of energy in the EU. Consumption increased by 17.2 % between 1985 and 1998, most rapidly since 1990 as a result of increased demand for petrol and diesel for transport.

Consumption of *coal, lignite and derivatives* fell by 29.5 % between 1985 and 1998, mainly as a result of replacement of coal by other fuels for electricity generation and industrial heat. Liberalised natural gas and electricity markets have encouraged electricity generators to choose the cheapest, most efficient and most flexible generating capacity. Implementation of the Large Combustion Plant Directive and the requirement for investing in pollution-abatement technologies have also provided some impetus for switching to relatively cleaner fuels such as natural gas.

Figure 6.5.	Total energy consumption by fuel, EEA



Note: Total energy consumption (or gross inland energy consumption) equals domestic energy production plus energy imports, minus exports and plus net withdrawals from stocks. Other fuels, including the net import and export of electricity, are not visible due to low values.
Source: Eurostat

☹ Fossil fuels remain the major source of energy in the EU.

Natural Gas has increasingly become the fuel of choice in many sectors as a result of improvements in gas turbine technology, low capital costs and the high efficiency associated with electricity from gas. Consumption rose by 60.6 % between 1985 and 1998.

The contribution of *nuclear* fuels increased by 42.3 % between 1985 and 1998. Much of this increase (23.1 %) occurred between 1985 and 1990, due mainly to the expansion of the French nuclear programme and some commissioning of new facilities in the United Kingdom. Nuclear generation is currently seen as an expensive option in the context of a liberalised market. Public concern has led to plans to phase out nuclear power in Belgium, Germany and Sweden, with other countries either declaring or considering moratoria on the building of new nuclear plants. At present only in Finland are there discussions on building a nuclear plant in the near future.

Consumption of *renewable energy* rose by 24.8 % between 1985 and 1998. However, despite increased support, its contribution only rose from 6.1 % to 6.6 % in the EEA. In the EU, the contribution of renewable energy in 1998 was 5.9 %, well short of the EU indicative 2010-target of 12 % (COM (97) 599).

In the Accession countries, the major recessions and restructuring which followed the collapse of central planning led to significant falls in total energy consumption between 1985 and 1997. Energy consumption per capita is now two thirds the average EU level. Total energy consumption in many countries is unlikely to return to the previous high levels before 2010 (European Commission, 1996). Fossil fuels account for 90 % of total consumption, with coal accounting for almost half.

6.6. Energy consumption by sector

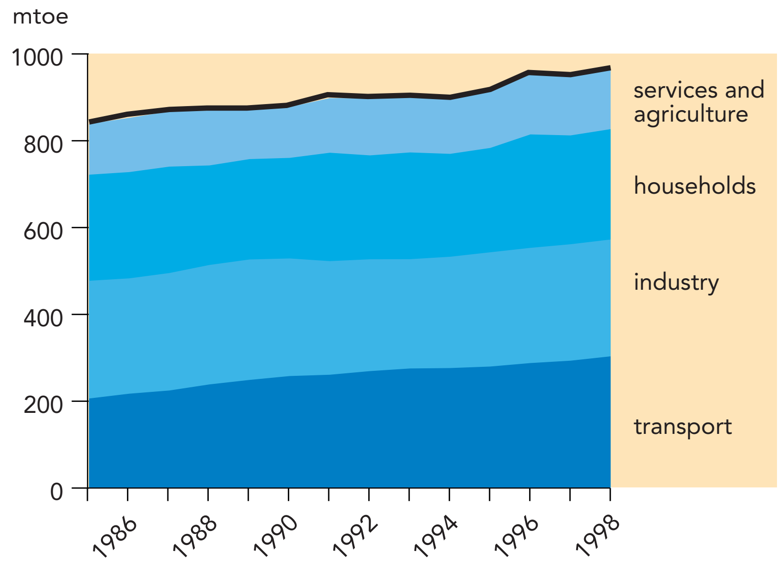
Energy consumption in almost all sectors grew between 1985 and 1998, most rapidly in the transport sector, which overtook industry as the largest consumer of energy in 1992 and accounted for 32 % of the total in 1998. Increased transport demand for passengers and goods has largely outstripped any gains from improved fuel efficiency.

Despite a growth in value added, energy consumption by industry fell by 1998 to just below the 1985 level. Industrial energy efficiency programmes are in place in all Member States, mostly based on the provision of information and auditing services. However, much of the improvement was due to structural change in the German economy. There have also been structural changes in other countries, including a shift of energy-intensive industries from the industrialised EEA countries to countries in transition. The industry sector share is expected to reduce as a result of growth in combined heat and power generation and a shift towards the provision of services.

In the household sector, policies based on a dual approach of cost savings and environmental awareness have been successful where district heating is used. The potential for energy consumption reductions in single dwellings, in particular for space heating, has yet to be fully exploited. In addition, improvements in energy efficiency per square metre and per appliance appear to have been offset by larger average sizes of dwellings, greater demand for air conditioning and increases in the number of household appliances.

Consumption in the services sector reflects the high growth of the sector. Energy costs are a low percentage of operating costs and there is therefore little incentive for efficiency improvements. Energy consumption in the agriculture sector is much smaller than in the services sector.

Final energy consumption by sector, EEA Figure 6.6.



Note: EU15 Member States and Norway only. Final energy consumption is the consumption of energy by final end users in the economy such as transport, households, industry, services and agriculture.
Source: Eurostat

☹ Final energy consumption continues to increase, mainly due to growing demand in the transport sector.

Windmills – the Danish success story

How does one increase the share of renewable energy in a country's electricity consumption and at the same time build an internationally competitive industry? A good example is the Danish wind energy sector.

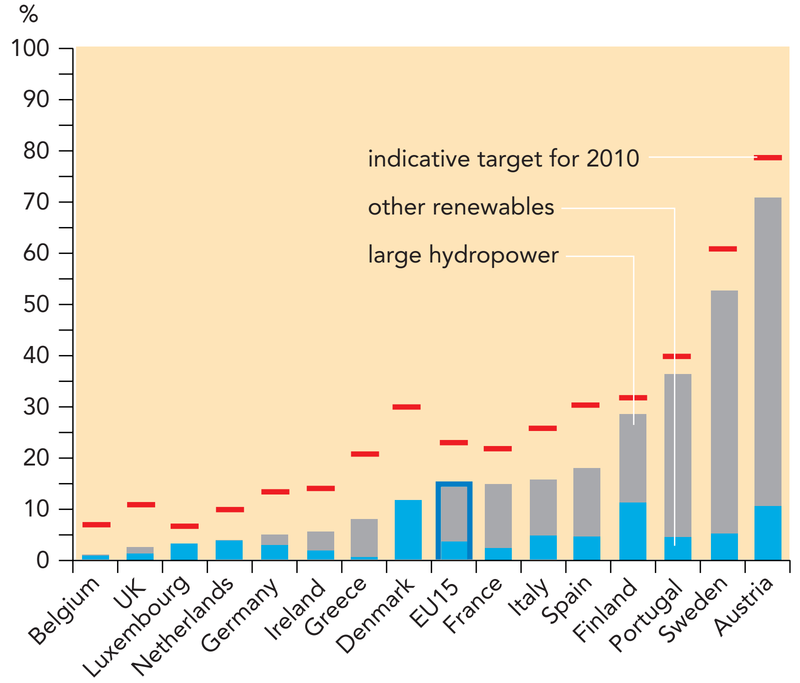
The Danish wind generator industry has been growing by some 40 % each year since about 1995. It accounted for half of the world wind energy market in 1999, with an annual turnover of EUR 1.5 billion. Nearly 4 000 people are directly employed by the industry.

The Danish government introduced a new energy policy in 1991 to promote renewable energy. One instrument was a law that gave renewable energy producers a guarantee that their energy would be bought at a commercially favourable and predetermined price. The policy has been successful, and wind power is expected to generate 13 % of the electricity consumed in 2000. Denmark is aiming for 20 % of its electricity to be generated from renewable sources by 2003, and 50 % by 2030.

A special feature of the sector is that individuals or cooperatives own 80 % of all wind turbines. A great number of citizens have thus played a role in the emergence of the wind sector. National regulations have encouraged private investment and ownership of small-scale wind farms. For example, privately owned wind turbines are given a tax refund on the national electricity tax.

Source: http://www.windpower.dk

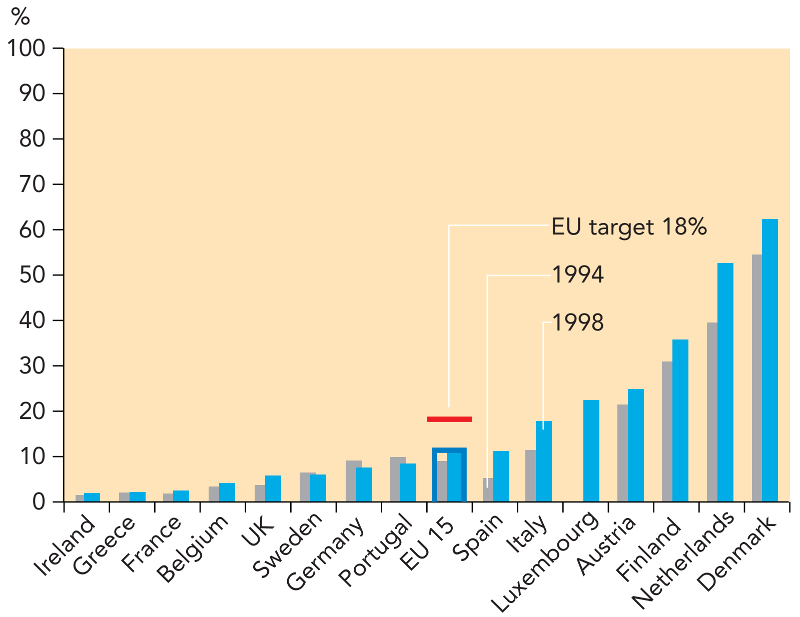
Figure 6.7. **Share of renewable energy in gross electricity consumption, EU15**



Note: An initial political agreement on the target levels presented here was reached among the Member States at the December 2000 meeting of EU Energy Ministers (Energy Council). Gross electricity consumption equals domestic generation, plus imports minus exports.
Source: Eurostat

The share of renewable energy sources in gross electricity consumption is still relatively low. Substantial growth is required to meet the proposed indicative targets for renewable electricity in the EU.

Figure 6.8. **Share of Combined Heat and Power electricity in gross electricity generation, EU15**



Note: No data for Luxembourg for 1994. The method for data collection by Eurostat on combined heat and power (CHP) is under revision. This may result in some adjustments of the percentage contributions of CHP electricity in gross electricity generation reported here.
Source: Eurostat

Penetration of Combined Heat and Power (CHP) has increased in most countries. However, more initiatives will be needed if the EU is to reach the indicative CHP electricity target in increasingly liberalised energy markets.

6.7. Electricity from renewable sources

In 1998 renewable sources contributed 14.1 % of electricity generation: 10.6 % from large hydropower installations (a capacity of 10 MW or more) and 3.5 % from all other renewables.

The proposed EU indicative target is for 22.1 % of gross electricity consumption in 2010 to come from renewable sources (COM(2000)279). This target is in line with the indicative target of doubling the share of renewable sources in total energy consumption in 2010 (see 6.5).

Due to site limitations and environmental considerations, the contribution of large hydro is expected to remain approximately constant between 1998 and 2010. The contribution from renewables other than large hydro renewables grew rapidly between 1996 and 1998, but significantly faster growth will be needed if the 2010 target is to be reached.

6.8. Combined heat and power

In conventional thermal power plants, typically 45 to 70 % of energy is lost as heat. Combined heat and power (CHP) makes use of such 'waste' energy, avoiding the environmental impacts of additional heat generation. The total efficiency (heat plus power) of CHP systems is higher than that of separately generated heat and electricity.

From 1994 to 1998, EU generation from CHP increased from 9 % of gross electricity generation to 11 %, 7 % short of the EU indicative target of 18 % by 2010 (COM(97)514).

Penetration of CHP in Denmark and the Netherlands is particularly high as a result of government support. Liberalisation of energy markets in Finland and the United Kingdom has stimulated investment in CHP. However, lower electricity prices may act against more investment in CHP plants, which are capital intensive. This has already been the case in Germany where CHP generation has decreased.

6.9. Other environmental issues

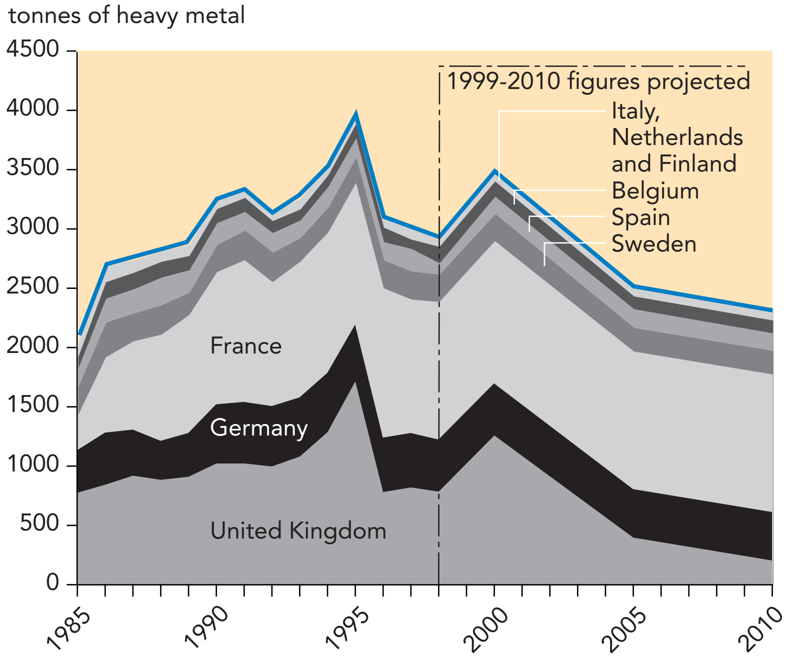
Data on other environmental impacts of energy production and use are limited. No data are presented in this report on the impacts of hydro-electricity generation. The construction of large dams and reservoirs can have adverse impacts on ecosystems. During operation there is a risk of dam failure. Further growth in large hydropower is, however, unlikely, as the vast majority of sites in western Europe have already been used. There are signs of growing concern about visual intrusion, noise and bird kills from wind generators but few data appear to be available.

An indication of the radioactive waste situation and its evolution over time is provided by data on the quantities of spent nuclear fuel produced. This is governed mainly by the quantity of electricity generated from nuclear plant, hence the projected decrease in quantities of spent fuel produced after 2000.

Tanker oil spills continue, for example an estimated 10 000 tonnes from the ERIKA tanker off the coast of France in December 1999. The amount spilt from tankers in the seas around the EU appears, nevertheless, to be decreasing, despite the increase in the marine transport of oil. This is possibly because of increased safety measures, resulting in part from increasing public pressure following well publicised accidents in recent years. However, the data does not include spills and discharges of below 7 tonnes from tankers and other shipping and is likely to be an underestimate because of unreported and undetected spills.

Following the ERIKA accident, the European Commission proposed reinforcing the control of ships visiting Community ports. It also proposed banning oil tankers with a single hull (the ERIKA was such a tanker) from EU waters and applying the same timetable for phasing out single-hull tankers as was adopted in the USA after the Exxon Valdez oil spill (2005, 2010, 2015, according to tonnage).

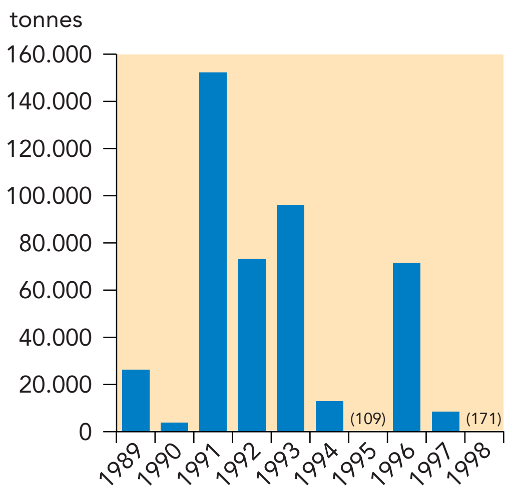
Generation of nuclear wastes: spent fuel arisings Figure 6.9.



Note: 1998 figures for Spain, Sweden and the United Kingdom based on provisional data. Figures from 1999 to 2010 based on 5 yearly OECD projections. Austria, Denmark, Greece, Iceland, Ireland, Liechtenstein, Luxembourg, Norway, Portugal have no nuclear generation. Italy phased out commercial nuclear power in 1987. The vast majority of highly radioactive waste is made up of spent fuel and of wastes from reprocessing spent fuel. Some countries reprocess spent fuel.
Source: OECD

😐 Annual generation of spent fuel has increased between 1985 and 1998 but is expected to decrease between 1999 and 2010. However, the stock of spent fuel and other nuclear waste awaiting final disposal continues to increase as discussions on the best and safest ways to dispose of these materials continue.

Oil spills above 7 tonnes per spill Figure 6.10.



Note: The mass of oil spilt is approximate, as some of the records do not contain the exact amount of oil spilt.
Source: Eurostat, based on data from ITOPF

😐 Major oil spills still occur at irregular intervals.

6.10. References and further reading

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7. Agriculture

policy issue	indicator	assessment
has the sector made progress in improving its eco-efficiency?	agriculture eco-efficiency	😐
in which direction are subsidies stimulating the sector?	CAP expenditures	🙂
in which direction is the sector developing?	agricultural intensity	☹
has agriculture balanced its inputs and outputs of nutrients and how serious is the problem of nutrient surplus?	nutrient surpluses	☹
what environmental protection measures are being taken by the sector?	agri-environmental management contracts	🙂
- " -	organic farming	🙂

Agriculture remains a major source of pressure on the environment. It is becoming even more intensive and specialised. For example, the area of permanent grassland decreased by nearly 4 % between 1990 and 1998, and whereas in 1990 four out of ten pigs were raised on farms with 50 or more pigs, the figure had risen to nine out of ten by 1997. Support for rural development, including agri-environmental measures that link income support with environmental improvement, is growing but is still only about one tenth of total EU agricultural subsidies. Despite some progress in reducing the use of fertilisers and managing manure, nutrient run-off and overloading of water bodies continues to give rise to eutrophication.

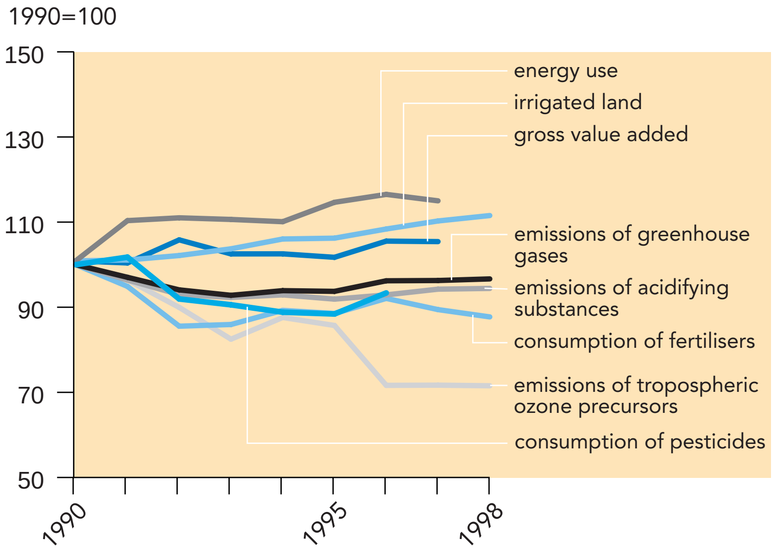
Agriculture is the sector where the need to balance the three dimensions of sustainable development is most evident. The sector is becoming less important in the economies of the Member States. However, farmers still manage 44 % of Europe's land area.

Driven by the Common Agricultural Policy (CAP), technological change and cheaper and faster transport, and to some extent by the development of a global market for agricultural products, much of Europe's agricultural area is devoted to intensive and large-scale production. In marginal areas, rising labour costs and falling prices have contributed to a reduced viability of farming, resulting in an increase in afforestation or even abandonment.

There is thus an ever more marked division between areas of highly intensive agriculture and marginal areas under a variety of agri-environmental regulations and subsidies. Such instruments, however, still cover only a small fraction of the sector, the remainder of which will continue to develop in an unsustainable way unless there is more progress with integrating environmental and agricultural policies.

	Resource use				Air emissions					Water			Hazardous substances		
	Land / soil	Water use	**Waste generation**	**Energy use**	**Climate change**	Ozone layer	**Acidification**	**Trop. ozone**	**Urban air quality**	**Riwer WQ**	Eutrophication	**Marine WQ**	Chemicals	**Soils: contaminated sites**	**Biodiversity**
Agriculture	●●● ↘	●●● ↗	●	● →	● →		●● →	● ↘	● ↘	●●● ↘	●●● →	● ↘	●●● ↘		●●● ↗
Contribution	44	abstr. 36 cons. 80		2	10		29	3			N 55 P 35	Pesticides	Pesticides		

Figure 7.1. **Indicators of eco-efficiency in the agricultural sector, EU15**



Notes: Gross value added at market prices, constant 1990 prices; excluding Ireland; 1990 data for Germany do not include the former GDR. Irrigated land relates to areas equipped to provide water to the crops; these include areas equipped for full and partial control irrigation, spate irrigation areas, and equipped wetland or inland valley bottoms. Consumption of fertilisers: quantity of fertilisers in metric tonnes of plant nutrient consumed in agriculture.
Source: EEA, EUROSTAT, ECPA, FAO

😐 Compared to other sectors, progress in improving the eco-efficiency of agriculture is limited overall.

Encouraging young people to farm in Norway

Agriculture in Europe is becoming more and more capital-intensive in spite of the fact that labour-intensive agriculture places less strain on the environment. The two largest farming associations in Norway, in cooperation with the youth branch of Friends of the Earth, are encouraging more recruitment of young people into agriculture.

Their campaign focuses on the social and environmental impacts of the loss of people from the agricultural sector - seven Norwegian farms have closed down every day for the past ten years. This has probably been a strong driving force behind the move towards more large-scale, resource-intensive and industrialised agriculture.

As part of the campaign to preserve small-scale farming, young people are being helped to find farms. A web service has been established to support this work; at http://www.gardsbruk.no, young people can search for farms for sale all over Norway. The service started at the beginning of 2000, and has been successful in offering both active farms and farms that have been closed down. Six thousand people use the service each month, and about 60 farms were sold or rented out between January and November 2000.

Source: http://www.gardsbruk.no

7.1. Agricultural eco-efficiency

The 5 % increase between 1990 and 1997 in gross value added (used as an indicator of agricultural production) is mainly due to an increase in productivity per hectare. Energy use and the area of irrigated land have increased more rapidly than gross value added, which is linked to a relatively faster growth of intensive production.

In general, there has been less progress in improving eco-efficiency in agriculture than in other sectors. Emission reductions, for example the 10 % fall in emissions of acidifying substances, have been significantly less than those achieved in some sectors, for example up to 50 % for some pollutants.

There has been some progress in reducing the consumption of fertilisers and pesticides, but problems of nutrient surplus persist (Section 7.3) and pesticide residues in the environment and in food remains of concern.

Emissions of greenhouse gases and tropospheric ozone precursors are relatively less important since the contributions of agriculture to total emissions are small: about 10 % of greenhouse gas emissions and less than 5 % of ozone precursors in 1997–98. Thus the reductions in the emissions from agriculture have had limited impact on total emissions of these substances. In the same way, the increase in energy use is of limited overall significance as the sector is a relatively small user of energy.

7.2. Developments in agriculture

Common Agricultural Policy support
Every year the EU spends half of its budget, around EUR 40 billion (about 0.5 % of the GDP of the EU), on supporting agriculture. Support for rural development (including agri-environmental measures) doubled between 1996 and 2000.

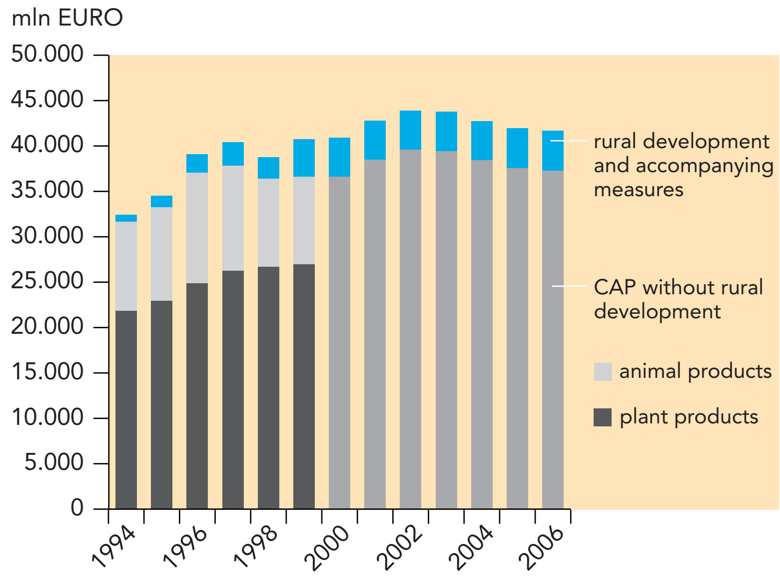
The original emphasis of the CAP on increasing agricultural productivity through price support and subsidised prices for inputs such as fertilisers, pesticides, water and energy generally encouraged higher production and led to intensification.

The MacSharry Reform of the CAP in 1992, the agri-environment Regulation (EEC 2078/92) and more recently the reforms related to Agenda 2000 have resulted in agricultural support shifting progressively away from market support towards direct income support. Market support decreased from 61 % of CAP subsidies in 1993 to 32 % in 1998. An increasing share of total support (up to 10 % in 2000) is tied to environmental requirements. Regulation 2078/92 introduced agri-environment measures and the Agenda 2000 reforms (Reg. 1257/1999 on rural development) created a direct link between income support and environmental protection.

From 2000 onwards the CAP budget is restricted to EUR 38 billion annually for market policy and EUR 4.3 billion for rural development, including agri-environmental measures. The rural development initiatives are co-financed by the European Commission (50 % to 75 %), making the total amount available for these measures more than it spends. Despite doubling since 1996, however, spending on rural development is still only about 10 % of total EU agricultural support.

Total support for agriculture, including national subsidies, represented around 1 % of GDP in 1996–1998, compared with 2 % in 1986–88 (OECD, 1999).

Expenditures under the Common Agricultural Policy — Figure 7.2.

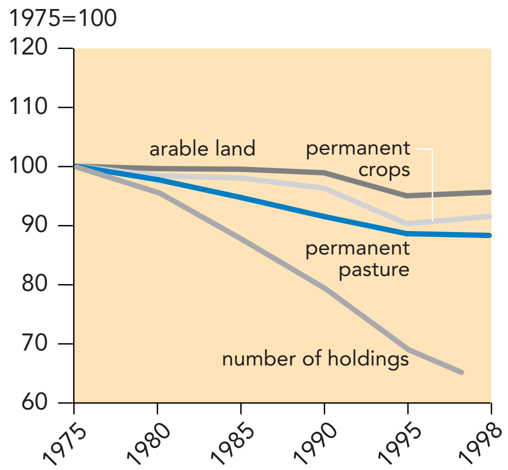


Note: 2000-2006 data are budget figures agreed for Agenda 2000.
Source: European Commission, DG Agriculture

☺ The support for rural development (including agri-environmental measures) has increased from 5 % of total agricultural support in 1996 to 10 % in 2000.

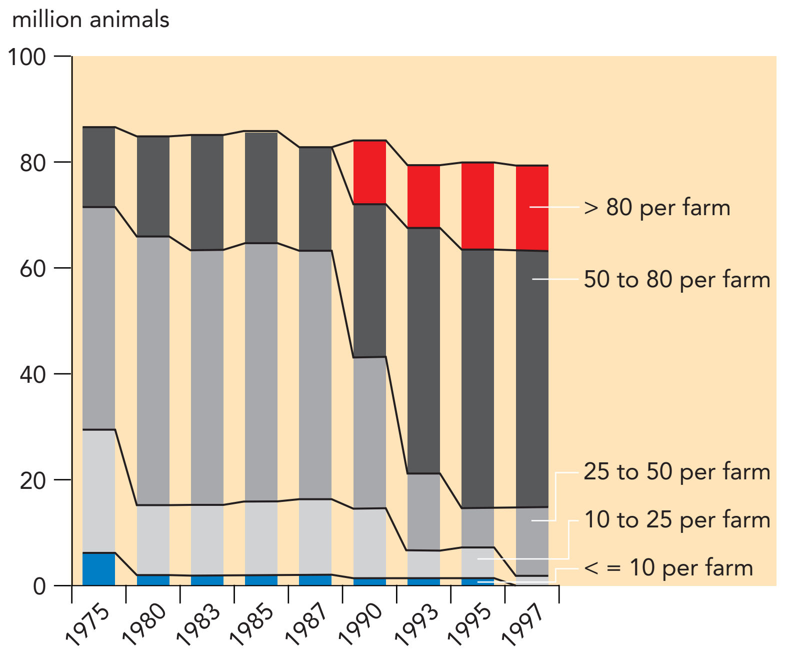
Development in number of holdings and land use by agriculture, EU12 — Figure 7.3.

Source: FAO and EUROSTAT



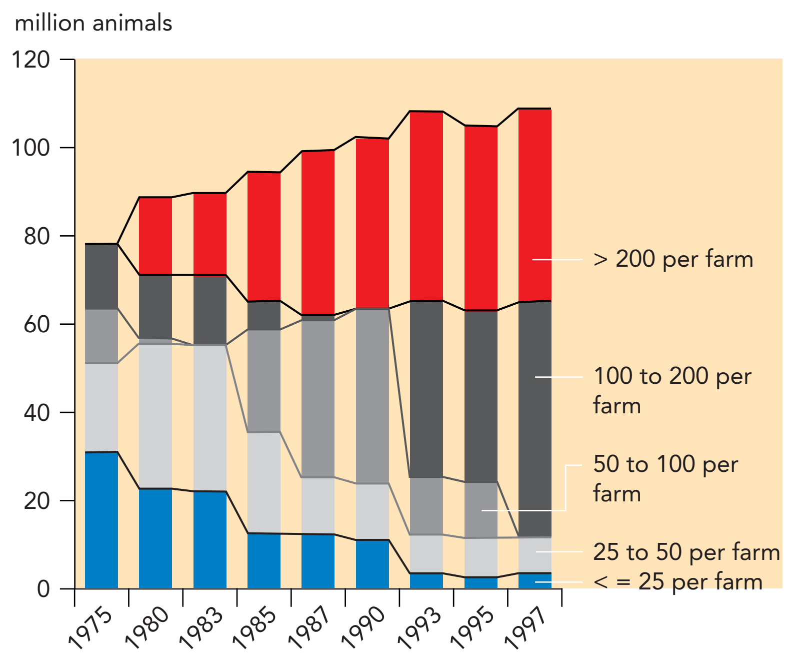
☹ Between 1975 and 1995, more than 3 million holdings (-31%) disappeared in the EU12. Together with a 10 % reduction in agricultural land, a slight reduction in cattle (but sharp increase in pigs number) this has lead to a considerable concentration of agricultural production. At the same time permanent pastures decreased by 11 % in the EEA member countries in the past 20 years.

Figure 7.4a. Distribution of total number of cattle by number per farm, EU12



Note: Calculated for farms breeding the animals
Source: Eurostat

Figure 7.4b. Distribution of total number of pigs by number per farm, EU12



Note: Calculated for farms breeding the animals
Source: Eurostat

Agricultural intensity

There is no unified measure of agricultural production, but the indicators used in this section illustrate important trends in intensification and specialisation, without aiming to be comprehensive. The number of holdings in the EU12 fell from more than 10 million in 1975 to 7 million in 1997. During the same period the gross value added by agricultural production increased by about 18 %, despite a slight shrinking of the agricultural area. The ratio of the number of specialised to mixed farms increased from 3.3:1 in 1990 to 4.3:1 in 1997.

Specialisation on field crops and pressures to increase yields have led to the ploughing up of permanent pastures and abandonment of extensive agricultural areas: the area of permanent pastures in the EEA member countries fell by 11 % between 1975 and 1998 (Chapter 15).

There has also been intensification of the livestock sector: between 1980 and 1997 the number of farms in the EU12 with livestock fell by 47 % while the number of cattle fell by 5 % and the number of dairy cows by 20 %. Milk production, however, remained largely stable. Pig numbers have been rising for many years – from 88 to 108 million in the EU12 between 1980 and 1997. Figures 7.4a and b show the resulting large changes in average numbers of animals per farm.

The figures mask the trend to very large cattle and pig units in some countries. In Belgium, Denmark, Ireland, the Netherlands and the United Kingdom the average number of pigs per farm in 1997 was more than 550 – four to six times the EU12 average.

Where intensive animal husbandry is concentrated in particular regions, much animal feedstuff is imported rather than grown locally, and the amount of animal manure produced is far greater than what is needed by local crops, generating substantial nutrient surpluses (*see next section*).

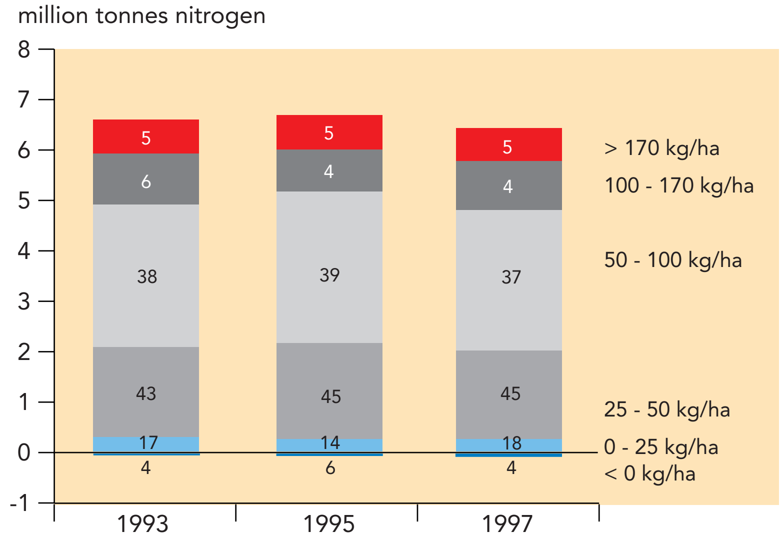
7.3. Nutrient surpluses

Leaching and run-off of plant nutrients from agricultural soils is a persistent problem of modern agriculture. Overloading of water bodies with these nutrients causes eutrophication. Phosphorus is the key nutrient for eutrophication in fresh waters and nitrogen in marine waters.

As agriculture is the main source of nitrogen emissions, the indicator focuses on the surplus of nitrogen from agricultural land. A surplus occurs when not all the inputs in the form of fertilisers and animal manure are taken up by the crops and removed by harvesting. A small surplus is standard agricultural practice and normal in most areas. However, in the EU more than 95 % of the 7.1 million tonnes of nitrogen surplus is likely to contribute to leakage of nitrogen into waters.

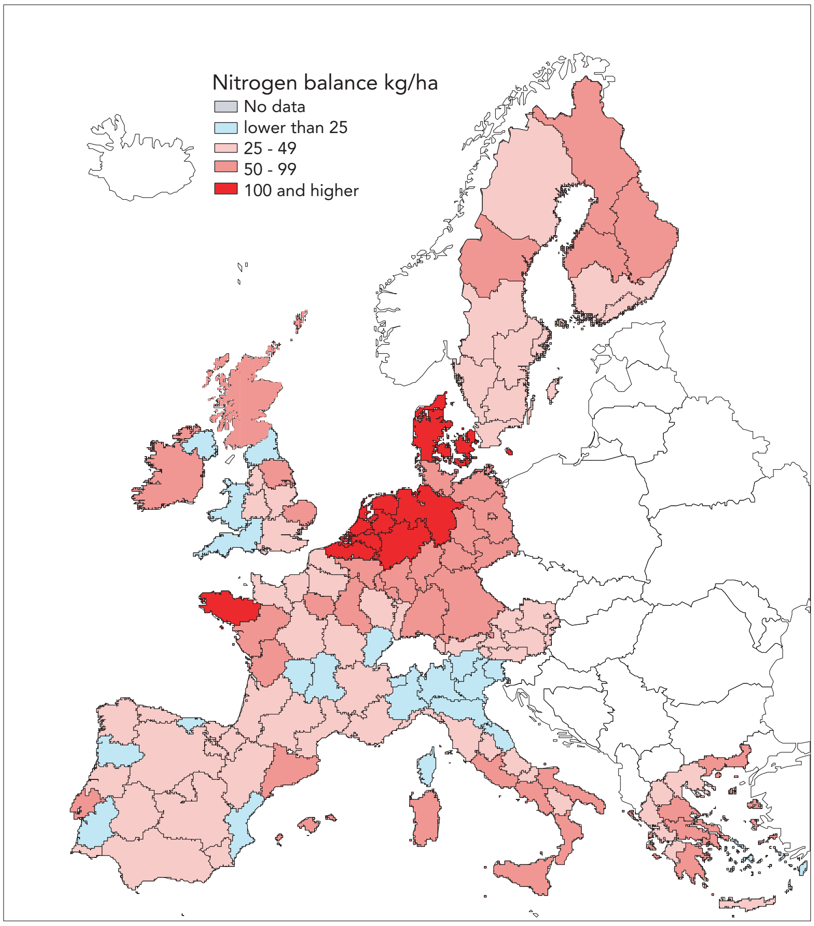
Calculations suggest that the total amount of nitrogen surplus and the distribution by category is stable. A quarter of the total tonnage of nitrogen surplus comes from less than 10 % of the regions covered by the calculations. Apart from Brittany, these are all located along the coasts of the North Sea and in the Rhine water catchment area. Of the 113 regions included in the calculations, 50 produced two thirds of the total amount of nitrogen which is certainly involved in pollution of water. The indicators on nitrogen in rivers (Chapter 11) show constant and high concentrations, with values in small rivers in agricultural areas exceeding the guideline concentrations in the Directive on Surface Water Intended for the Abstraction of Drinking Water.

Standardised nitrogen surpluses from agricultural land, EU15 Figure 7.5a.



Notes: The nitrogen surplus is broken down according to surplus density classes, calculated at the regional (NUTS2) level. Number of regions contributing to a class tonnage is mentioned on the bars. Only regions for which data are available over the whole period are included. These 113 regions contribute 95% of the total surplus, which is around 7.1 million tonnes of nitrogen per year.
Source: EEA calculations with Eurostat data

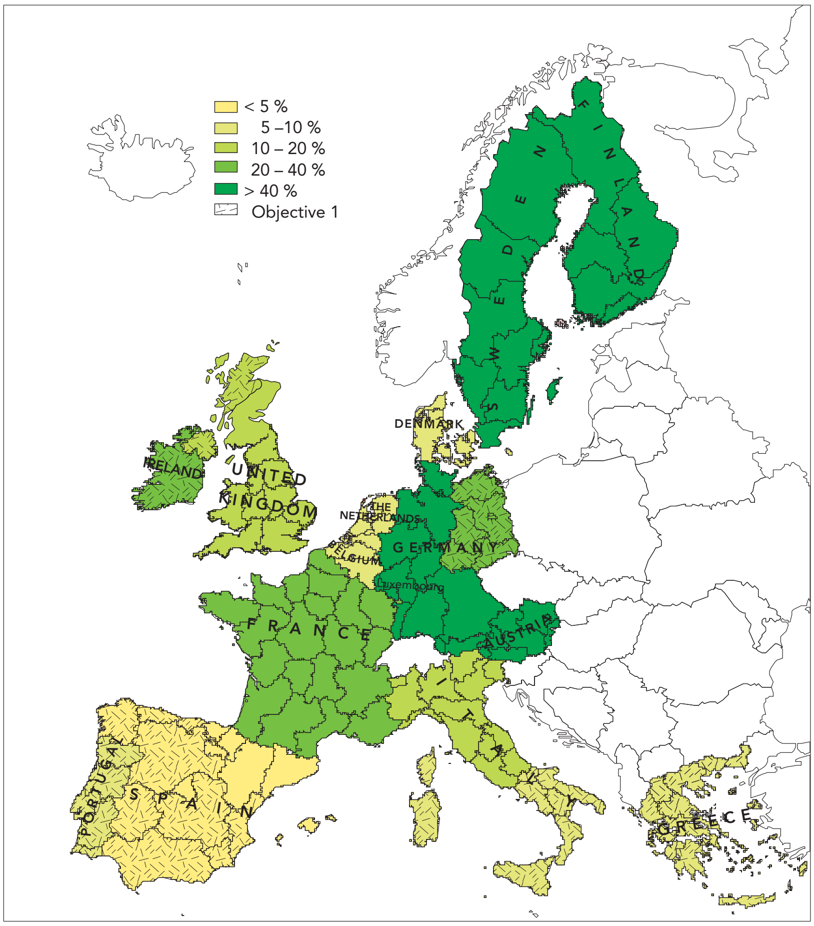
Nitrogen surplus, 1997 Figure 7.5b.



Source: Eurostat

☹ Nitrogen surpluses from agriculture are not falling. More than 95 % of the total surplus is at levels likely to contribute to nitrate contamination in water and thus to eutrophication. A quarter of total amount of nitrogen surplus originates from less than 10% of the regions.

Figure 7.6. Area under agri-environmental management contracts



Notes: Percentage of the utilised agricultural area under agri-environmental measures following Regulation No 2078/92; status on 15.04.98. In objective 1 areas 75% of the costs are financed from the EU budget, in other areas this is 50%.
Source: European Commission, DG Agriculture

☺ In 1998 one farmer out of seven had an agri-environment contract and more than 20 % of EU15 farmland was covered by agri-environmental measures.

7.4. Environmental management by farmers

Agri-environmental management contracts
The agri-environment Regulation 2078/92 and Regulation 1257/1999 on rural development (Section 7.2) provide for programmes to encourage farmers to carry out environmentally beneficial activities on their land. Farmers are paid the costs of providing the environmental services that go beyond good farming practice and are compensated for any costs incurred and loss of income.

The programmes include measures to reduce impacts on air, biodiversity, landscape, soil and land, and water. They cover every aspect of agriculture, including the management of non-farmed zones such as field margins. Measures can be tailored to specific agricultural and environmental situations.

Substantial environmental benefits can accrue – reductions in the use of nitrogen fertiliser; better application techniques; nature protection; and conservation of landscape features.

In 1998 one farmer out of seven had an agri-environment management contract and more than 20 % of EU farmland was covered by agri-environmental measures. The target set in the fifth environmental action programme (5EAP) of 15 % coverage by 2000 has already been exceeded.

Uptake in the new Member States is very high: 78 % of holdings in Austria, 77 % in Finland and 64 % in Sweden, compared with the EU12 (excluding Germany) average of 9 %. It may be noted that uptake is low in countries with high nitrogen surpluses (Section 7.3).

Environmentally-friendly practices

While there are a number of examples of measures taken by farmers to achieve more environment-friendly agriculture, there is no systematic collection of data.

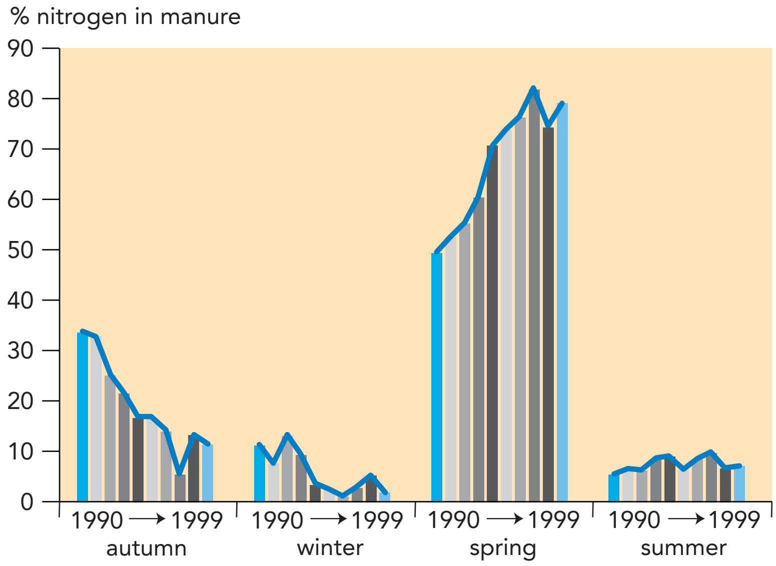
One example is the increase in manure storage capacity at farms in response to the Nitrate Directive, which requires each farm to have sufficient capacity to hold manure and slurry on the farm over the winter until it can be put to use in the spring. In Denmark, for example, there is now capacity to store 97 % of the manure produced for more than six months. This enables manure spreading to be timed to ensure a higher uptake by crops and less leaching. Between 1990 and 1999 the percentage of manure spread during spring and summer in Denmark increased from 55 % to 86 %.

Organic farming

Organic farming can be of benefit to the environment. In particular, it can help to create habitats in which biodiversity is encouraged by management practices. However, in general organic farming is less productive, so that more land is needed for a given output. Organic farming should therefore not be considered the only solution to the environmental problems of agriculture, and other approaches may be important as well.

The area under organic farming in the EEA has increased from 0.314 million ha in 1990 to 3.2 million ha in 1999. It now covers 2.5 % of agricultural land; this is expected to increase to 5–10 % in 2005. Six countries - Austria, Liechtenstein, Finland, Italy, Denmark and Sweden – had more than 5 % of their agricultural area organically farmed in 1999, compared to between 1 % and 2.5 % in most other countries. The increase has been stimulated by EU support for organic farming as an agri-environmental measure (Regulation 2078/92 and Regulation 1259/99).

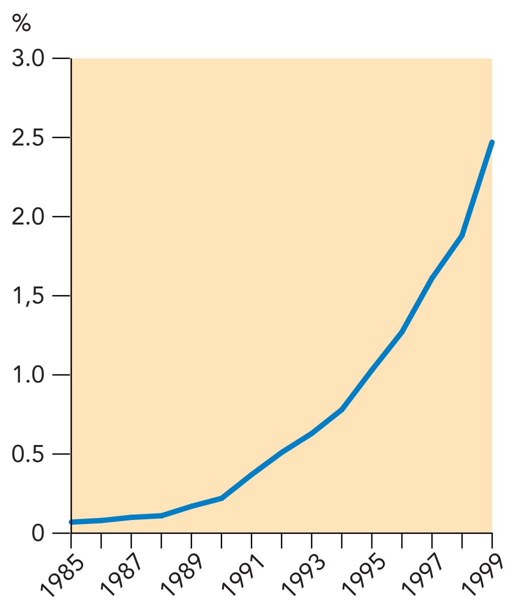
Spreading of animal manure in Denmark Figure 7.7.



Source: NERI 2000

During the past decade several practices in agriculture have become more environmentally friendly. For example, in Denmark the percentage of manure spread during spring and summer increased from 55 % to 86 % between 1990 and 1999.

Share of organic farming in total agricultural area Figure 7.8.



Source: Lampkin, SÖL survey, Willer & Yussefi, 2000

Organic farming now accounts for 2.5 % of the agricultural area in the EEA region. There has been a 5- to 10-fold increase in organic agriculture in every country in the region during the past 5-10 years.

Table 7.1. Share of organic farming in the area of agricultural land

	1987	1991	1995	1999
		%		
Belgium	0.09	0.14	0.26	1.31
Denmark	0.18	0.65	1.50	5.55
Germany	0.18	1.57	2.65	2.67
Greece	0	0.01	0.06	0.41
Spain	0.01	0.02	0.09	1.29
France	0.18	0.27	0.39	1.09
Ireland	0.03	0.09	0.28	0.58
Italy	0.03	0.10	1.22	6.03
Netherlands	0.17	0.46	0.58	1.20
Portugal	0.01	0.05	0.27	1.25
United Kingdom	0.05	0.19	0.28	1.45
Austria	0.24	0.79	9.79	8.44
Finland	0.55	0.52	2.07	6.35
Sweden	0.15	1.21	2.81	9.98
Iceland	0	0	0.03	0.11
Liechtenstein	0	0	0	6.60
Norway	0.03	0.24	0.56	1.79
EEA	**0.10**	**0.37**	**1.03**	**2.47**

Source: Lampkin, Willer and Yussefi, SÖL-survey, 2000

7.5. References and further reading

CEC, 1999. *Agriculture, Environment, Rural Development: Facts and Figures – A challenge for Agriculture.* European Commission, Luxembourg.

8. Progress in key environmental issues

While improvements can be seen in a number of environmental problems, difficult issues remain. Given that the emission of greenhouse gases is intimately linked with energy consumption, then all the difficult problems – the use of energy, water and land, and the problems of nitrates and waste – are reflections of the overall scale of resource use.

Summarising the overall development of main environmental problems in the EU requires the identification of the most pressing issues and the use of a limited number of related indicators. During the past two years, the European Commission together with the EEA and the EU Member States have selected a limited set of indicators out of the many environmental indicators available. These 'headline indicators' have been chosen for their ability to indicate progress in key environmental areas, linked to the 6th Environmental Action Programme (CEC, 2001). By definition the indicators resulting from this selection and consultation process are very suitable for providing a general overview of the seven environmental issue chapters in this report.

However, for many environmental issues, the ideal headline indicator, as defined during the consultation process with the member countries, could not be constructed because of inadequate or non-existent data. In these cases a proxy indicator has been used, except for hazardous chemicals where work is still underway. Most of the indicators presented in this chapter are reproduced in the following chapters with full notes and references. The indicators in this chapter cover the EU15 countries only.

Environmental headline indicators for the EU, status January 2001 Table 8.1.

Issue	Current indicators	Proposals for ideal indicators
6th Environmental Action Programme theme: **Climate change**		
1. Climate Change	aggregated emissions of 3 main greenhouse gases	aggregated emissions of 6 greenhouse gases of the Kyoto Protocol
6th Environmental Action Programme theme: **Nature & biodiversity**		
2. Nature & Biodiversity	designated "Special Protection Areas" (Birds Directive)	biodiversity index, or conservation status of key species and habitats
3. Air Quality: acidification	aggregated emissions of acidifying substances	same
6th Environmental Action Programme theme: **Environment & human health**		
4. Air Quality: summersmog	aggregated emissions of ozone precursor substances	same, and: number of days of pollution exceeding standards
5. Urban Air Quality	number of days of exceedance (several pollutants)	urban air quality indicators or index; urban transport indicators
6. Water Quality	phosphate and nitrate concentration in large rivers	European index for the status of water bodies
7. Chemicals	indicator in development	production of hazardous chemicals
6th Environmental Action Programme theme: **Waste & resources**		
8. Waste	municipal and hazardous waste generated & landfilled	resource use in line with the waste strategy
9. Resource Use	gross Inland Energy Consumption	material balance indicator
10. Water Quantity	total fresh water abstraction	intensity of water use
11. Land Use	land use by selected categories	land use change matrix

Figure 8.1. **Emission of greenhouse gases**

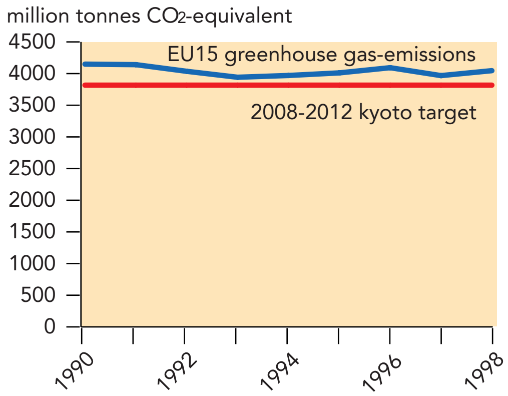


Figure 8.2. **Emissions of acidifying substances and ozone precursors**

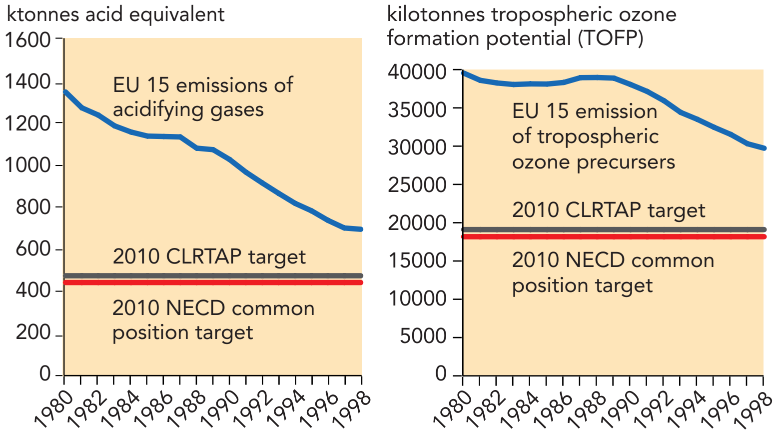
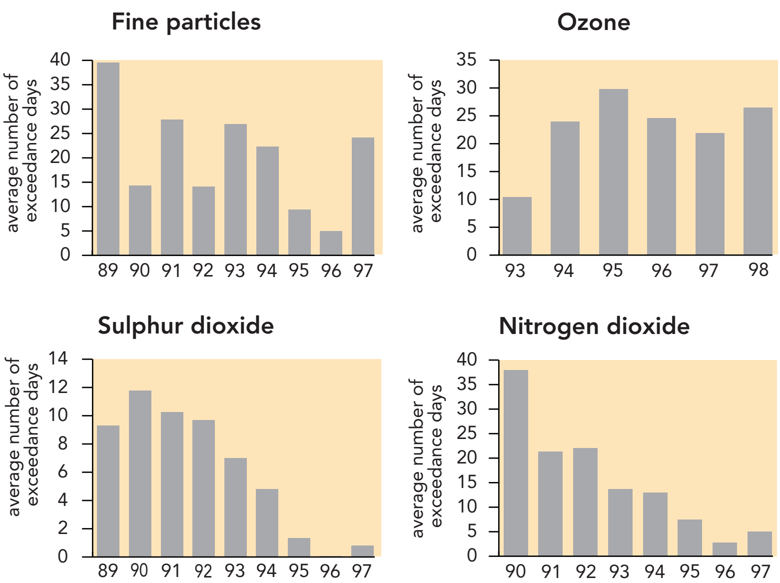


Figure 8.3. **Urban air quality**



8.1. Core indicators

Climate change

Emissions of greenhouse gases in the EU, and in most countries, increased again in 1998. Further efforts will be needed to reach the Kyoto target.

Air pollution

Emissions of acidifying substances and ozone precursors have decreased considerably.

Several countries should reach the international targets by 2010 if current trends continue. Additional measures are however necessary in France, Greece, Ireland, Italy, Portugal, Spain, and Belgium (especially for nitrogen oxide, NMVOCs and ammonia), Denmark (especially for ammonia and nitrogen oxide) and Finland (especially for nitrogen oxide and NMVOCs).

The area of land in Europe that receives more acidifying substances than nature can cope with has generally decreased since 1990. However, the exposed area has increased in France, Greece and Ireland because of continuing high and sometimes increasing emissions in these and neighbouring countries.

Air quality in urban areas has generally improved. Persistent problems remain with fine particles and ozone, which threaten human health. The contribution of transport to these is important.

No trends can yet be detected in the concentrations of fine particles and ozone in cities, although there are indications that peak concentrations of ozone are falling.

Water quality
The current indicator for water quality focuses on nutrients in rivers; the ideal indicator would provide a more complete description of the quality of surface waters.

Phosphorus concentrations in rivers in many regions have fallen significantly over the past 15 years, showing the effect of more and better wastewater treatment.

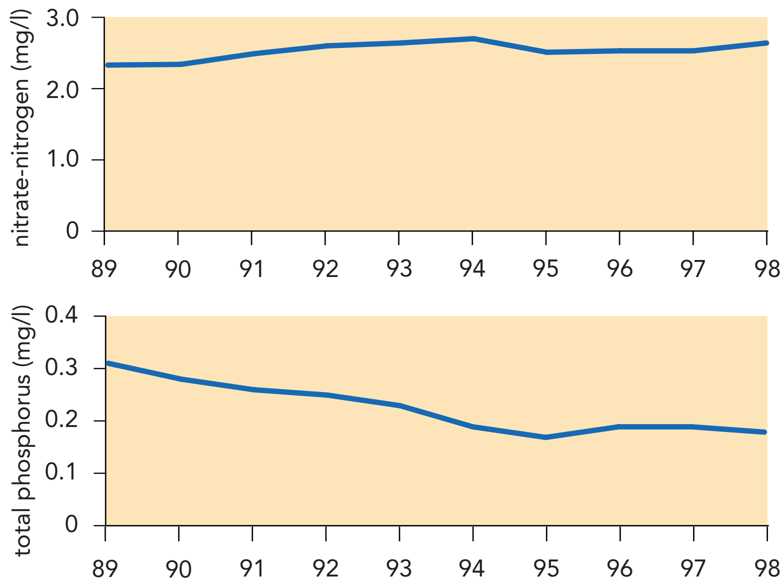
Nitrate concentrations have not fallen, since nitrates originate mainly from agriculture, which in general has been intensified. Although most rivers in Europe have medium to high concentrations of nitrates, safety levels for the protection of drinking water are only exceeded in larger river catchments that drain areas with a high proportion of farming land and intensive agricultural production.

More and better treatment of wastewater has also led to improvements in the oxygen content of rivers. However, small rivers, which should be of high quality because of the many functions they fulfil, still have the poorest quality in terms of oxygen content.

Waste
The amount of municipal waste generated (per year and per capita) has grown by 15 %, in the seven countries included in the indicator, as a result of the increase in the number of households and in consumer spending. Hazardous waste quantities have also been growing each year.

More incineration has lead to a decrease in the amount of waste landfilled since 1993. However, despite efforts to increase incineration and other methods of waste management, the amount going to landfill in 1998 is about the same as it was in 1990 because of the sheer growth in generation of waste.

Nitrogen and phosphorus in large rivers Figure 8.4.



Municipal waste – Hazardous waste Figure 8.5.

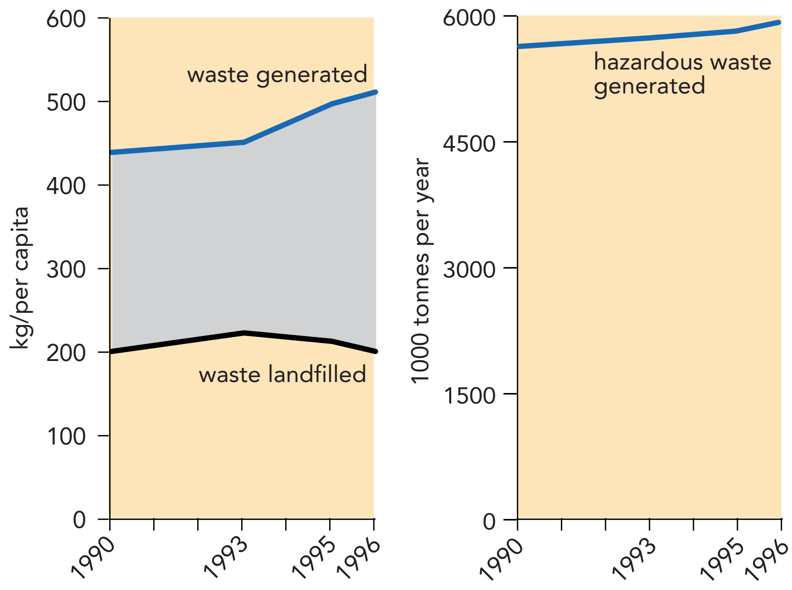


Figure 8.6. **Water abstraction – Land use – Energy consumption**

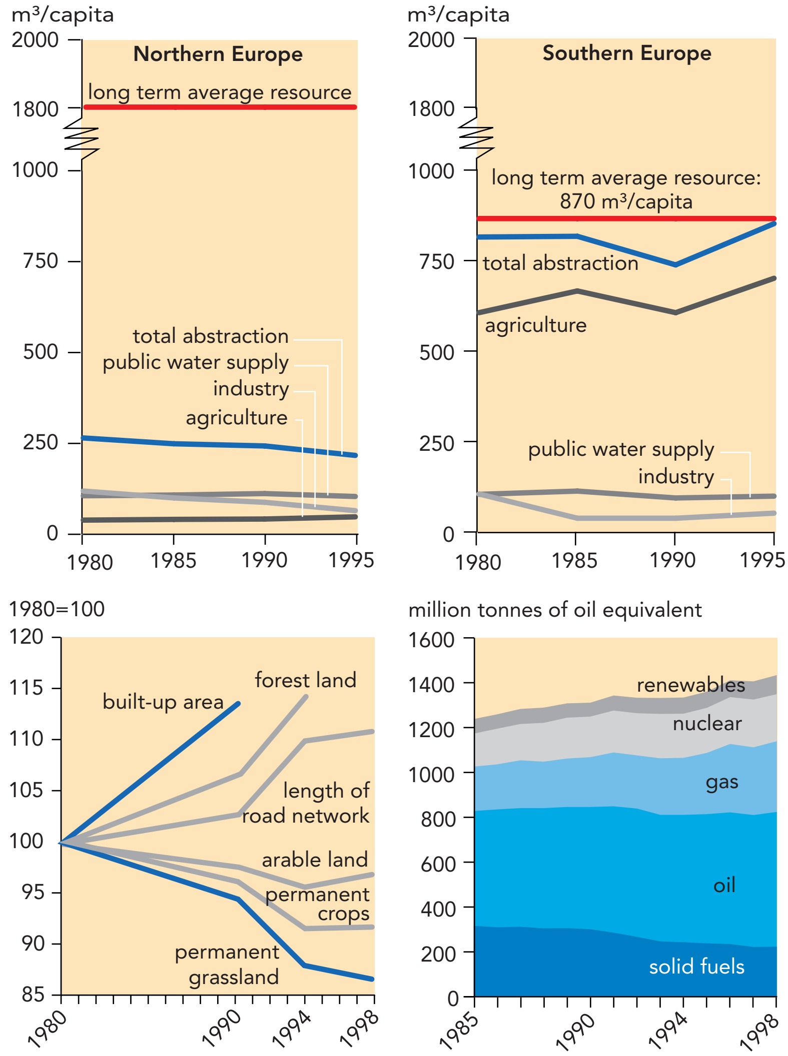
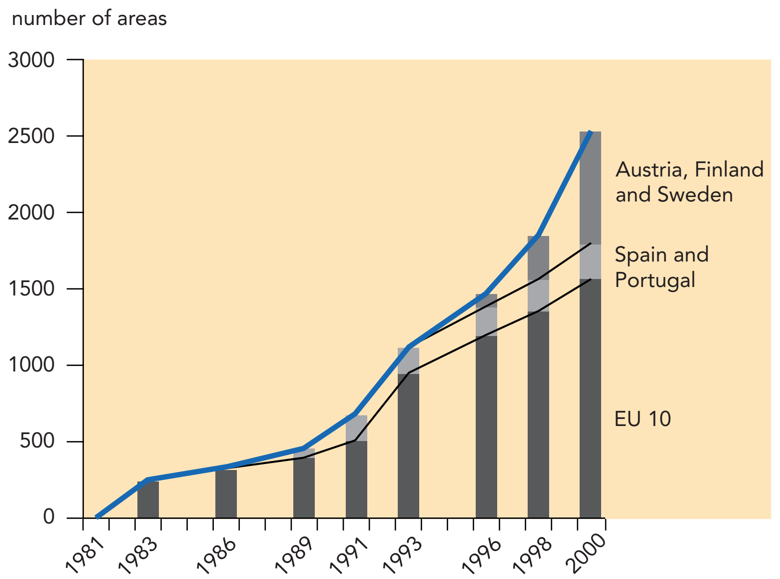


Figure 8.7. **Nature and biodiversity: designation of Special Protection Areas**



Note: cumulative figure, Special Protection areas according to the European Birds Directive.

Resource and land use

In this edition of *Environmental signals* no separate chapter on resources is included, although the energy chapter contains relevant information.

The three headline indicators on resource use and land use show general increases in pressures on the environment. Only water abstraction in northern European countries has decreased. Abstraction in southern Europe, mainly for irrigation, has increased and is now unsustainable.

Energy use is still increasing and remains dominated by fossil fuels.

A comprehensive assessment of development in land use is not yet possible; the indicator shows, however, that 'land-taking' uses have increased. This has an influence on nature and biodiversity, but the evidence for this is only anecdotal.

Biodiversity

An overview indicator on the status of biodiversity in Europe would require a complete coverage of changes in the natural status of each piece of land (and sea), which is not currently available.

The designation of Special Protection Areas under the EU Birds Directive is used as a proxy indicator. This reflects the change in protection status in an increasing number of areas in the EU, but says nothing about the quality of the protected areas. Grasslands, for example, this year's topic within the biodiversity topic, are under pressure from changes in agriculture leading to a decrease in permanent grassland, which is not being prevented by any protection policy.

8.2. Conclusion

The general conclusion from this overview is that the environmental problems that are most difficult to solve persist. Given that the emission of greenhouse gases is intimately linked with energy consumption, then all the difficult problems – the use of energy, water and land, and the problems of nitrates and waste – are reflections of the overall scale of resource use. This suggests that a more 'upstream' approach is needed if environmental problems are to be solved. This means that if environmental and sustainability aims and targets are to be reached, higher efficiencies in the use of materials and energy will be necessary, which in turn requires actions that influence the character and scale of production and consumption. Chapter 2 discusses the policies and mechanisms, such as pricing and subsidies, that can be used to influence societal processes. With continuing economic growth, and thus continuing pressure on resources, continual development of such instruments will be needed. As incomes rise, financial stimuli become less and less effective, and societal acceptance of financial measures, structural economic changes or measures aimed at changing behaviour will have to be won time and time again.

8.3. References

CEC, 2001. *Headline Environmental Indicators for the European Union*. Commission of the European Communities, Eurostat and the EEA, Luxembourg.

9. Climate change

policy issue	indicator	assessment
are average temperatures staying below provisional "sustainable targets"?	global and European mean temperature	☹
are the Kyoto Protocol targets within reach?	emissions of greenhouse gases	😐
how are the emissions of each of the gases changing, and which sectors contribute?	carbon dioxide emissions	😐
- „ -	methane emission	☺
- „ -	nitrous oxide emissions	😐
- „ -	fluorinated gas emissions	☹

Achieving the Kyoto Protocol target for greenhouse gas emissions for the EU and the Member States will require substantial further reductions, particularly in carbon dioxide emissions. However, energy and transport demands, and the associated carbon dioxide emissions, are likely to continue to increase. It is unlikely that current measures, including improvements of energy efficiency and increasing the share of renewable sources of energy, will achieve enough to offset these increases. Major policy changes will be needed beyond the Kyoto target dates (2008 – 2012) if sustainable development is not to be seriously jeopardised by climate change.

The EU, along with other major international bodies, has identified climate change as likely to be the dominant environmental issue of the 21st century.

According to the Intergovernmental Panel on Climate Change (IPCC, 2001a and 2001b):

- "An increasing body of observations gives a collective picture of a warming world and other changes in the climate system;
- Emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate;
- There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities;
- Human influences will continue to change atmospheric composition throughout the 21st century;
- Anthropogenic climate change will persist for many centuries;
- Recent regional climate changes have already affected many physical and biological systems;
- Projected changes in climate extremes could have major consequences;
- Adaptation is a necessary strategy at all scales to complement climate change mitigation efforts."

The IPCC (IPCC, 2001b) also provides specific conclusions for Europe, including:

- "Adaptive capacity is generally high in Europe for human systems; southern Europe and the European Arctic are more vulnerable than other parts of Europe;
- Summer run-off, water availability and soil moisture are likely to decrease in southern Europe; increases are likely in winter in the north and south;

Emissions of greenhouse gases			% of total
Households			22%
Fisheries			
Tourism			Included in households
Transport	●●	↗	20%
Energy	●●	↘	27%
Agriculture	●	↘	10%
Industry	●●	↘	21%
Tertiary sector			
Military			

- Half of alpine glaciers and large permafrost areas could disappear by the end of the 21st century;
- River flood hazard will increase across much of Europe;
- There will be some broadly positive effects on agriculture in northern Europe; productivity will decrease in southern and eastern Europe;
- Loss of important habitats (wetlands, tundra, isolated habitats) would threaten some species."

The goal of the United Nations Framework Convention on Climate Change (UNFCCC) is to reach atmospheric greenhouse gas concentrations that would prevent dangerous anthropogenic interference with the climate system but that would allow sustainable economic development. Achieving this would require substantial (50 % to 70 %) global reductions in greenhouse gas emissions from the 1990 levels, far beyond the reductions set at Kyoto.

As carbon dioxide emissions from energy use are a major part of total greenhouse gas emissions, reaching these targets will mean reducing the use of fossil-fuel-based energy in the transport, energy and industry sectors. Measures to reduce emissions of other greenhouse gases will also be required.

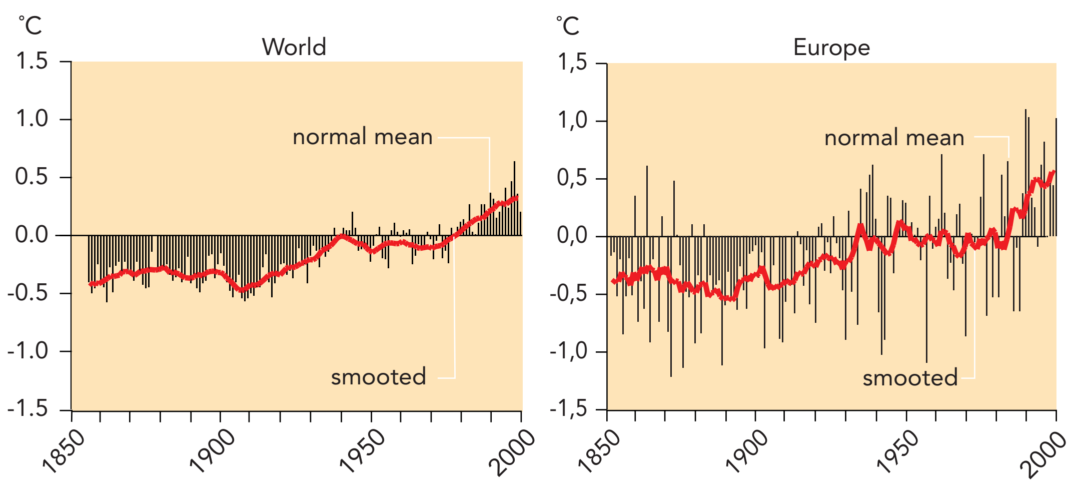
9.1. Climate change indicators

The main indicator of climate change is global mean temperature. The potential consequences of increased global temperatures include rising sea levels, changes in rainfall patterns leading to floods and droughts, changes in biota and food productivity, and increases in infectious diseases. These effects will have impacts on socio-economic sectors such as agriculture, and on water resources.

It is likely that the increase in temperature in the 20th century was the largest of any century during the past 1000 years. Temperature increase in Europe is consistent with the global trend, although natural variations are larger. There is new and stronger evidence that most of the warming observed over the past 50 years is attributable to human activities. Under IPCC emission scenarios, between 1990 and 2100 global average temperature and sea level are projected to rise by 1.4° C to 5.8° C and 0.1 m to 0.9 m, respectively. Glaciers, icecaps and the extent of sea ice are projected to continue to decrease further.

There is no consensus on 'sustainable' climate change targets. The EU Council of Ministers has proposed that global mean temperatures should not rise by more than 2° C above pre-industrial levels. This target will not be met if the increases in global mean temperature projected by IPCC occur.

Observed global and European annual mean temperature deviations,1856–1999 Figure 9.1.



Notes: Temperature plotted as the variation from the 1961–1990 mean. The bars show the annual average as the variation from 1961–1990 mean, and the line the 10-year smoothed trend.
Source: CRU, 2000

☹ Global mean temperature has increased by about 0.6 °C over the past 100 years. Globally the 1990s were the warmest decade on record, and 1998 the warmest year.

9.2. International policy developments

According to the UNFCCC Kyoto Protocol, the EU and its Member States are committed to reducing emissions of a basket of six greenhouse gases by 8 % below the 1990 level over the period 2008 to 2012, and the central and east European (CEE) countries to reductions of 0 % to 8 %. In June 1998, a system of 'burden sharing' or 'target sharing' was agreed by EU Member States (European Community, 1998).

By September 2000, 84 Parties to the UNFCCC had signed the Kyoto Protocol. However, only 30 Parties have ratified it and, as yet, no major developed country has ratified. The Protocol will enter into force when it has been ratified by at least 55 Parties to the Convention, including developed countries accounting for at least 55 % of carbon dioxide emissions from this group in 1990.

According to the Kyoto Protocol, net changes in carbon stocks due to changes in forest area since 1990 (the so-called 'Kyoto forests') and some other carbon sinks can be used to meet reduction targets. A special report on land use, land-use change and forestry (IPCC, 2000) shows the large range of uncertainties regarding various types of carbon sinks – for example, questions about the permanence of carbon sinks, distinctions between human-induced and natural carbon uptake and release, and the accuracy of measurements to determine changes in carbon stocks and flows.

The Kyoto Protocol also introduced three important new 'flexibility mechanisms' (Kyoto Mechanisms) to help reach the targets. These mechanisms include emissions trading between developed countries, joint implementation (JI) and the clean-development mechanism (CDM). The latter are project-based mechanisms allowing countries that adopted a target at Kyoto to meet part of that target through projects to reduce emissions in developing countries (CDM) or other developed countries (JI).

Table 9.1. **Change in greenhouse gas emissions since 1990 and the Kyoto Protocol target or the EU burden sharing agreement (excluding land-use change and forestry)**

Country	Actual emission trend (% change 1990–1998)	Kyoto Protocol target/ EU burden sharing 2008–2012 (% from 1990)	1998 total greenhouse gas emission (tonnes per capita)	1998 carbon dioxide emission (tonnes per capita)
Austria	6	-13.0	10	8
Belgium	7	-7.5	14	12
Denmark	9	-21.0	14	11
Finland	6	0.0	15	12
France	1	0.0	9	7
Germany	-16	-21.0	12	11
Greece	15	25	11	10
Ireland	20	13	17	11
Italy	5	-6.5	9	8
Luxembourg	-58	-28	14	12
Netherlands	8	-6.0	15	12
Portugal	18	27	7	5
Spain	21	15	9	7
Sweden	1	4.0	8	6
United Kingdom	-9	-12.5	11	9
EU Total	**-2**	**-8.0**	**11**	**9**
Norway	8	1.0	12	9

Notes: All six Kyoto Protocol gases are included, but fluorinated gas emissions are indicative. Base year is assumed to be 1990 for all gases (except for fluorinated gases, where it is 1995). Emissions from Denmark are not adjusted for electricity trade. Emissions and removals ('sinks') due to land-use change and forestry (LUCF) are excluded because of major uncertainty in their estimates and because no decisions have yet been taken which LUCF activities can be included to meet the Kyoto Protocol targets.
Source: UNFCCC, EEA

The sixth Conference of Parties (COP6, November 2000, The Hague, the Netherlands) was suspended and it was decided to reconvene the conference in July 2001. The Parties did reach general agreement on the establishment of two new funds – aimed mainly at developing countries – for technology transfer, capacity building and adaptation measures. However, there is as yet no agreement on how the developed countries should meet the emission reduction that the Kyoto Protocol requires by 2008–2012. The EU favours the use of domestic measures to limit emissions while countries with large areas of forests such as the United States, Canada and Australia, favour the use of carbon sinks as well as the Kyoto Mechanisms to achieve their targets. Parties still have to agree definitions and accounting rules for carbon sinks, particularly for sinks such as soil, which will have an important impact on the size of the carbon sinks that countries can use to reach their Kyoto target.

Regarding the Kyoto Mechanisms, an important issue is the possibility of unlimited 'hot air' emission trading. Some countries, such as Russia, could have large quantities of unused assigned emissions available for trading. This issue is often referred to as trading in 'hot air' since it could imply that no real reduction in emissions would occur. The extent of this problem is uncertain as it depends on the economic development of such countries.

9.3. Current policies and measures

A key issue for the EU has been to ensure that domestic measures are taken to limit emissions. The EU Council has therefore proposed, and repeated several times, a limit on the use of Kyoto mechanisms (European Community, 2000). Various Member States, including Denmark, France, Germany, the Netherlands and the United Kingdom, adopted new comprehensive national programmes in 1999 or 2000 to reduce greenhouse gas emissions. Some Member States have announced plans to use the Kyoto Mechanisms to reach their commitments. For example, the Netherlands has indicated that it expects to fulfil 50 % of its required emission reductions in this way.

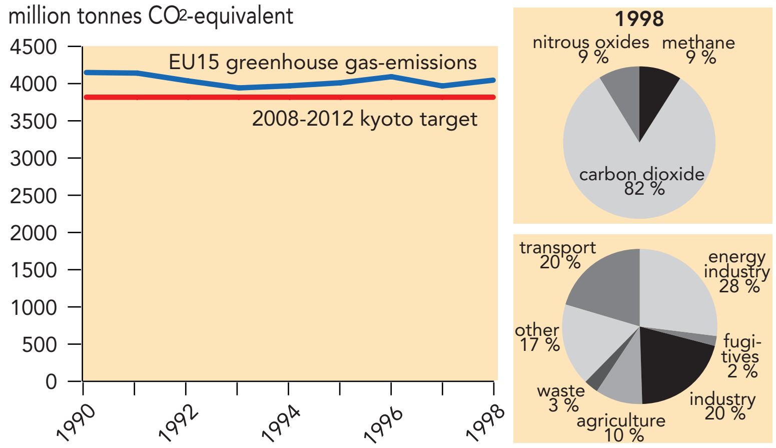
Policies and measures at the EU or national level include:

- energy/carbon dioxide taxes in various Member States;
- a negotiated agreement between the European Commission and the car industry to reduce carbon dioxide emissions from new passenger cars by 25 % between 1995 and 2008;
- the requirement of the Integrated Pollution Prevention and Control (IPPC) Directive to use Best Available Technology and to improve energy efficiency;
- the requirement of the Landfill Directive to reduce the amount of organic waste landfill (thus reducing methane emissions) and to collect landfill gas for energy use;
- EU energy-efficiency: demonstration programmes and several Directives on requirements for appliances and various agreements with manufacturers and importers on minimum energy standards.

A key additional issue is effective and reliable monitoring of emissions and verification of these emissions through the EU greenhouse gas monitoring mechanism.

The Kyoto targets for the Accession countries, which are similar to those for the EU Member States, have mostly already been met, as a result of economic recession rather than specific measures to reduce emissions. Emissions could increase again, however, depending on economic developments in these countries.

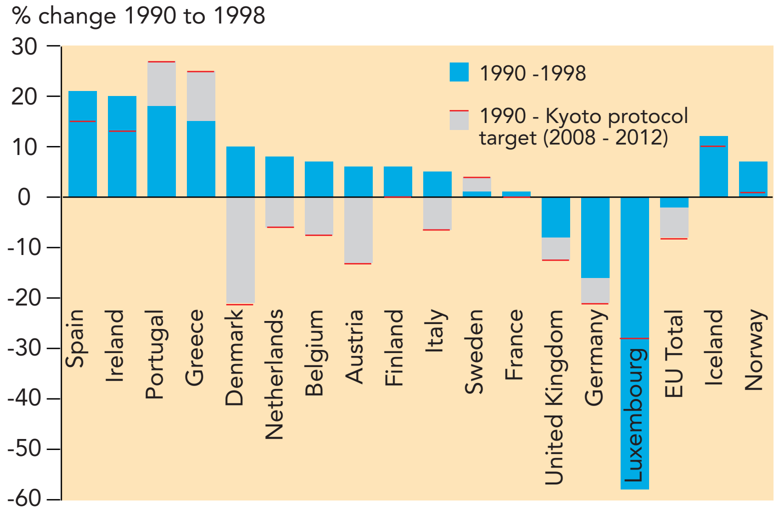
Figure 9.2. Total EU greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, fluorinated gases)



Notes: The EU (Kyoto Protocol) target is a reduction of 8 % below 1990 levels for the basket of six gases: carbon dioxide, methane, nitrous oxide and fluorinated gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride). For these fluorinated gases the year 1995 has been used as base year in this report. These data exclude land-use change and forestry. Global warming potentials used (to give total GWP emissions in Mt carbon dioxide equivalent): carbon dioxide=1, methane=21 and nitrous oxide=310, and different country specific values for each of the fluorinated gases.
Source: EEA compilation of Member States data submitted to UNFCCC and EU Monitoring Mechanism. HFC, PFC and SF_6 estimates for some countries from European Commission (2000h)

😐 Emissions of the six greenhouse gases fell by 2 % between 1990 and 1998. However, they are projected to fall by only 1 % by 2010 (from 1990 levels), with carbon dioxide emissions increasing by 3 % to 4%, methane emissions decreasing by 30 % and nitrous oxide emissions decreasing by 16 %. Fluorinated gas emissions are projected to increase by 60 % to 70 % (from 1995).

Figure 9.3. Percentage change in total greenhouse gas emissions in EEA member countries from 1990 and 1998 compared with their Kyoto Protocol targets



Note: Percentage change in total greenhouse gas emissions (weighted according to their global warming potential) compared with the individual country Kyoto Protocol targets, indicating that most countries still have a considerable way to go to reach their targets.
Source: EEA

9.4. Total greenhouse gas emissions

Environmental Signals 2000 reported a decrease in the total emissions of the three main greenhouse gases (carbon dioxide, methane and nitrous oxide) of 1 % between 1990 and 1996, despite a substantial increase in GDP. The 1998 data show a further small decrease in total emissions of 2 % of all six gases between 1990 and 1998, mainly due to a stabilisation of carbon dioxide emissions and reduction of nitrous oxide and methane emissions. Most of the 1990 to 1998 decrease resulted from large decreases in Germany and the United Kingdom. Emissions increased in all other EU countries except Luxembourg.

The main sources of greenhouse gas emissions are:

- carbon dioxide (81 %) – the main greenhouse gas – from fossil fuel combustion;
- methane (9 %) from agriculture (cattle and manure management), waste (waste disposal in landfills) and fugitive emissions from fuels (e.g. in the gas distribution networks);
- nitrous oxide (9 %) from agriculture (soils and fertiliser use), industrial processes (mainly adipic and nitric acid production) and, as a by-product, from passenger-car catalysts;
- fluorinated gases (1 %) from industry.

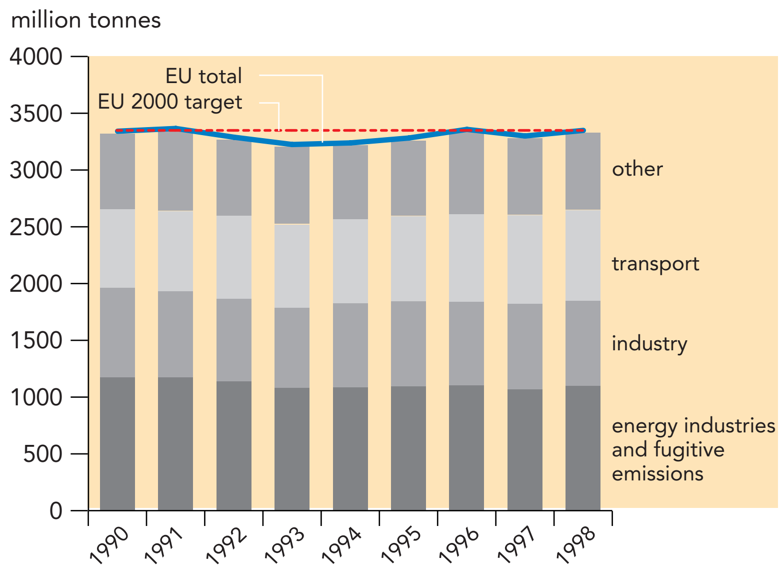
Although emission reductions were achieved between 1990 and 1998, meeting the EU Kyoto Protocol target is likely to be difficult. Socio-economic trends suggest that energy and transport demands, and therefore the associated emissions, are likely to increase. An overview of recent projections by Member States (European Commission, 2000c) suggests that existing policies and measures (including the agreement with the car industry to reduce carbon dioxide emissions from new passenger cars) could result in total EU greenhouse gas emissions falling by 1 % by 2010, from 1990 levels. Results from a Commission study, which uses Community-wide models, show similar projected reductions, assuming use of existing measures (European Commission, 2000e, 2000f, 2000g, 2000h).

Combining the results of both approaches (Member States' information and Community-wide models), suggests an increase by 2010, from 1990 levels, of 3 % to 4 % for carbon dioxide, a decrease of 30 % for methane and 16 % for nitrous oxide, while fluorinated gases would increase by 60 % to 70 % from 1995 levels.

Greenhouse gas emissions from Norway increased by 13 % between 1990 and 1998, which is not in line with Norway's Kyoto target of a 1 % increase by 2008–2012.

There is, however, scope for emission reductions through better implementation of existing policies and additional measures listed in Section 9.9.

Total EU carbon dioxide emissions — Figure 9.4.



Note: Excludes land-use change and forestry. Target for 2000 is the UNFCCC and the Fifth Environmental Action Programme target of stabilisation of carbon dioxide emissions by 2000 at 1990 levels. Transport excludes emissions from international transport (in accordance with UNFCCC). No specific targets have been set for carbon dioxide beyond 2000. However, the EU (Kyoto Protocol) target for 2008–2012 is a reduction of 8 % below 1990 levels for the basket of six gases, including carbon dioxide.
Source: EEA

☹ Between 1990 and 1998 total EU carbon dioxide emissions stabilised, mainly due to reductions in Germany, the United Kingdom and Luxembourg. Carbon dioxide emissions are projected to increase by 3 % to 4 % by 2010 from 1990 levels. The largest rise is expected to occur in the transport sector with a projected increase of 25 % from 1990 levels, assuming implementation of the EU strategy to reduce emissions from cars.

9.5 Carbon dioxide emissions

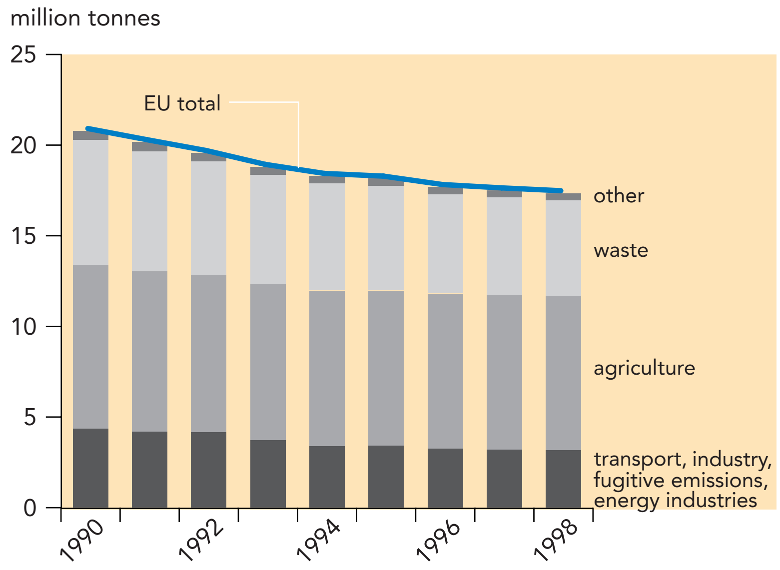
Carbon dioxide is the most significant greenhouse gas; it contributes about 80 % of total EU greenhouse gas emissions. Total EU emissions in 1998 were similar to those in 1990. Emissions fell between 1990 and 1994, mainly because of relatively slow economic growth, increases in energy efficiency, economic restructuring of the new *Länder* in Germany and the switch from coal to natural gas, mainly in the United Kingdom. Emissions then increased by 3 % between 1994 and 1998.

The EU target of stabilisation of carbon dioxide emissions at the 1990 level by 2000 is likely to be reached. No specific targets have been set for carbon dioxide beyond 2000, as carbon dioxide is included in the Kyoto target.

The upward trend in carbon dioxide emissions from transport is largely due to growing traffic volumes, as there has been very little change in average energy use per vehicle kilometre. In the future, policies such as the voluntary agreements with the car industry are expected to bring average energy use down. The first annual report on the effectiveness of this agreement (European Commission, 2000d) shows a reduction of almost 6 % in carbon dioxide emissions from new passenger cars between 1995 and 1999. However, in order to meet the final target more effort by European and non-European car manufacturers is needed.

Recent Member State projections (European Commission, 2000c) suggest that existing policies and measures would, at best, limit the increase of total EU carbon dioxide emissions to 3 % by 2010, from 1990 levels. Results from a Commission study (European Commission, 2000e) suggest an increase of total EU carbon dioxide emissions of 4 % (almost 7 % if the agreement with the car industry is not implemented). The largest increase in carbon dioxide emissions would be in the transport sector, with a projected increase of 25 % from 1990 levels, assuming implementation of the car industry agreement. Without implementation, transport carbon dioxide emissions would increase by 35 %.

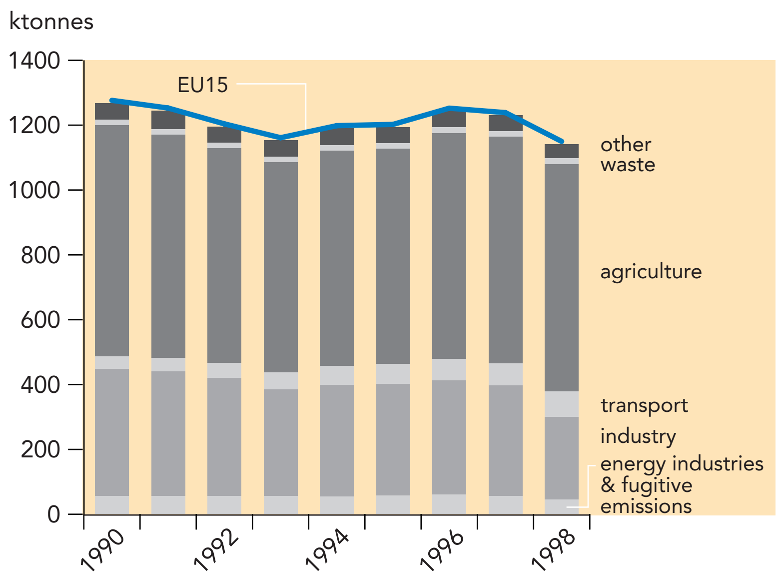
Figure 9.5. Total EU emissions of methane



Source: EEA

EU methane emissions fell by 17 % between 1990 and 1998, mainly due to reductions in emissions from agriculture and landfills. Further reductions are projected (up to 30 % by 2010 from 1990 levels), provided that existing policies and measures are fully implemented.

Figure 9.6. Total EU emissions of nitrous oxide



Source : EEA

The currently available data shows no clear trend in nitrous oxide emissions, although the 1998 estimates represent a 10 % reduction on 1990 values. A reduction of up to 16 % by 2010 from 1990 levels is projected, provided that existing policies for agriculture and industry are fully implemented.

9.6. Methane emissions

Emissions in the EU fell by 17 % between 1990 and 1998, mainly because of a decrease in agricultural emissions (primarily from reductions in livestock) and better landfill emission controls.

The main sources (in 1998) included: agriculture, mostly from ruminant animals (49 %); waste treatment and disposal, including a large contribution from landfills (30 %); and emissions from coal mines and leaks from natural gas distribution systems (16 %). The methane emission estimates have larger uncertainties than carbon dioxide emissions as the main sources (agriculture and waste) are not well quantified. No specific targets have been set for methane emissions.

It is not clear whether the current favourable trends will continue. Recent projections (European Commission, 2000c, 2000f, 2000g) suggest that existing policies and measures could result in total EU methane emissions falling by 30 % by 2010, from 1990 levels, with the main decreases being in the waste sector and agriculture.

The Landfill Directive is expected to make an important contribution to the achievement of these reductions. The Directive requires the installation of energy recovery systems at all new sites in the future and diversion of biodegradable waste from landfills, for example by paper recycling, composting, anaerobic treatment or incineration. Various Member States already have stricter legislation in place.

The reform of Common Agricultural Policy (CAP), which has already had an impact on agricultural emissions, is expected to have a further impact up until 2010. This is due mainly to reductions in livestock numbers, especially pigs and cattle, as well as changes in manure management.

9.7. Nitrous oxide emissions

There is considerable uncertainty in the emission estimates. Emissions between 1990 and 1998 show no clear trend, although 1998 emissions were 10 % below those in 1990.

The main sources (in 1998) included: agriculture, mainly from organic and synthetic fertiliser use and leguminous crops (61 %); and industrial processes, including adipic acid and nitric acid production (22 %). A small but rapidly increasing source is the transport sector, as a result of the introduction of catalytic converters, which use is still growing; this will, however, have limited impact on the overall trend.

No specific targets have been set for nitrous oxide. Controls on industrial emissions overall will help to reduce emissions. Agricultural sources are more difficult to control.

Recent projections (European Commission, 2000c, 2000f) suggest that existing policies and measures, including the reform of the Common Agricultural Policy (CAP), could result in total EU nitrous oxide emissions falling by 16 % by 2010, from 1990 levels, including a decrease of 6 % in emissions from agriculture.

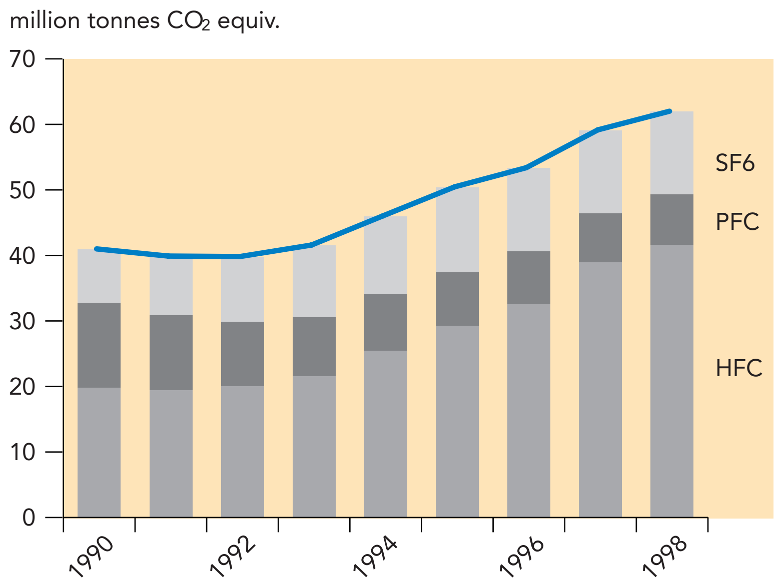
9.8. Fluorinated gas emissions

In 1998 HFCs contributed 67 % to the total emissions of fluorinated gases, followed by SF_6 with 20 %. Industry is the most significant source (99.9 % in 1998), with the largest emissions of HFCs a by-product of production of HCFC-22. The most important source for SF_6 is electricity distribution (used in switches), and of PFC processes in the aluminium and electronics industries. Emissions of these gases have increased rapidly and may rise further, as HFCs continue to be substituted for substances banned under the Montreal Protocol.

No specific targets have been set for these gases but their emissions, while small compared with the three main greenhouse gases, are relevant to achieving the Kyoto Protocol targets because of their rapid increase.

Recent projections (European Commission, 2000c, 2000h) suggest that total EU emissions of fluorinated gases could increase by 60 % to 70 % by 2010, from 1995 levels.

Total EU emissions of fluorinated gases (HFCs, PFCs, SF6) Figure 9.7.



Notes: Emissions are expressed in Global Warming Potentials with different country specific values for each of the fluorinated gases. Methodologies for inventories of these gases have been developed much more recently than for the other gases. Various countries still do not report their emissions.
Source: EEA

Emissions of HFCs have increased rapidly since they are substitutes for substances banned under the Montreal Protocol for the protection of the ozone layer, and are expected to increase by 60 % to 70 % by 2010 from 1995 levels.

9.9. Possible future policy responses

Early in 2000 the Commission published a green paper on greenhouse gas emissions trading within the EU (European Commission, 2000a) and a Communication on a new European climate change programme (ECCP) (European Commission, 2000b). Early in 2001 the ECCP is expected to result in a list of potential EU policies and measures developed with the involvement of stakeholders.

Community greenhouse gas emission projections, with existing measures, are described in Section 9.5. The recent Commission study using Community-wide models (European Commission, 2000e, 2000f, 2000g, 2000h) suggests that the Kyoto Protocol target seems achievable, with emission decreases of 3 % for carbon dioxide, 30 % for methane and 17 % for nitrous oxide, if a range of 'additional cost-effective policies and measures' are adopted and implemented at Member State and Community level. However, an in-depth policy discussion of such additional measures is needed, for example, at Community level within the ECCP.

Possible new policies and measures, additional to those already agreed, are summarised in Table 2. Some of these are already being planned or implemented by various Member States.

Table 9.2. **Possible future EU policies and measures to reduce greenhouse gas emissions**

Greenhouse gas	Sector	Policies and measures	Linked with indicator
Carbon dioxide	Transport	Passenger cars: implement negotiated agreements with manufacturers in Japan and Korea, and companies not members of the European Automobile Manufacturers Association	Fig. 5.1
		Freight transport by road: intermodal freight transport, fair and efficient pricing, internalisation of external costs	Fig. 5.5, 5.6, 5.11
		Aircraft: taxation of fuel, operational measures	
	Industry	Improved energy efficiency in industry through environmental agreements	
		Emissions trading	
		More use of combined heat and power generation	
	Energy	Reduce/remove fossil fuel subsidies	
		More fuel switching	Fig. 6.5.
		Greater energy efficiency	Fig. 6.1, 6.4
		More use of combined heat and power generation	Fig. 6.8
		Greater share of non-fossil sources in primary energy consumption (target 12 % contribution from renewables in 2010)	Fig. 6.5, 6.7
	Household	Extend energy-efficiency standards to other equipment	Fig. 3.4
	Agriculture	Improve manure management and feed conversion efficiency	Fig. 7.1, 7.5, 7.7
Methane	Waste	Recover energy from landfill gas. Reduce amounts of biodegradable waste going to landfill (already a requirement of the Landfill Directive)	Fig. 14.3
	Energy	Reduce natural gas leakage	
	Agriculture	Reduce fertiliser application and improve manure management	Fig. 7.7
Nitrous oxide	Industry	Install Best Available Technology for adipic acid and nitric acid production	
	Transport	Reduce emissions from passenger car catalysts	
Fluorocarbons	Industry	Reduce HFC emissions as a by-product of HCFC-22 production	
		Specific measures to reduce other fluorocarbon emissions	

9.10. References and further reading

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European Commission (2000e). *Economic evaluation of sectoral emission reduction objectives for climate change, Economic evaluation of emissions reductions in the transport sector of the EU*. Contribution by AEA and NTUA to a study for DG Environment, December 2000.

European Commission (2000f). *Economic evaluation of sectoral emission reduction objectives for climate change, Economic evaluation of emissions reductions of nitrous oxide and methane in agriculture in the EU*. Contribution by AEA to a study for DG Environment, November 2000.

European Commission (2000g). *Economic evaluation of sectoral emission reduction objectives for climate change, Economic evaluation of emissions reductions of methane in the waste sector in the EU*. Contribution by AEA to a study for DG Environment, November 2000.

Local response to climate change in Spain

How can a city help to achieve the ambitious EU target for energy from renewable sources? The Catalan city of Barcelona is facing this challenge through a new Ordinance, introduced in August 2000, that requires most new buildings to make use of solar power for the heating of water. The Ordinance applies to medium- and large-sized buildings of all types.

Barcelona also plans to install thermal solar panels on all the buildings owned by the city by 2004, targeting the schools first, for educational reasons. The city hopes that by 2004 about one third of all hot water will be heated by solar power. Partial grants for the necessary investment are provided from city, regional and EU funds.

This initiative demonstrates that local authorities can make a significant contribution by finding practical answers to global environmental threats.

Source: ENDS Daily 3/8-2000

European Commission (2000h). *Economic evaluation of sectoral emission reduction objectives for climate change, Economic evaluation of emissions reductions of HFCs, PFCs and sulphur hexafluoride in Europe*. Contribution by Ecofys to a study for DG Environment, April 2000.

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IPCC (2001b). *Climate Change, Third Assessment Report, Contribution by working group 2, Climate Change 2001: Impacts, Adaptation and Vulnerability, Summary for Policymakers*. WMO/UNEP/IPCC, February 2001.

10. Air pollution

policy issue	indicator	assessment
will policy targets be reached?	emissions of ozone precursors	😐
are we protecting the population effectively against exposure to ground level ozone?	limit value exceedance days for ozone	😐
are emissions decreasing?	emissions of particulates	😐
are we protecting the population effectively against exposure to fine particles?	limit value exceedance days for particulate matter	☹
will policy targets be reached?	emissions of acidifying substances	☺
are we protecting the environment effectively against acidification and eutrophication?	area with exceedance of critital loads	😐

Most of the reductions in emissions of atmospheric pollutants that have been achieved over the past two decades have resulted from economic change, from measures directed at large sources in the industry and energy sectors, and measures to limit emissions from road transport. There has been less success in reducing emissions from other sources such as agriculture. The area where the critical loads for acidification are being exceeded has fallen significantly. However, substantial parts of the population in EEA member countries are still exposed to high concentrations of ground level ozone and fine particles. Reaching the emission reduction targets for 2010 will require substantial further reductions and additional policies and measures in most Member States.

The air we breathe should be clean. From a human health perspective, the main outstanding air pollution problems are tropospheric ozone and particulate matter. Acidification and ozone remain the main threats to ecosystems.

	Acidification		Trop. ozone		Urban air quality	
Agriculture	●●→	30%	●↘	5%		
Fisheries						
Energy	●●↘	30%	●↘	10%	●●↘	
Transport	●●●↘	25%	●●●↘	55%	●●●↘	80%
Industry	●↘		●●↘			
Tertiary sector	●↘					
Households	●↘					
Tourism	●↘					
Military	●↘					

A relatively small number of pollutants (SO_x, NO_x, NH_x, NMVOC) and fine particulates are the main causes of these problems, and a significant development during the past few years has been a shift to a multi-pollutant, multi-effect air pollution abatement strategy, which recognises that reducing a limited number of pollutants can have a positive effect on various air pollution problems. This approach has led to international legal instruments that impose nationally-differentiated targets for emission reductions of four main pollutants. As a substantial part of the emissions result from the burning of fossil fuels, an effective measure is to reduce the use of fossil energy sources. The measures that will be required to reach the Kyoto Protocol targets for greenhouse gas emissions (Chapter 9) will therefore also result in reductions in air pollution.

There has been little change in the situation regarding the depletion of the stratospheric ozone layer since Environmental Signals 2000; emissions of ozone-depleting substances are therefore not discussed in this report.

10.1. Policy developments

The Air Quality Framework Directive (96/62/EC) established the basic principles of a common strategy: it set objectives for ambient air quality that should avoid, prevent or reduce harmful effects on human health and the environment. Following this Directive, a number of limit values are being set for the atmospheric concentrations of the main pollutants (Table 10.1).

The Framework Directive requires that if limit values are being exceeded, Member States must devise abatement programmes to prevent the exceedances by a set date. The first 'daughter' Directive (1999/30/EC), which entered into force in July 1999, set limit values for sulphur dioxide, nitrogen oxides, particulates (PM10) and lead in ambient air. The limit values are to be met in 2005 and 2010, but Member States must prepare attainment programmes well in advance of those dates for the areas where this is likely to be most difficult. This Directive will be reviewed and, if necessary, amended in 2003–2004.

Council and Parliament reached agreement on a second daughter Directive (2000/69/EC) in October 2000, setting limit values for carbon monoxide and benzene.

A third daughter Directive on ozone was proposed in June 1999 together with a National Emission Ceilings Directive (NECD), with emission and air quality targets chosen in a consistent way. Council agreed a common position with some changes in October 2000.

Meeting the targets for atmospheric concentrations listed in Table 10.1 requires reductions in emissions. The first international instrument addressing emissions of pollutants transported across international boundaries was the UNECE Convention on Long Range Transboundary Air Pollution (CLRTAP). A number of CLRTAP Protocols are in force in the EU and its Member States.

Limit and threshold values for ambient air quality Table 10.1.

Pollutant	averaging period	protects	value	target: no. of exceedances	to be met	reference
Sulphur dioxide	1h	health	350 μg/m³	< 25 times	01-01-2005	1999/30/EC
Sulphur dioxide	24h	health	125 μg/m³	< 4 times	01-01-2005	1999/30/EC
Sulphur dioxide	year/winter	ecosystems	20 μg/m³	none	19-07-2001	1999/30/EC
Nitrogen dioxide	1h	health	200 μg/m³	< 19 times	01-01-2010	1999/30/EC
Nitrogen dioxide	year	health	40 μg/m³	none	01-01-2010	1999/30/EC
Nitrogen oxides	year	ecosystems	30 μg/m³	none	19-07-2001	1999/30/EC
PM10[1]	24h	health	50 μg/m³	< 36 times	01-01-2005	1999/30/EC
PM10[1]	year	health	40 μg/m³	none	01-01-2005	1999/30/EC
Lead[2]	year	health	0.5 μg/m³	none	01-01-2005	1999/30/EC
Ozone	8h	health	120 μg/m³	< 26 days	2010	COM (2000) 613 final[3]
Ozone	May–July	ecosystems	AOT40<18 mg/m³.h[4]	none	2010	COM (2000) 613 final[3]
Benzene	year	health	5 μg/m³	none	01-01-2010	2000/69/EC
Carbon monoxide	8h	health	10 mg/m³	none	01-01-2005	2000/69/EC

Notes:
1: These limits should be reached by 2005; more stringent limit values later, dependent on review in 2003–2004.
2: Different limit value and attainment date around industrial installations.
3: Amended in agreed Common Position 10-10-2000.
4: AOT40 stands for accumulated exposure to ozone above 40 ppb (80 μg/m³).
Source: EEA

The Second Sulphur Protocol (1994) introduced an effect-based approach, setting national emission targets to reduce the exceedance of critical deposition levels (or 'critical loads' – the amount of deposition below which significant harmful effects are not expected to occur) for ecosystems. This resulted in national commitments for emission reductions that reflect the different sensitivities of the ecosystems affected.

The NECD covers the same pollutants as the CLRTAP (sulphur dioxide, nitrogen oxides and non-methane volatile organic compounds) and, for the first time, ammonia. The NECD uses a similar approach to the Second Sulphur Protocol, but extends it to include reductions in exceedances of WHO guidelines for ozone. Since the long-term objective of no exceedance is not attainable within the foreseeable future even if all known measures are implemented, the ceilings in the proposed Directive were designed to meet interim objectives in 2010 as a first step. In June 2000, The Council reached a Common Position on the proposed NECD. The Council agreed to both the interim and the long-term objectives of the proposal.

In parallel, the CLRTAP agreed in December 1999 on national emission ceilings for many European countries (including all EU Member States) and signed a new multi-pollutant Protocol in Gothenburg for the same four pollutants as the NECD.

Table 10.2 summarises the main current and proposed emission targets for the EU as a whole. There are substantial differences in emission ceilings, and hence emission reduction percentages, for different countries, because of the different sensitivities of the affected ecosystems. The proposed national emission ceilings for 2010 should be regarded as only interim as they will not provide full protection of ecosystems and human health everywhere in the EU. Assuming a baseline scenario, emissions of pollutants are projected to be reduced substantially by 2010, but some ecosystems in 2010 are likely still to be receiving deposition above critical loads, and limit values for ozone, particulates, nitrogen oxides and benzene will continue to be exceeded (European Commission, 2000).

Current EC legislation that should help reach the emission targets for acidifying substances and ozone precursors includes Directives on the reduction of emissions from large combustion plants and on vehicle emissions, the quality of petrol and diesel fuels, and the sulphur content of certain liquid fuels. A Directive on the storage and distribution of petrol and the Solvents Directive aims to limit emissions of volatile organic compounds.

Apart from the NECD, there is currently no EU legislation proposed or in force aimed at reducing emissions of ammonia or PM10. The NECD does not address particle emissions, only emissions of some particle precursors.

Table 10.2. **Emission reduction targets for the EU**

Policy/Pollutant	Base year	Target year	Reduction (%)
UNECE-CLRTAP Sulphur dioxide[1]	1980	2000	62
Sulphur dioxide[3]	1990	2010	75
Nitrogen oxides[3]	1990	2010	50
Non-methane VOCs[2]	1987	1999	30
Non-methane VOCs[3]	1990	2010	59
Ammonia	1990	2010	17
NECD[4] Sulphur dioxide	1990	2010	77
Nitrogen oxides	1990	2010	51
Non-methane VOCs	1990	2010	60
Ammonia	1990	2010	18

Notes:

[1] Target from the 1994 Second Sulphur Protocol. The different emission ceilings for each Member State correspond to a 62 % emission reduction for the EU.

[2] Targets from NMVOCs Protocol. These are the same for individual Member States and for the EU.

[3] Targets from the multi-pollutant Protocol (1 December 1999). The emission reduction target for the EU (corresponding with different emission ceilings for each Member State) is shown.

[4] Targets from the Common Position reached in June 2000 on the 1999 NECD. The emission reduction target for the EU (corresponding with different emission ceilings for each Member State) is shown, based on the most recently available 1990 estimates (which may differ from earlier estimates).

Source: EEA

10.2. Ozone

The presence of non-methane volatile organic compounds, nitrogen oxides, carbon monoxide and methane in the atmosphere contributes to the formation of ground level (tropospheric) ozone. These 'ozone precursors' can be aggregated on the basis of their tropospheric ozone-forming potential to assess the relative impact of the different pollutants.

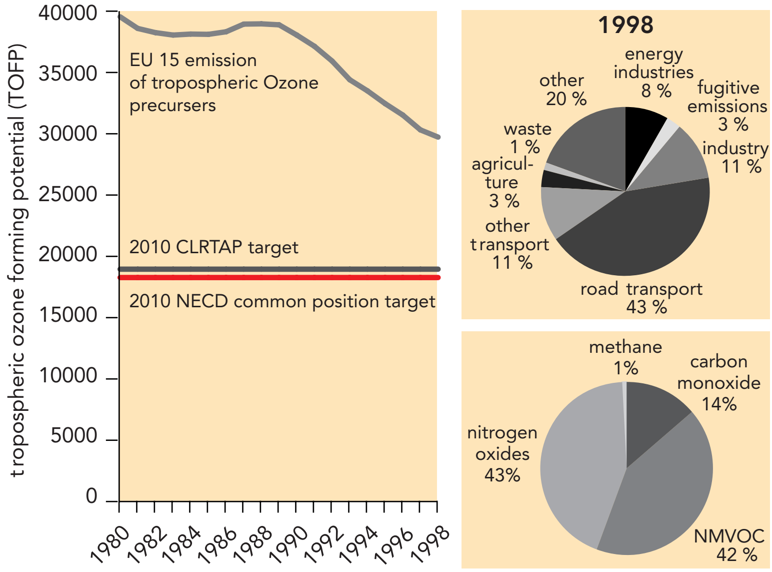
Exposure to periods of a few days of high ozone concentration can have adverse health effects, in particular inflammatory responses and reduction in lung function. Exposure to moderate ozone concentration for longer periods may lead to a reduction in lung function in young children. Tropospheric ozone can also affect ecosystems, mainly through damaging leaves and other parts of plants.

Emissions

Total emissions of ozone precursors in most countries are falling. In the EU as a whole they fell by 22 % between 1990 and 1998. Road transport and industry have contributed most to this reduction through increased penetration of diesel and catalytic converters for road vehicles and implementation of the Solvents Directive in industry. The largest percentage reductions occurred in Germany, Luxembourg and the United Kingdom. Emissions in Portugal and Greece have increased.

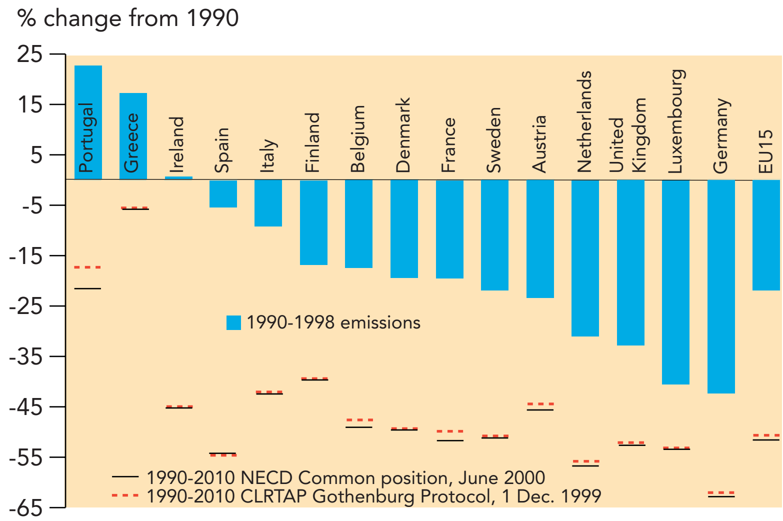
The fifth environmental action programme set emission targets for NOx (30 % reduction in 2000 from 1990) and NMVOC (30 % reduction in 1999 from 1990). These targets have not been reached. Substantial further emission reductions are required to achieve the Gothenburg Protocol and National Emission Ceilings Directive (NECD) targets for 2010: a reduction of EU total emissions of nitrogen oxides and volatile organic compounds by about 51 % and 60 % respectively, from 1990 levels.

Emissions of ozone precursors, EU15 Figure 10.1.



Notes: The targets for 2010 are the Gothenburg Protocol target (December 1999) and the more recent National Emission Ceilings Directive (NECD) Common Position targets (June 2000) for non-methane volatile organic compounds and nitrogen oxides. Carbon monoxide has been included in the 2010 target lines assuming emissions remain constant from 1998. Weighting factors are used to derive tropospheric ozone-forming potentials (TOFP) so that emissions can be combined in terms of their contribution to tropospheric ozone: nitrogen oxides 1.22, non-methane volatile organic compounds 1.0, carbon monoxide 0.11 and methane 0.014.
Source : EEA and UNECE/EMEP

Change in national emissions of ozone precursors since 1990 compared with 2010 targets Figure 10.2.



Notes: The targets for 2010 are the Gothenburg Protocol target (December 1999) and the more recent NECD Common Position targets (June 2000) for the EU and individual countries for non-methane volatile organic compounds and nitrogen oxides individually. Carbon monoxide has been included in the 2010 target lines assuming emissions remain constant from 1998. The emission data for Spain exclude emissions from Spanish overseas territories.
Source: EEA and UNECE/EMEP

Emissions of ozone-forming gases (ozone precursors) have fallen by 22 % since 1990, mainly due to introduction of catalysts on new cars. However, emission targets for VOCs and NOx set in the fifth environmental action programme have not been reached, and substantial reductions of non-methane volatile organic compounds and nitrogen oxides are still required to achieve 2010 targets.

Exposures
The indicator presented in this section is the number of days a year on which the current limit level for ozone (110 μg/m^3 for an eight-hour mean concentration) set by the EC for the protection of human health in Council Directive 92/72/EEC is exceeded. Exceedance days are averaged for all ozone stations in a city and then a population-weighted average is calculated for all cities with reported ozone data. Indicators values before 1994 cover few cities and consequently have limited representativeness. Data after 1993 cover an urban population of 50 million–75 million. The indicator is subject to year-to-year fluctuations because of changes in the monitoring stations that report data, and also because it represents conditions with relatively high ozone concentrations; these depend on special meteorological situations, the occurrence of which varies from year to year.

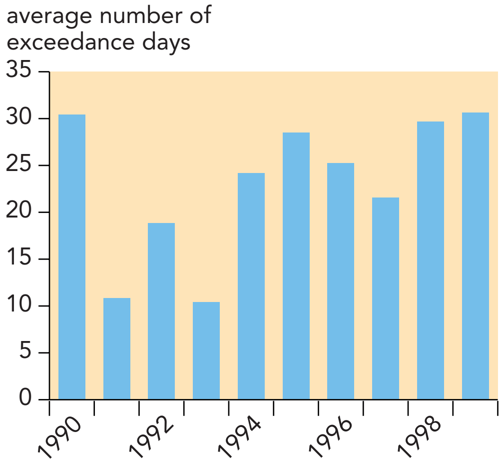
Although reductions in emissions of ozone precursors appear to have led to lower peak concentrations of ozone in the troposphere, the current limit level is frequently exceeded for large fractions of the population of the EU. Estimates for 1999 suggest that 42 % of the population was exposed to concentrations above the limit level on between one and 25 days, and 12 % on more than 50 days. There were more than 10 exceedance days in all EU countries except the northern European countries and Portugal.

The proposed Ozone Directive sets a new target, that a limit value of 120 μg/m^3 (as a rolling eight-hour average) should not be exceeded on more than 25 days per year. This is consistent with the target for emissions of ozone precursors set in the proposed National Emission Ceilings Directive (NECD). Due to the differences in the definitions of the limit values, the information collected under the current Ozone Directive cannot be used to assess exceedances of the proposed new limit value. However, exceedances of that value are probably occurring in a number of Member States.

The reductions in ozone precursor emissions that should result from enforcement of the NECD and the CLRTAP Protocols are unlikely to reduce ozone concentrations to below the current and proposed limit values over the whole of the EEA. In north-west Europe about 25 exceedance days of the 120 μg/m^3 limit are still expected in 2010.

Figure 10.3. **Exceedance of the EU human health threshold value for ozone in EEA18 urban areas**

Notes: Exceedance days are days with an eight-hour average ozone concentration of more than 110 μg/m^3 (the threshold value for protection of human health).
Source: EEA



Ozone levels in Europe are exceeding the threshold set for protection of human health. Year-to-year fluctuations and changes in monitoring networks preclude firm conclusions on trends in population exposure; analysis of monitoring data suggests that peak ozone concentrations are decreasing, but median values are tending to increase.

10.3. Particulates

Breathing in fine particulate matter can have adverse effects on human health. The impact is associated with PM10 (particulate matter with a diameter less than 10 µm) or even smaller particles. Inhalation of such particles can increase the frequency and severity of respiratory symptoms and the risk of premature death. Fine particles may also play a role in global climate change, having a regional cooling effect.

Emissions

PM10 in the atmosphere can result from direct emissions (primary PM10) or emissions of particulate precursors (nitrogen oxides, sulphur dioxide and ammonia) which are partly transformed into particles by chemical reactions in the atmosphere (secondary PM10).

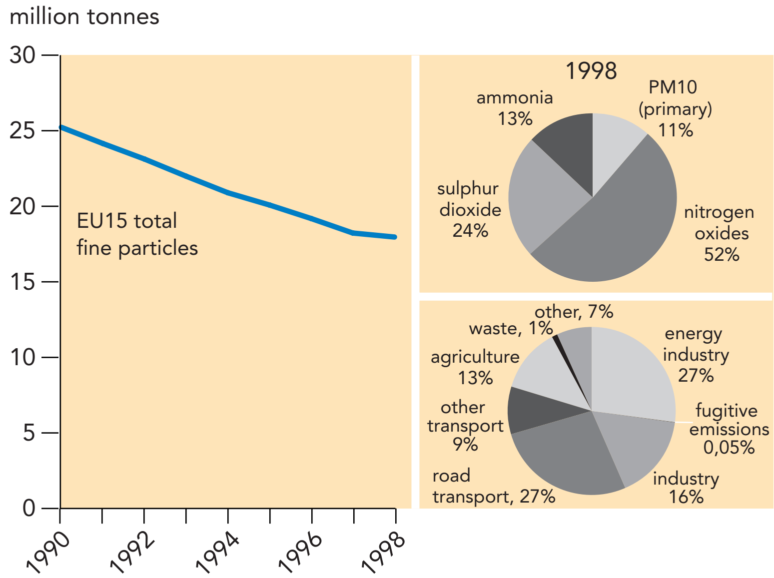
Emissions of primary and secondary PM10 in the EU fell by 29 % between 1990 and 1998. Energy industries, road transport and industry contributed most to this reduction through fuel switching and abatement in the energy industries and increased penetration of catalytic converters for road vehicles. The data are uncertain since the emission data for primary PM10 is not as robust as that for other pollutants, and the estimates of secondary PM10 precursor emissions include sulphur dioxide, nitrogen oxides and ammonia only, as well as being based on rather simplified assumptions about their behaviour in the atmosphere. Organic compounds may form an important fraction in the secondary PM10, but reliable information on this contribution is not available.

Figure 10.4 shows the contributions of each sector to primary particulate emissions, and the contributions of each precursor gas to secondary particulates.

Emissions of primary PM10 and secondary PM10 precursors are expected to continue to fall as improved vehicle engine technologies are adopted and emissions from stationary fuel combustion are controlled through abatement or the use of low-sulphur fuels such as natural gas. However, according to latest information, sources other than these – such as wood burning and organics emissions – may be dominant for PM10 as well as difficult to control. Calculations under the Auto-Oil II programme suggest that emission reductions will be insufficient to bring PM10 concentrations below the limit value even by 2010.

Currently there are no emission ceilings or reduction targets for PM10 in the EU or the CLRTAP frameworks (except for secondary emissions through CLRTAP and the National Emission Ceilings Directive).

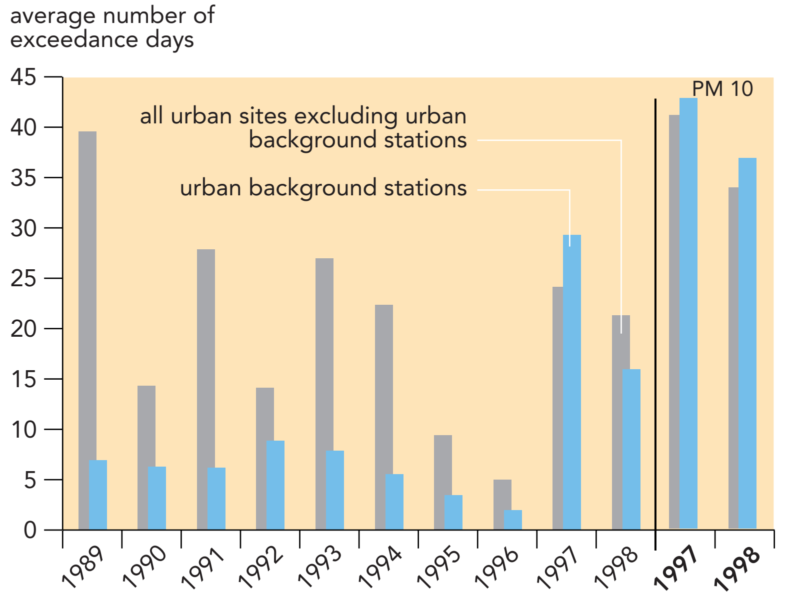
Emissions of primary and secondary fine particulates (PM10), EU15 Figure 10.4.



Notes: Primary and secondary fine particulates are aggregated in this indicator, by using aerosol formation factors for secondary particles as follows: SO_2 0.54; NO_x 0.88 and NH_3 0.64 (see ETC/AQ, 2000). No targets exist for emissions of primary particulates.
Source: EEA

No targets have been set for emissions of fine particles. Reduction in emissions of the particle precursors sulphur dioxide, nitrogen oxides and of primary PM10 from energy industries and road transport have contributed significantly to a 29 % reduction of total PM10 emissions between 1990 and 1998.

Figure 10.5. **Exposure to fine particles above EC threshold values**



Notes: Exceedance days are defined as days with black smoke (BS) 24-hour average concentrations above 125 µg/m³; Total Suspended Particles (TSP) 24-hour average above 120 µg/m³; PM10 24-hour average above 50 µg/m. Number and set of cities and measuring methods vary from year to year, and this may cause much of the inter-annual variation. The increase after 1996 is mainly due to the introduction of PM10 data into the statistics. Only for the most recent years monitoring data on fine particulates (PM10) are available to a significant extent, which are shown separately at the right-hand side of the diagram.
Source: EEA

☹ A large fraction of the urban population is exposed to levels of fine particulate matter in excess of threshold values set for the protection of human health.

Tough measures to fight bad air quality in France
Few cities in Europe are doing enough to ensure lasting improvements in air quality. The key driving force is ever-increasing car traffic. Although there has been some progress due to technical improvements (catalysts), reducing the overall level of car usage is a hard and lengthy process. In the meantime, people are regularly exposed to air pollution levels that are damaging their health.

In 1997 Paris was given extensive powers to act on days with bad air quality. One of the tools available was the power to restrict car usage on days with highly polluted air. The Paris authorities used this option for the first time in October 1997. Half of the cars in Paris were prohibited from driving. At the same time public transport was made free.

This short-term measure was a success – the number of cars in central Paris on that day fell by a remarkable 20 %, reducing the pressure on air quality.

Sources: http://www.airparif.asso.fr, http://www.paris-france.org

Exposures
The data on exposures are presented in terms of the limit values for suspended particles set in Council Directive 80/779/EEC, which are based on WHO recommendations. The averaging procedure is as for ozone. It is, however, difficult to derive any conclusions on trends, because ambient concentrations of suspended particles have been monitored over the years by widely different techniques, and monitoring of PM10 has only started recently. The apparent increase after 1996 is due mainly to the inclusion of recent PM10 monitoring data. However, the number of monitoring stations is still small and may not be representative. Measured PM10 concentrations may also be affected by weather conditions, so no conclusions should be drawn from the apparent slight decrease from 1997 to 1998. In spite of all these limitations the indicator may serve to underpin the conclusion formulated in the box above, and demonstrate the need to harmonise particle monitoring in Europe.

The recently adopted daughter Directive for sulphur dioxide, oxides of nitrogen, particulate matter and lead in ambient air (Council Directive 1999/30/EC) set a limit value for PM10 of 50 µg/m³ (24-hour average), not to be exceeded more than 35 times a calendar year. Note that if the average number of exceedance days as shown in this indicator is below 36, there may still be individual stations where the limit value is not met.

Despite the likely future reductions in emissions, concentrations of PM10 in most of the urban areas in the EEA are expected to remain well above the limit values in the near future.

10.4. Acidifying substances

Emissions of sulphur dioxide, nitrogen dioxide and ammonia into the atmosphere contribute to acidification and eutrophication which can cause damage to soil, aquatic and terrestrial ecosystems, and buildings and materials. These three pollutants can be aggregated on the basis of their acidifying potential, allowing the relative impact of emissions of each pollutant to be assessed.

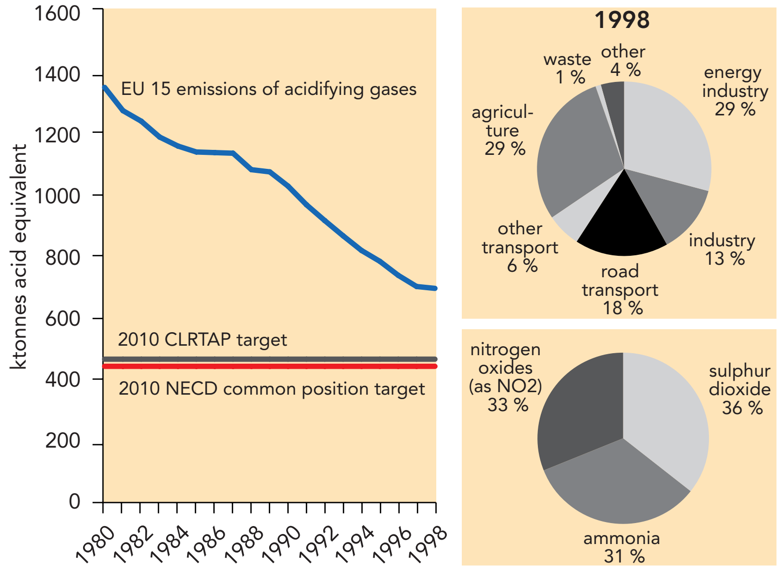
Emissions

Emissions of acidifying gases have fallen significantly in most Member States. In the EU as a whole, emissions fell by 32 % between 1990 and 1998 despite an increase in GDP.

These substantial reductions were mainly due to a 70 % reduction in sulphur dioxide emissions since 1980, primarily resulting from a switch in the energy, industry and domestic sectors from high sulphur solid and liquid fuels to natural gas; economic restructuring of the new *Länder* in Germany; and the introduction of flue-gas desulphurisation in some power plants. Reductions in emissions of nitrogen oxides resulting from abatement measures in road transport and large combustion plants have to some extent been off-set by increased road traffic. The fifth environmental action programme emission targets for NOx (30 % reduction in 2000 with respect to 1990) have not been achieved. Ammonia emissions are stabilising, although emissions from agriculture – the major source – are uncertain and difficult to control.

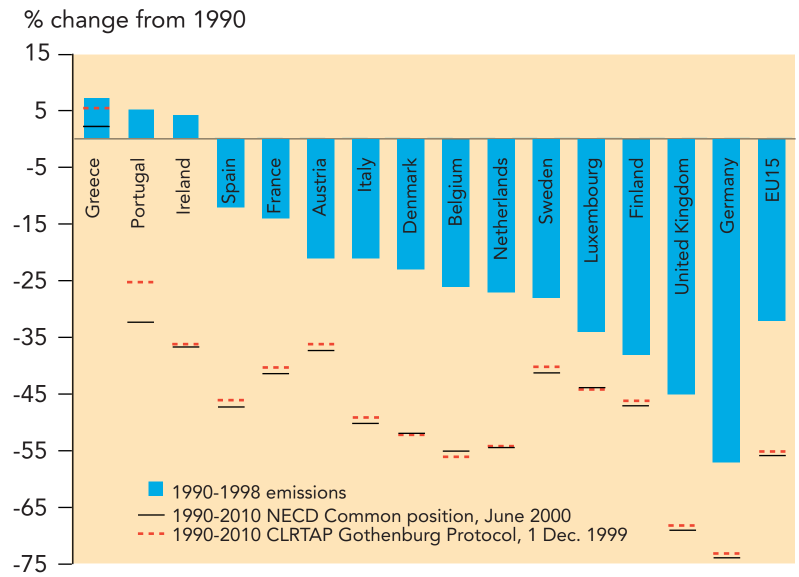
Substantial further reductions of emissions of acidifying substances are needed to achieve the Gothenburg Protocol and National Emission Ceilings Directive targets.

Emissions of acidifying gases, EU15 Figure 10.6.



Notes: The targets for 2010 are the Gothenburg Protocol target (December 1999) and the more recent National Emission Ceilings Directive (NECD) Common Position targets (June 2000) for sulphur dioxide, nitrogen oxide and ammonia. Weighting factors are used to derive acid equivalents so that emissions can be combined in terms of their acidifying effect: sulphur dioxide * $^1/_{32}$, nitrogen oxide * $^1/_{46}$ and ammonia * $^1/_{17}$.
Source: EEA and UNECE/EMEP

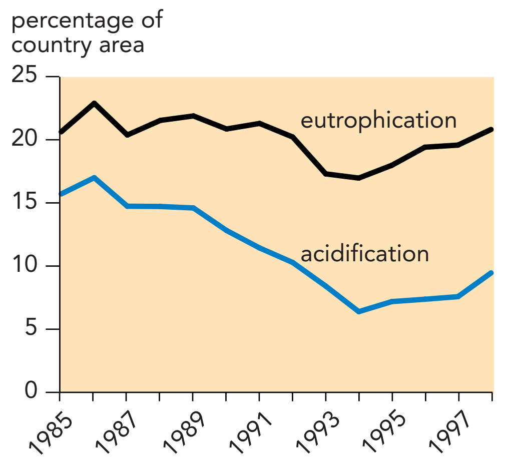
Change in total acidifying substance emissions since 1990 compared with the 2010 targets, EU15 Figure 10.7.



Notes: The targets for 2010 are the Gothenburg Protocol target (December 1999) and the more recent NECD Common Position targets (June 2000) for the EU and countries for sulphur dioxide, nitrogen dioxide and ammonia. Weighting factors are used to derive acid equivalent so that emissions of sulphur dioxide, nitrogen dioxide and NH_3 can be combined in terms of their acidifying effect: sulphur dioxide * $^1/_{32}$, nitrogen dioxide * $^1/_{46}$ and ammonia * $^1/_{17}$. The emission data for Spain exclude emissions from Spanish overseas territories.
Source: EEA and UNECE/EMEP

☺ The 32 % reduction in EU15 emissions of acidifying gases between 1990 and 1998 is due mainly to a reduction in sulphur dioxide emissions resulting from a switch from coal and heavy fuel oil to natural gas, and abatement measures – such as flue-gas desulphurisation – in power plants.

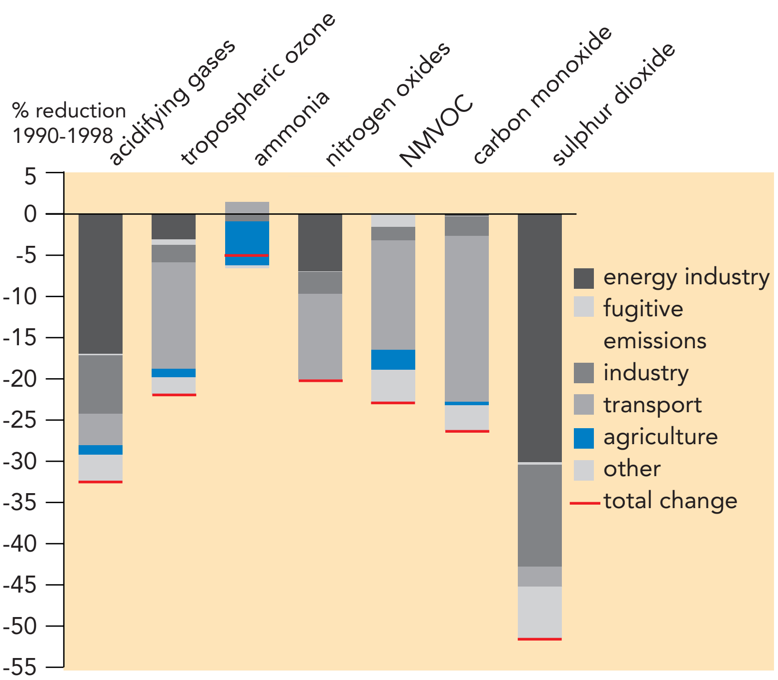
Figure 10.8. **Ecosystem damage area by air pollution, EEA18**



Note: Area with the exceedance of fifth percentile critical loads. Due to a change in the methodology – taking the joint effect of sulphur and nitrogen deposition into account – the share of country area is smaller than presented in Environmental signals 2000.
Source: EMEP

Increases in the percentage of ecosystems exposed to nitrogen deposition in excess of critical loads since 1990 in several countries have reversed the decreasing trend in the area exposed to acidification and increased the area exposed to eutrophication.

Figure 10.9. **Contributions of societal sectors to the reduction of air pollutant emissions**



Source: EEA

Areas exposed to acidification and eutrophication
Deposition of sulphur and nitrogen compounds contributes to acidification of soils and surface waters, and can result in leaching of elements vital for plant nutrition and damage to vegetation and water fauna. Deposition of nitrogen compounds (from nitrogen oxide and ammonia emissions) can lead to eutrophication, resulting in disturbance of natural ecosystems and disappearance of plant species, excessive algal blooms in coastal waters and increased concentrations of nitrate in groundwater. The area of exceedance of critical loads provides an indication of the ecosystem area in which damage could occur.

The total EEA area of exceedance of critical loads for acidification has decreased considerably since 1985, mainly as a result of reductions in sulphur deposition. There has been much less reduction in nitrogen deposition and no reduction in the area of exceedance of critical loads, which has actually increased in several countries. In 40 % of the area in EEA countries the percentage of ecosystems exposed to damaging eutrophication effects has increased since 1990. The percentage of ecosystem area exposed to eutrophication in the Netherlands, the United Kingdom, France, Ireland, Italy, Portugal, Spain and Greece increased between 1990 and 1998 (EMEP, 2000).

10.5. Sectoral contributions to emission reduction

A summary of the achievements of the various sectors in reducing air pollutant emissions shows a clear effect of regulatory measures taken in the past 25 years. The largest reductions have been realised by the energy sector and by industry as a result of national laws, the Large Combustion Plants Directive from 1988 and the Solvents Directive (99/13/EC). The second largest achievement resulted from the introduction of three-way catalysts for cars following the 1991 Directive on measures to be taken against air polluting emissions from motor vehicles. More reductions by the transport sector are expected as a result of a number of Directives adopted in 1999. Further reductions from industry and the energy sector can be expected through improved implementation of existing policies and measures.

Ammonia emissions from the agricultural sector have been reduced because of the reduction in the number of cattle that resulted from the introduction of milk quotas. Better manure management in a few countries also contributed. However, the agriculture sector – the main source of ammonia emissions – is well behind other sectors in achieving emission reductions, given its nearly 30 % share in acidifying emissions (Figure 10.6) and taking into account the international targets to be reached.

10.6. References and further reading

EMEP (2000a). *Analysis of UNECE/EMEP emissions data*. EMEP MSC-W Note 1/00. Oslo.

EMEP (2000b). *Transboundary acidification, eutrophication and photo-oxidants in Europe*. EMEP report 1/00 and 2/00. Oslo.

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European Community (2000). *Council conclusions of June 2000, Common Position on the proposed Directive on national emission ceilings for certain atmospheric pollutants*. Council of the European Union.

11. River Water Quality

policy issue	indicator	assessment
are nutrient policies resulting in cleaner rivers?	nitrogen concentrations in rivers	☹
-"-	ammonium concentrations in rivers	☺
-"-	phosphorus concentrations in rivers	☺
-"-	biochemical oxygen demand	☺
is urban wastewater policy proving effective?	urban wastewater treatment	☺

There has been good progress in reducing discharges to European rivers of some pollutants, but concentrations of nutrients in many rivers remain well above background levels. Nitrate pollution, mainly from agriculture, remains unacceptably high, particularly in rivers whose catchments include large areas used by agriculture. Phosphorus pollution is continuing to decrease, mainly as a result of more and better wastewater treatment. Discharges of organic materials to rivers have fallen in many parts of Europe, also as a result of better wastewater treatment, and many rivers are now well oxygenated. The Water Framework Directive (2000/60/EC) aims to achieve good surface water status in all European water bodies by 2015.

There has been marked progress in reducing discharges from point sources such as urban wastewater treatment plants and industries. While some heavily polluting industries have built their own treatment installations, implementation of the Urban Wastewater Treatment Directive (91/271/EEC) has stimulated the building of municipal wastewater treatment plants – although this has been a rather slow process. However, there is still no effective control of discharges from diffuse sources, of which agriculture is the most important. Implementation of the Nitrate Directive (91/646/EEC) has been unsatisfactory in most EU Member States. Reduction of pollution by nitrates and phosphorus from agriculture requires less use of fertilisers, technical improvements on farms and in some areas a reduction in the numbers of farm animals (Chapter 7).

	River water quality	
Households	●●●↘	Waste water discharges
Fisheries		
Tourism	●	Waste water discharges
Transport		
Energy	●	Hydropower installations, and discharges of cooling water
Agriculture	●●●↘	Drainage of wetlands, straightening of rivers, channelisation, disharges of slurry, water withdrawal, pesticides and nutrients
Industry	●↘	Waste water disharges
Tertiary sector		
Military		

11.1. Nutrients in rivers

Nitrogen compounds in rivers can cause eutrophication and can also be directly harmful: nitrate affects drinking water quality, and ammonium consumes oxygen and is toxic to some aquatic fauna above certain levels, depending on water salinity, temperature and pH. The natural concentration of nitrate is variable but in most European rivers is less than 0.3 mg N/l. The corresponding value for ammonium is 0.015 mg N/l. Ammonium is generally a transient component in the nitrogen cycle and is rapidly converted to nitrate in clean and well oxygenated waters.

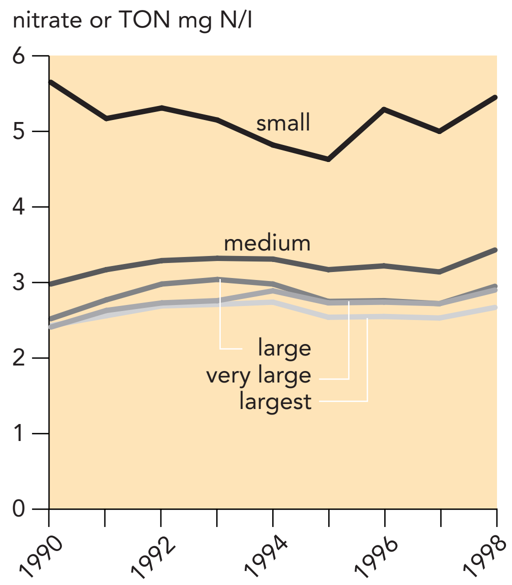
Phosphorus is the key nutrient for eutrophication in fresh waters. Natural concentrations vary from catchment to catchment, depending upon factors such as geology and soil type, and range from zero to 50 µg P/l. Waters containing concentrations above 500 µg P/l are considered to be of relatively bad quality.

Nitrogen and phosphorus are also key nutrients causing eutrophication in coastal and marine waters, and rivers are an important source of nitrogen for most European seas. The reduction of eutrophication in coastal and marine waters will thus require the reduction of riverine discharges of nitrogen and phosphorus.

11.2. Nitrogen in rivers

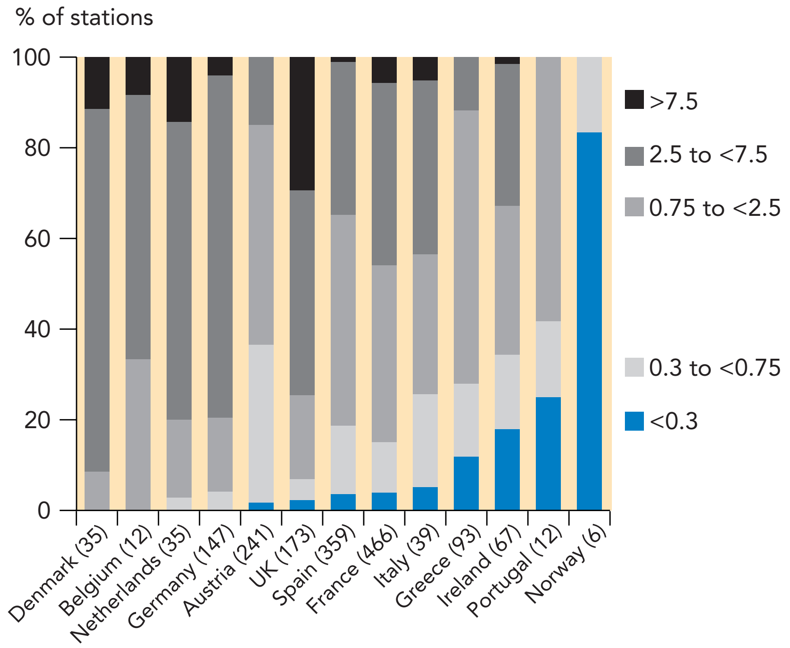
The concentration data for nitrate or total oxidised nitrogen show no change with time over the period 1990 to 1998. However, small rivers have higher concentrations than larger ones, perhaps reflecting the impact of agriculture. The concentration of nitrate in rivers is significantly influenced by year-to-year variability in run-off. Concentration data adjusted for this variability would improve the information on trends.

Nitrate or total oxidised nitrogen concentrations in different sized European rivers Figure 11.1.



Note: Median of measured annual average concentrations. Total oxidised nitrogen (TON) is the sum of nitrate and nitrite. Some countries monitor TON instead of nitrate. Nitrite levels are often much lower than nitrate, and therefore for the purposes of this assessment, nitrate and TON are considered to be approximately equivalent.
Source: EEA

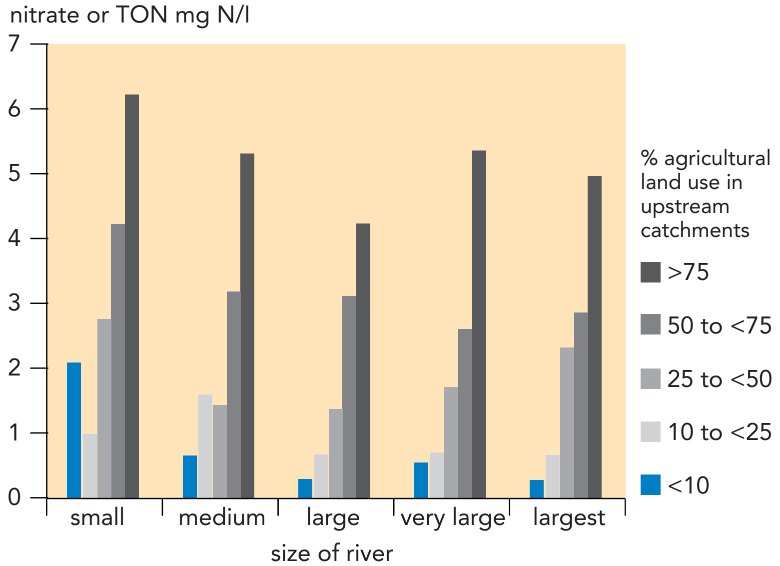
Distribution by country of nitrate or total oxidised nitrogen concentrations in European rivers Figure 11.2.



Note: See note on total oxidised nitrogen in Figure 11.1. Aggregated data across all sizes of river for the most recent year for which data are available. The number of stations per country is in brackets.
Source: EEA

☹ Nitrate concentrations have not changed. The high concentrations in smaller rivers reflect the impact of agriculture.

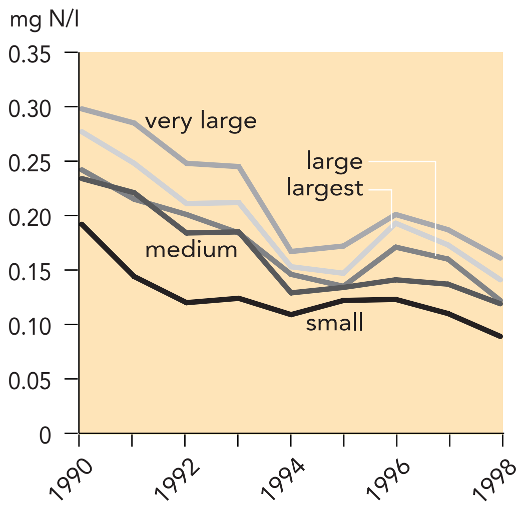
Figure 11.3. **Nitrate or total oxidised nitrogen concentrations in relation to agricultural land use**



Note: Median of measured annual average concentrations.
Source: EEA

Figure 11.4. **Total ammonium concentrations in different sized European rivers**

Note: Median of measured annual average concentrations.
Source: EEA



The concentrations of ammonium in EU rivers fell during the 1990s, reflecting the general improvement in wastewater treatment over this period. However, current concentrations are still well above 'background' or natural levels.

On the basis of the most recently available river size-aggregated data for the 1990s, Denmark has the highest levels of nitrate or total oxidised nitrogen monitored at its river stations. This country has only small rivers, and intensive agriculture. Norway probably has the lowest level. However, Norway only provided information on six stations, which may not give a fully representative picture of the situation. The same applies to Portugal and Belgium, who provided data on only 12 stations each.

There is also an increase in nitrate or total oxidised nitrogen concentrations with increasing total agricultural land use in the upstream catchments. In the five European countries with relevant data, the highest concentrations of nitrate or total oxidised nitrogen are found in small and medium-sized rivers. Median concentrations of nitrate in small rivers in the most agricultural catchments exceed the Directive on Surface Water for Drinking (75/440/EEC) guideline concentration for nitrate of 5.6 mg N/l.

11.3. Ammonium in rivers

Total ammonium concentrations fell between 1990 and 1998, with the highest concentrations tending to be in the larger rivers and the lowest in the smallest. This probably reflects the location of the main source of ammonium: discharges from sewage treatment works. The falling concentrations reflect the general improvement in wastewater treatment. In particular, secondary treatment will remove 75 % of ammonium while primary treatment removes none (Section 11.6). Generally the United Kingdom, Denmark, Finland and France have the lowest concentrations of total ammonium at the monitoring stations; and Austria and Belgium the highest.

11.4. Phosphorus in rivers

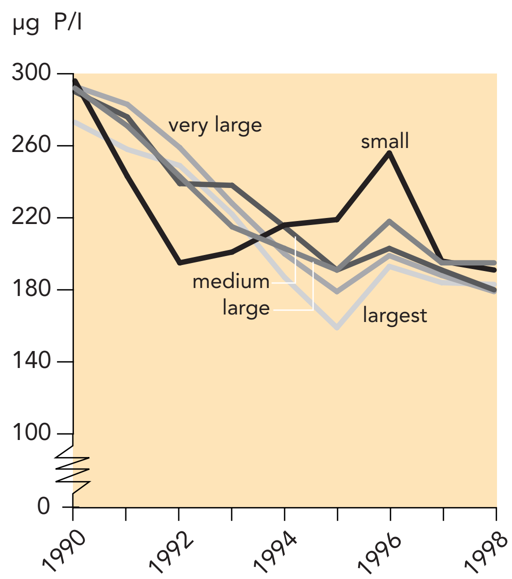
Phosphorus concentrations in rivers of all sizes generally fell during the 1990s.

A number of measures can be used to quantify phosphorus concentrations in water – the two main ones being orthophosphate and total phosphorus concentrations. Orthophosphate is readily incorporated into plant material and its concentration provides an approximate measure of bioavailable phosphorus. Total phosphorus provides a measure of all phosphorus components including those associated with sediments and suspended sediments. Sediments can remain a source of phosphorus even after other sources have been reduced. In terms of total phosphorus there is little difference between the different sized rivers over this period. However, there are clearer differences in terms of orthophosphate, with medium-sized rivers having slightly higher concentrations.

In terms of total phosphorus, the lowest concentrations are generally found in those countries with low population density and a high level of sewage treatment. Thus the river stations in Sweden and Finland have lower concentrations than those in some western countries such as Denmark, France and the United Kingdom.

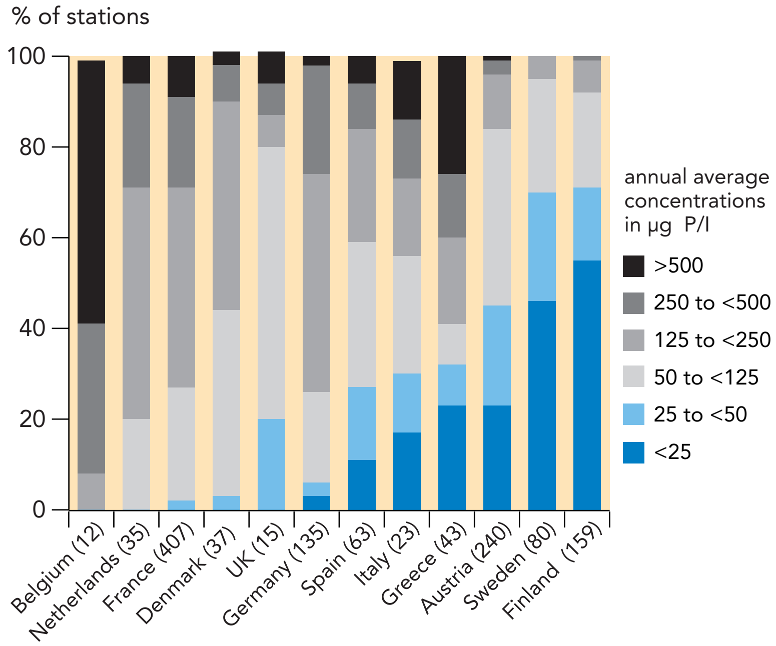
The relationship between catchment land use and measured concentrations reflects the relative importance in terms of sources of pollutants of different human activities in the catchments upstream of river stations. As for nitrogen, rivers that drain catchments with a high percentage of agricultural land use have higher phosphorus concentrations than rivers that drain catchments with little agriculture. Similarly, phosphorus concentrations are higher in rivers that drain catchments with greater urban land use. This reflects the importance of both sources of phosphorus.

Total phosphorus concentrations in different sized European rivers — Figure 11.5.



Note: Median of measured annual average concentrations.
Source: EEA

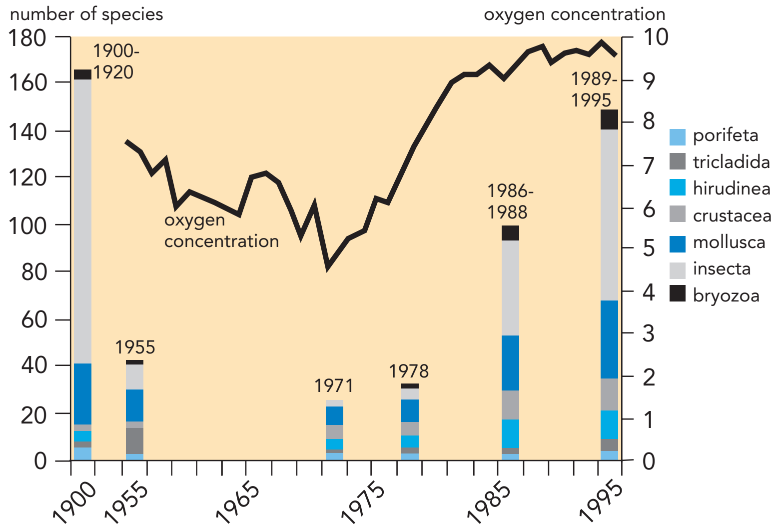
Distribution of total phosphorus concentrations in European rivers — Figure 11.6.



Note: Aggregated data across all sizes of river for the most recent year for which data are available. The number of stations per country is in brackets.
Source: EEA

☺ Concentrations of phosphorus have generally decreased. Country differences reflect the amounts of sewage discharge and effluent from wastewater treatment plants, and emissions from agriculture.

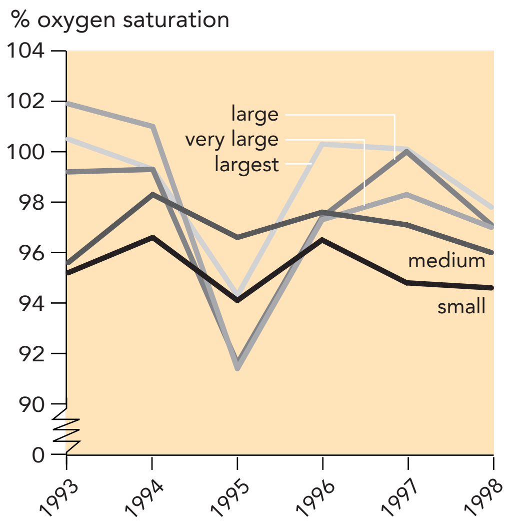
Figure 11.7. **Development of oxygen concentration and biota in the Rhine**



Source: German Federal Ministry of the Environment, 1998

Figure 11.8. **Dissolved oxygen in rivers**

Note: Annual average of dissolved oxygen. If there were no pollution, oxygen levels in rivers would fluctuate slightly around the saturation level at the ambient temperature, salinity and pressure. Because the solubility of oxygen in cold water is higher than in warm water, the natural saturation concentrations (in mg/l of oxygen) in the rivers of Europe will vary according to the water temperature. Oxygen concentrations expressed as percentage saturation levels take these temperature-related differences (and other chemical and physical properties of the water) into account. Thus 100 % saturation in warm southern rivers would equate to 100 % saturation in colder northern rivers although the actual equivalent oxygen concentrations in mg O_2/l would be different.
Source: EEA



☺ There has been little change in dissolved oxygen in rivers of all sizes over the past six years. However, the majority of rivers in most EEA countries had good oxygenation – over 70 % oxygen saturation – and a high proportion had over 95 % oxygen saturation.

11.5. Organic pollution

Organic matter derived from human activities is a major source of pollutant discharge to surface waters, especially rivers. Severe organic pollution may lead to rapid deoxygenation of water and the disappearance of fish and aquatic invertebrates. The most important sources are urban wastewater, industries such as paper and food processing, and silage effluent and slurry from agriculture.

Increased industrial and agricultural production, coupled with more of the population being connected to sewerage, has resulted in increases in discharges of organic waste into surface water in most European countries since the 1940s. Over the past 15 to 30 years, however, biological treatment of wastewater has increased, and organic discharges have consequently decreased in many parts of Europe. The result is that many rivers are now well oxygenated.

The river Rhine provides a good example of the improvements that have been achieved since the 1970s.

Annual oxygen levels

Low oxygen levels in water are caused mainly by organic pollution from the discharge of poorly treated or untreated wastewater. Such pollution leads to an increase in microbiological activity and hence depletion of oxygen levels. A high input of nutrients can cause an increase in plant growth. This leads to an increase in organic matter which creates an oxygen demand when it degrades, causing a further depletion of oxygen levels. Low oxygen results in a decrease in plant and animal species and a reduction in the quality of the water. This affects the uses of the water for human consumption and other purposes.

From an ecological perspective, the annual average oxygen level may not be the best descriptor of oxygen conditions in rivers. The aquatic fauna is particularly affected by episodes of low oxygen concentrations. Oxygen levels vary through the year and through the day; the lowest oxygen levels generally being observed just before sunrise in summer months. Normal sampling procedures have little chance of recording minimum oxygen levels.

The available information on annual average oxygen saturation levels in different sized rivers between 1993 and 1998 shows little evidence of change with time. Levels tend to be lowest in small rivers and highest in large rivers. The average saturation levels were generally over 90 % saturation – at these levels no significant effects on aquatic communities are expected. There was also a noticeable dip in levels in 1995, particularly in Austria. The reason for this is not known but it could be due to the particular climatic conditions in that year.

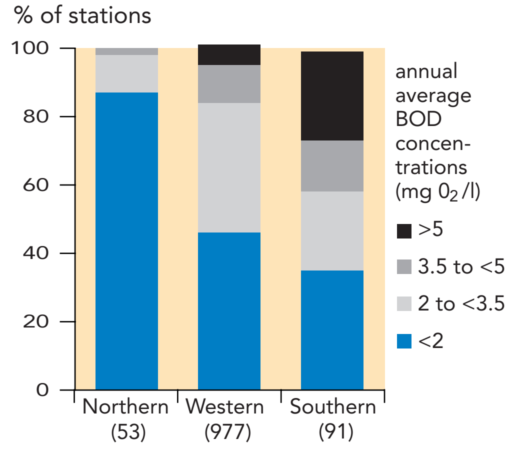
Biochemical Oxygen Demand

Biochemical oxygen demand is a measure of the oxygen demand arising from the microbiological breakdown of organic matter in water. Changes in dissolved oxygen concentrations are measured under controlled laboratory conditions (usually over five days but in northern European countries over seven days). In many European countries, biochemical oxygen demand is increasingly being replaced by total organic carbon measurement.

High biochemical oxygen demand may indicate a potential for reduced oxygen levels in water, which would affect the biodiversity of aquatic communities. It is one of the main parameters used in the Urban Wastewater Treatment Directive for controlling discharges. A biochemical oxygen demand level of less than 2 mg O_2/l is indicative of a relatively clean river, and more than 5 mg O_2/l of a relatively polluted river.

Biochemical oxygen demand levels generally fell during the early 1990s in all sizes of river. In more recent years, levels appear to have increased slightly again in all but the smallest rivers. Small rivers have the lowest levels and larger rivers the highest, probably reflecting the discharges from sewage treatment works and industry, the largest of which tend to be on the larger rivers. However, recent data indicate that many European countries had a majority of river stations with low concentrations of biochemical oxygen demand, with a large percentage of stations showing concentrations below 2 mg O_2/l. The levels of biochemical oxygen demand are generally lower in northern countries than in western or southern countries.

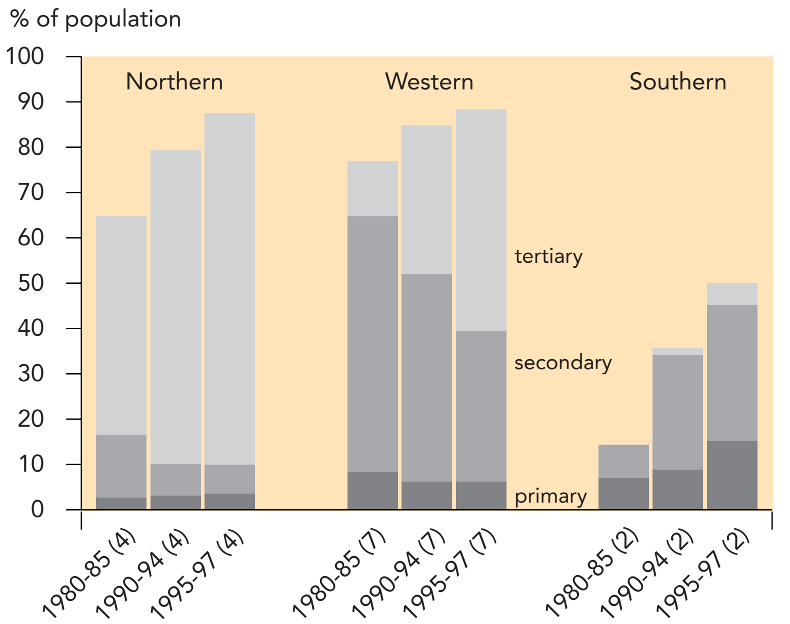
Distribution of biochemical oxygen demand concentrations in different parts of Europe — Figure 11.9.



Note: Northern: Finland (BOD7); Southern: Greece and Italy (BOD5); Western: Austria, Belgium, France, Ireland, Denmark, the Netherlands and the United Kingdom (BOD5). Data for the most recent available year aggregated across all sizes of rivers. The number of stations per region is in brackets.
Source: EEA

In many European countries the majority of river stations had low concentrations of biochemical oxygen demand. Southern and Western European countries still have some polluted rivers.

Urban wastewater treatment — Figure 11.10.



Notes: Only countries with data from all periods included. Number of countries in brackets. Northern: Iceland, Norway, Sweden, Finland; Western: Austria, Ireland, United Kingdom, Luxembourg, the Netherlands, Germany, Denmark; Southern: Greece, Spain. Primary wastewater treatment removes part of the suspended solids, but no ammonium; secondary (biological) treatment uses aerobic or anaerobic micro-organisms, retains 20 % to 30 % of the nutrients and removes around 75 % ammonium; tertiary treatment includes phosphorus retention and in some cases nitrogen removal.
Source: OECD/Eurostat

☺ The development of wastewater treatment has continued, with greater use of more advanced treatment methods.

From inflammable river to fish paradise in the United Kingdom

Ten years ago, signs along the Mersey River warned citizens not to throw lighted cigarettes into the river, as there was a danger of igniting vapours from the polluted water. The few fish remaining in the river attracted public health warnings due to cadmium and mercury contamination.

Nowadays, anglers are scrambling to buy fishing rights in the same river. Seals have been seen in the estuary, and even octopuses have been observed. In 1985, the Mersey Basin Campaign started, aiming to improve the water quality so that all rivers, streams and canals in the area would be able to support fish by the year 2010.

So far, more than 170 projects have been launched, with cooperation between five county authorities, NGOs, businesses and farmers. Schemes have ranged from improving wastewater treatment and reducing the number of sewer outfall pipes, to NGOs participating in establishing litter clean-up, tree and wildflower planting and footpath maintenance.

A special award scheme has been launched for companies that contribute to a cleaner river by changing their work practices. Another project aims to help farmers in the catchment area turn to less polluting practices. In 1999, the project developed the first fully-accredited Environmental Management System at a farm in Cheshire.

Source: http://www.merseybasin.org.uk/

11.6. Urban wastewater treatment

The percentage of the population connected to tertiary treatment has increased since 1980 in all European regions. In Austria and Spain, the proportion of the population connected to sewers and wastewater treatment has more than doubled over the last 17 years. In Spain, however, only around 50 % of the population was having their wastewater treated by 1995.

In the 1980s many western European countries, such as the Netherlands and Austria, had secondary treatment of most wastewater, and countries like Finland and Sweden had mostly tertiary treatment. In the late 1980s and 1990s, many western countries constructed treatment plants with nutrient removal. In Germany the majority of wastewater treatment plants with phosphorus elimination (tertiary treatment) are also run with nitrification/denitrification.

Among southern European countries, tertiary treatment in Greece increased from zero to 10 % of the population in the last seven years.

The Urban Wastewater Treatment Directive requires Member States to provide collecting systems for all agglomerations of more than 2 000 people (or their equivalent in terms of organic matter loads), and secondary treatment for all such agglomerations discharging into fresh waters and estuaries and for all agglomerations of more than 10 000 discharging into coastal waters. More advanced treatment with nutrient removal is required in sensitive areas. As the indicator covers all wastewater treatment it cannot be used to assess compliance with the Urban Wastewater Treatment Directive.

The increase in the capacity of treatment plants as a result of the Directive is expected to be significant for all Member States except Sweden, Finland and the Netherlands, where treatment plants already have a very high capacity. The greatest planned increase is in Southern countries such as Spain, Portugal and Greece; a large increase is also planned in Ireland.

In general, the capacities of collecting systems should increase by 22 % over the 13 years of implementation of the Urban Wastewater Treatment Directive and the capacity of treatment works should increase by 69 %. By 2005, the capacity of collecting systems and treatment works should be able to cope with all the organic discharges in most Member States (CEC, 1998).

As a result of these efforts, discharges to rivers of nutrients and organic matter from point sources are expected to decrease further over the next four years. This will be particularly so in terms of phosphorus and organic matter. Levels of phosphorus and biochemical oxygen demand in rivers are therefore expected to continue to fall, particularly in southern countries.

The Nitrate Directive is intended to control and reduce the emissions and impacts arising from agriculture. However, the European Commission has highlighted that not all Member States have correctly implemented the measures required to control the impacts of nitrate on river quality. Levels of nitrate in rivers showed no signs of decreasing during the 1990s. This will remain the case until appropriate measures required by the Nitrate Directive are fully implemented.

11.7. References and further reading

CEC, 1998. *Report on Council Directive 91/271/EEC of 27 Feb 1998*. Commission of the European Communities.

12. Hazardous substances in marine waters

policy issue	indicator	assessment
will the ospar target of ceasing emissions be reached?	inputs of hazardous substances	☺
have the emission reductions led to improvements for marine biota?	concentrations of hazardous substances in blue mussels	☺

Inputs of six important hazardous substances – heavy metals and organics – into the north-east Atlantic fell significantly between 1990 and 1998, after increasing for several decades. Inputs are either direct into the sea or indirect from discharges into rivers or emissions into the air. The reductions demonstrate the success of measures resulting from initiatives at the global, European and national level. There are some indications that concentrations of some of these substances in blue mussels – chosen as representative of marine organisms that may be affected by such substances – are beginning to fall, but in many cases concentrations remain above levels that pose an ecological risk for the species concerned. Such ecological risk, however, does not imply that the consumption of such species poses any risk to human health.

The two indicators refer to hazardous substances for which reduction measures have been in place for several years. The 10 000 other chemicals in the marine environment may include several hazardous substances for which no or insufficient reduction measures have been taken, but there is no regular monitoring of these substances. The positive assessment does not take into account this lack of information on other chemicals.

Vast amounts of waste and pollution from different sources end up in the seas: from direct dumping, discharges and spills, from rivers, and deposited from the atmosphere. Most of this material is diluted and dispersed in the deep oceans, but contamination of sediments and biota is common in most European marine waters. Elevated concentrations (above background levels) of hazardous substances such as heavy metals and some organic compounds have been found in marine organisms and sediments, particularly near some river outflows and in seas with little connection to the open ocean, and near some point sources of pollution.

Measures to reduce the input of hazardous substances into marine waters are being taken as a result of various initiatives at global, European, regional and national levels. International instruments like the marine conventions (OSPAR, HELCOM and the Mediterranean Action Plan) provide a binding legal framework. In the OSPAR and HELCOM areas, for example, the target is a reduction in the emissions, discharges and losses (emissions from diffuse sources) of several hazardous substances towards zero emissions in 2020. In the long run, this is the only way of ensuring that marine ecosystems will be preserved.

	Trend in pressure	Pressure on marine water quality
Households	● →	Discharge of hazardous substances, use of chemicals
Mariculture	● ↗	Discharge of hazardous substances, use of antibiotics
Transport	● ↗	Oil spills from ships, leaching of TBT from ship antifouling, emissions to air from ships and cars
Energy	● →	Oil spills from off-shore installations, use of chemicals at off-shore installations
Agriculture	●● ↘	Pesticides, fertilisers
Industry	●● ↘	Main producer and user of chemicals. Reduced discharge of heavy metals
Military	● →	Dumped munition

12.1. Inputs of hazardous substances into the north-east Atlantic

After increasing for several decades, direct and riverine inputs of cadmium, mercury, lead, zinc, lindane and PCB7 into the north-east Atlantic fell significantly between 1990 and 1998. These six are representative of two important groups of hazardous substances: heavy metals and organics. Mercury and PCB7 receive particular attention and priority in international reduction measures because of their high eco-toxicity.

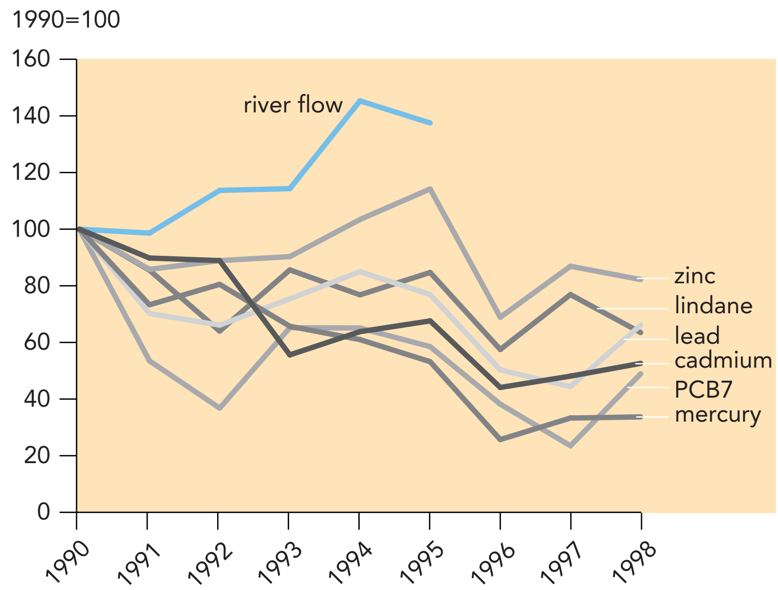
The main reasons for the decreases in riverine inputs are:

- increase of sewage treatment (Section 11.6), which has reduced emissions of all substances into water;
- improvements in industry (fertiliser industry and chemical industry for cadmium, zinc and lead; chlor-alkali production for mercury);
- less use of some substances in products (cadmium in plastics, mercury in the amalgam used by dentists, lead in petrol);
- less use of lindane in agriculture;
- the ban on non-contained use of PCBs.

Inputs of cadmium, mercury and lead from the atmosphere into the North Sea fell between 1987 and 1995. Most of the material deposited comes from countries bordering the sea, since such material only has a short residence time in the atmosphere. The amounts deposited depend on the air transport characteristics of the region.

There are no data for inputs of hazardous substances into the Mediterranean. In general the concentrations of metals in Mediterranean rivers are lower than in most western European rivers. Inputs of cadmium to the Mediterranean are probably stable, and inputs of lead and zinc may be falling, as a result of retention of metals in these rivers (EEA/UNEP, 1999).

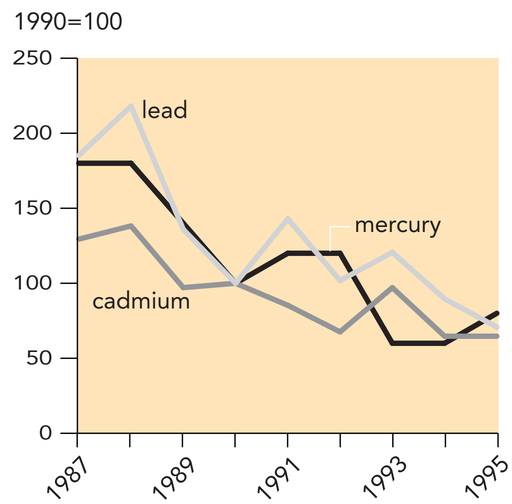
Direct and riverine inputs of hazardous substances into the north-east Atlantic — Figure 12.1.



Notes: Sum of direct and riverine inputs. Time-series of PCB7 input into the Bay of Biscay and the Iberian coast comprises only the period 1992–1995. Input data of Spain on zinc and lindane in 1990 are lacking, while reported inputs in 1997 and 1998 are relatively high. Due to lack of data for zinc, lindane and PCB7 no reduction percentage in inputs into the Bay of Biscay and the Iberian coast is calculated. River water flow data of 1997 and 1998 are not presented because of incomplete data.
Source: EEA based on OSPAR data

☺ Direct and riverine inputs of six hazardous substances into the north-east Atlantic fell between 1990 and 1998, showing the effects of OSPAR setting a target for emission reductions.

Atmospheric inputs of cadmium, mercury and lead into the North Sea — Figure 12.2.



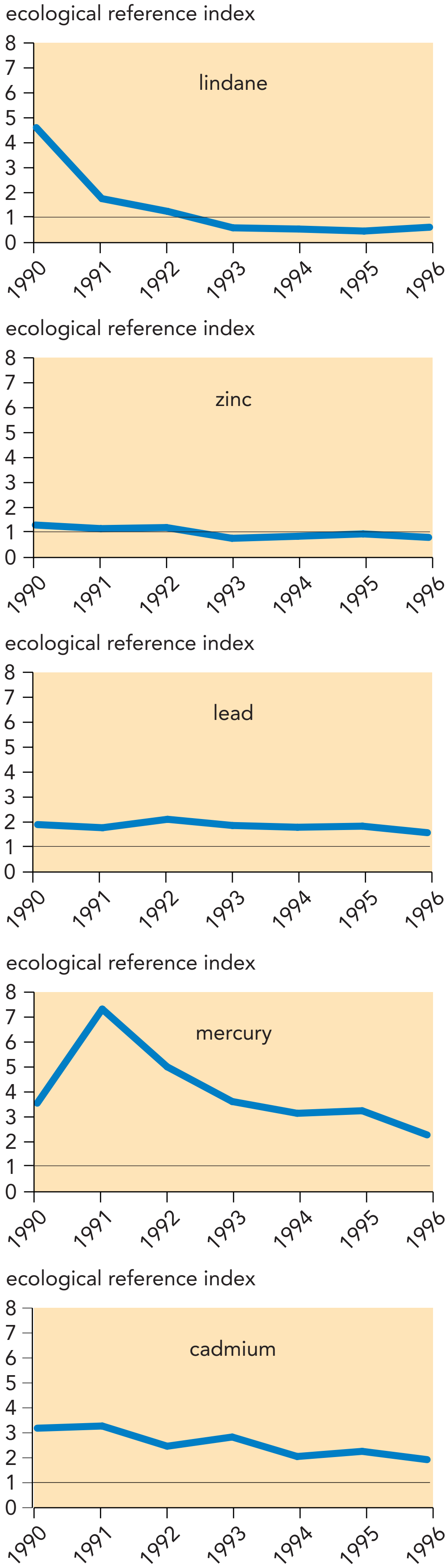
Source: based on OSPAR data

☺ Atmospheric inputs of heavy metals into the North Sea fell between 1987 and 1995, showing the effect of air pollution abatement policies in the countries surrounding the North Sea.

Figure 12.3. **Hazardous substances in blue mussels in the North East Atlantic**

Note: The ratio between mean concentrations of hazardous substances in the blue mussel and values for Background/Reference concentrations (BRC-values) or Ecotoxicological Assessment Criteria (EAC-values) for these substances has been used to present the development on a comparable scale. The BRC/EAC-values have no legal significance and are only related to risks for marine ecosystems and not to human health risks (from consumption of mussels). The ratio is called Ecological Reference Index (ERI). BRC/EAC-values have an upper and lower limit; the upper value has been used to calculate the ERI. ERI = 1 for the upper limits of the BRC/EAC-range.

Data source: OSPAR/MON 1998



12.2. Concentrations of hazardous substances in marine organisms

The measure used for this indicator is the Ecological Reference Index (ERI) for the blue mussel. This species has been chosen for the monitoring of local marine water quality because it is widespread and, unlike many other marine animals, it does not migrate. The ERI is the ratio between the mean concentration of a pollutant in an organism and the OSPAR Background/Reference Concentration (BRC) or the upper value of the range of OSPAR Ecotoxicological Assessment Criteria (EAC) for that pollutant and that organism. BRC-values have been set for heavy metals in mussels and an EAC-value has been set for lindane on the basis of toxicity tests with marine and freshwater organisms and includes a safety factor. Because of the uncertainties, the EAC-value is presented as a range of concentrations (typically of a factor of ten).

An ERI value above '1' may indicate an ecological risk for the species concerned. Concentrations below the upper limit of the ERI range may be considered relatively ecologically safe. An ecological risk for a species does not imply that there is any risk to human health from its consumption.

Lindane

The reductions in lindane inputs between 1990 and 1996 have resulted in a clear decrease in the ERI value in the blue mussel. In 1993 the average concentration dropped below the upper limit of the EAC-range. At many locations a statistically significant decrease in lindane concentrations in species has been observed (OSPAR/MON, 1998).

☺ Mean concentrations of lindane, cadmium and zinc in blue mussels in the north-east Atlantic fell in the period 1990 to 1996, which is consistent with falling inputs. Inputs of mercury and lead also fell during this period, but no clear trends are apparent for their mean concentrations in the blue mussel.

Heavy metals

The decreasing inputs of heavy metals should be leading to decreasing concentrations in the blue mussel. However, a high natural (seasonal) variability of concentrations in mussels, variability in age and sex of collected mussels, the relatively small number of time series for blue mussels and differences in the bio-availability of hazardous substances, as well as uncertainties on the representativeness of the samples may influence the results. Statistically significant trends are found mainly at locations in estuaries and fjords, which are closer to the sources of pollution.

Overall there appears to have been a reduction in the concentrations of cadmium and zinc in blue mussels, but the situation for lead and mercury is less clear. In 1993 the average zinc concentration dropped below the BRC-value, but concentrations of the other metals remained around twice that value (higher for mercury) throughout the period 1990–1996.

Percentage reduction in the direct and riverine inputs of hazardous substances into the north-east Atlantic between 1990 and 1998

Table 12.1.

Substance	Arctic waters	Greater North Sea	Celtic seas	Bay of Biscay and Iberian coast
Cadmium	-83	-30	-68	-18
Mercury	-47	-62	-74	-77
Lead	-46	-9	-3	-91
Zinc	7	-31	-26	n.c.
Lindane	-76	-39	-9	n.c.
PCB7	-95	-40	-61	n.c.

Notes: see Figure 12.1; n.c = not calculated.
Source: EEA based on OSPAR data

Cleaning up the Baltic Sea

The Baltic Sea Joint Comprehensive Environmental Action Programme (JCP) aims to ensure the lasting ecological restoration of the Baltic area. The JCP arose from the 1990 Baltic Sea Declaration.

Pollution in the Baltic comes from a number of municipal and industrial point sources and from diffuse sources such as agriculture, rural settlements and transportation. The JCP started by identifying 132 'hot spots' of particular interest – mainly around point sources. By 1999, the number of hot spots had fallen by 17, and technical assistance was provided for 64 % of the remainder.

The JCP manages a wide range of projects in order to reduce pollution at the hot spots. The main approach is through technical improvements, particularly for industrial and wastewater plants. Problems from wastewater plants are tackled by providing additional capacity, aiming to avoid overflows. Many projects focus on the development of management plans. This approach is used for problems resulting from agriculture, and also to help prevent damage from tourism in vulnerable wetlands or coastal zones.

The HELCOM objective with regard to hazardous substances (HELCOM Recommendation 19/5) is the cessation of discharges, emissions and losses of hazardous substances by the year 2020. The draft HELCOM 4th Periodic Assessment Report concludes that most of the chlorinated organic compounds have decreased over the last 30 years in the whole Baltic Sea area, although many of these still cause concern.

Source: http://www.helcom.fi

12.3. References and further reading

Baan, P. J. A. and G. J. J. Groeneveld, in prep. *Testing of indicators for the coastal and marine environment of Europe. Part 2: Hazardous substances.* EEA Technical Report.

EEA/UNEP, 1999. *Environmental assessment series No 5, State and pressures of the marine and coastal Mediterranean environment.* Copenhagen.

OSPAR Commission, 2000. Quality status report 2000. OSPAR Commission, London.

OSPAR, 1998. *Integrated assessment of inputs to the OSPAR Convention Area 1990–1996.* (Outcome of INPUT Special Assessment Workshop, The Hague, 26-27 March. Presented by the Netherlands. ASMO 98/5/9_E(L).)

OSPAR/MON, 1998. *Summary report of Ad Hoc Working Group on Monitoring (MON).* Copenhagen, 23-27 February.

13. Soil: Contamination from localised sources

policy issue	indicator	assessment
prevention and control of sources of contamination	percentage contributions to soil contamination from localised sources	☹
funding of remediation activities	expenditures on clean-up	😐
management and control of contamination	progress in management of contaminated sites	😐

There are more than 1.5 million industrial and waste disposal sites in the EU which could be potential sources of soil contamination. Some 300 000 specific sites have already been identified as definitely or potentially contaminated. However, the process of site investigation is not complete and problems of definition may preclude an accurate assessment. Major pollutants include organic contaminants such as chlorinated hydrocarbons and mineral oil; heavy metals; and, in some parts of Europe, artificial radionuclides. Management of contaminated sites is a phased process, which is still only at the preliminary stage in the EU. Preliminary surveys to produce inventories of possible sites are well advanced or have been completed in some regions, but detailed investigations and remediation activities are progressing only slowly. Little information is available on the likely EU-wide cost of remediation.

This chapter summarises the information available on soil contamination from localised sources such as industry, waste disposal, mining and military activities, as distinct from diffuse contamination such as acidification and salinisation (Section 13.4, End note 1).

Almost all EU countries are developing national inventories of contaminated sites, but these are not comparable due to different legal frameworks and different definitions. About 300 000 sites have been identified as a result of a screening process that is well advanced in several EU countries; the total number of sites might exceed 1.5 million (EEA, 1999) (Section 13.4, End note 2).

Contaminated sites may pose a threat to health and to the local (and occasionally more distant) environment as a result of releases of contaminants to ground or surface waters, uptake by plants, direct contact by people and fire or explosion of landfill gases.

In contrast to the position for air and water, there are no specific EU objectives or targets for soil protection; rather it is addressed indirectly through measures directed at protecting air and water or developed for particular sectors. The Water Framework Directive, the Landfill Directive and the Integrated Pollution and Prevention Control Directive are, however, specifically relevant to soil contamination from localised sources (Chapter 14).

The problem of soil contamination is only one of many soil-related problems in the EU, addressed in a recent UNEP/EEA report 'Down to Earth: soil degradation and sustainable development in Europe', the main findings of which are summarised in Box 13.1.

	Soil contamination from localised sources
Households	
Fisheries	
Tourism	
Transport	●
Energy	
Agriculture	
Industry	●●●
Tertiary sect	
Military	●●● →

13.1. Soil polluting activities from localised sources

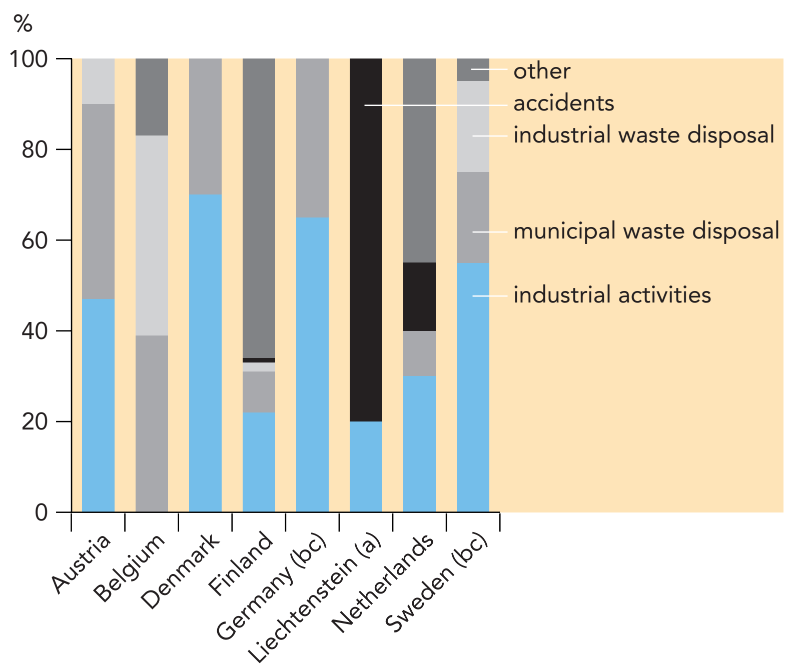
In most of the countries analysed, local soil contamination is due mainly to municipal waste disposals and industrial activities no longer in operation, and to past accidents. In some cases, the scale or even the existence of a contamination problem is only established as a result of a new construction project (Stade de France; Millennium Dome, United Kingdom), or following an accident (dam failure at Donana Park, Spain) or a natural event (flooding of La Loire, France).

Problems of local contamination are closely connected with the methods of waste disposal used during the past 20 to 30 years – huge amounts of more and more hazardous waste were deposited without adequate precautions for the protection of the environment – and increasing use of hazardous substances at industrial and commercial locations. This has led to soil and groundwater contamination due to handling losses, defects, industrial accidents and leaching of hazardous substances at waste disposal sites.

A wide spectrum of contaminants is expected as a result of the broad range of industrial and commercial activities that can give rise to soil contamination. Major pollutants include organic contaminants such as chlorinated hydrocarbons, mineral oil, heavy metals and, in some parts of Europe, artificial radionuclides. It has not yet been possible to make a quantitative assessment.

Implementation of the legislative and regulatory frameworks in place (Landfill Directive, Integrated Pollution and Prevention Control Directive) should result in fewer inputs of substances which might give rise to severe contamination of soils and a better control of contamination resulting from handling losses and accidents at industrial sites. As a consequence, most future actions should be able to focus more on historical problems.

Percentage contributions to soil contamination from localised sources — Figure 13.1.



Notes: Belgium: data refer to Flanders. Germany: 'Industrial Activities' also includes 'Accidents' and 'Other', and 'Municipal Waste Disposal' also includes 'Industrial Waste Disposal'. (a) Minor accidents are not included. (b) The percentage share refers to the total number of identified, suspected sites. (c) Data refer exclusively to abandoned sites (not in operation). The types of industrial activity (either historical or currently in operation) that pose a risk to soils and groundwater, and the spectrum of the various polluting activities, vary between countries. These variations may result in different classification systems and in incomplete information being available in some countries.
Source: EEA

☹ No quantitative information is yet available about the scale and severity of contamination from activities such as waste disposal, industry and accidents in the EU that could pose risks to soil and groundwater.

Box 13.1. Soil degradation in Europe

Europe's soil resource is being irreversibly lost and degraded at an unprecedented rate. Pressures are generated by the concentration of population and activities and by changes in climate and land use.

Major problems are irreversible losses due to soil sealing and erosion, problems of slope stability, local and diffuse contamination, and acidification. Degradation in some parts of southern and south-eastern Europe has led to a reduction in the soil's capacity to support human communities and ecosystems, and to desertification.

Soil loss and deterioration are likely to continue unless economic development is decoupled from pressures on the soil resource through integration of protection measures with sectoral policies.

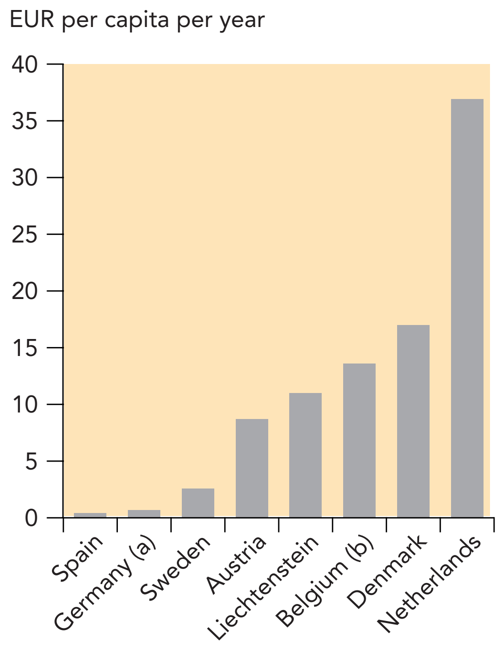
While there have been some local, national and European initiatives, not all are protective of soil and there is no overall policy framework similar to those in place for air and water. Nor is there a reporting mechanism to assess the effectiveness of existing measures or the level of implementation of legislation.

There is an urgent need for a European soil monitoring and assessment framework and for closer collaboration among administrations to improve access to information, enhance data comparability and avoid duplication.

Source: EEA/UNEP, 2000

Figure 13.2. **Expenditure on contaminated site remediation in selected countries (EUR per capita per year)**

Notes: (a) Projection from estimates of expenditures from some of the Länder. (b) Data refer to Flanders.
Source: EEA



There is an almost 100-fold difference in annual clean-up expenditures per capita among reporting countries, and expenditure per country cannot be related to the number of remediated sites. A considerable amount of public money has to be provided to fund remediation programmes.

Table 13.1. **Clean-up costs in selected European countries**

Country	Site investigation	Clean-up measures	Total
	EUR million (percentage in brackets)		
Austria	7 (10)	60 (90)	67
Belgium	14 (17)	65 (83)	78,6
Liechtenstein	0.03 (9)	0.3 (91)	0.33
Sweden	3 (13)	20 (87)	23

Note: Belgium: data refer to Flanders.
Source: EEA

Box 13.2. Financing the clean-up of 'orphan' sites in Switzerland

How can one solve the common problem of what to do when a contaminated site is discovered, but the owner is unknown or unable to clean it up? Many contaminated sites in Europe are old, increasing the chance that they are 'orphaned'.

On 1 January 2001, the Swiss introduced a tax on landfills and exports of wastes. The tax is earmarked for the clean-up of contaminated orphan sites. There are an estimated 3 000–4 000 such sites in Switzerland, and efforts to clean them up have not been entirely successful.

The new tax should improve the situation, since the central government will be able to support the Cantons in their clean-up efforts.

Source: ENDS Daily: 5/4-2000

13.2. Expenditures on clean-up

There is an almost 100-fold difference in annual clean-up expenditure (public and private) per capita between reporting countries. In general, all countries apply the 'polluter pays' principle to various degrees. Additionally, public money is made available to fund remediation activities (see Box 13.2). Differences between countries are partly due to the fact that information on private expenditure is scarce. They also reflect the different scale of the problem in each country and the different standards being applied, rather than the level of concern or the political will to deal with the problem.

Site-to-site differences and the range of national remediation approaches and targets preclude useful comparisons of total expenditure per single site. Remediation costs are on average ten times higher than site investigation costs.

13.3. Progress in management of contaminated sites

Contaminated sites require a phased programme of long-term management, which is likely to include preliminary surveys and investigations, monitoring, detailed site investigations, risk assessment, feasibility studies and detailed planning and implementation of remediation measures.

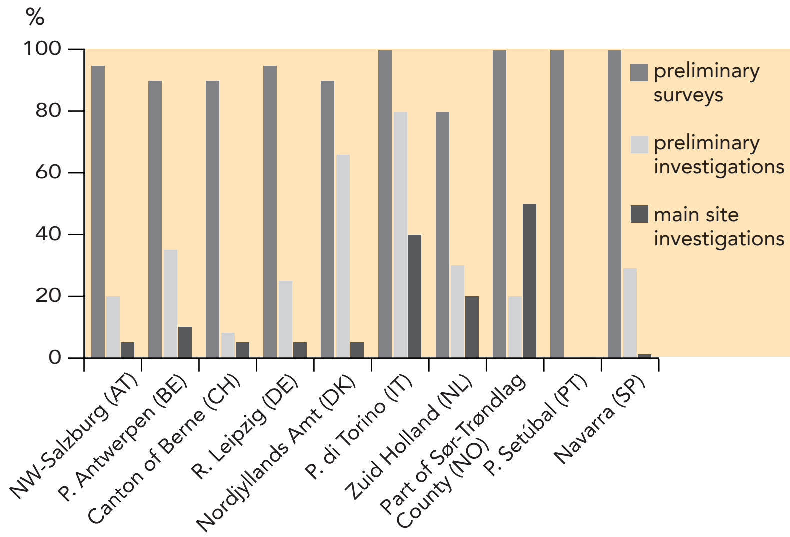
Data on the situation in 1999 have been collected for selected reference regions which have high national standards of contaminated site management and data acquisition, but these are unlikely to be typical and the findings should not be extrapolated to other regions or situations. No time trends can yet be derived.

In all these regions, the first step – a preliminary survey to produce an inventory of potential sources of contamination – has been completed or nearly completed.

Subsequent stages, such as more detailed investigations and planning of remediation activities, are progressing slowly, with substantial differences between the surveyed regions.

Remediation is certain to be far more time-consuming, as well as more expensive, than these earlier stages and no information is yet available on the progress of remediation in terms of the total requirement in the EU.

Progress in the management of contaminated sites in selected European regions — Figure 13.3.



Notes: Information on remediation in progress and remediation completed has not been included.
Source: EEA-ETC/S, Proceedings and results of the 2nd Contaminated Sites Workshop held in Dublin, November 1999

Only the first phase of contaminated site management (inventory of potentially contaminating sources) has been completed in the limited number of regions surveyed. Subsequent phases are likely to be significantly more time-consuming and expensive.

Progress in management of contaminated sites in selected European countries — Table 13.2.

	Baseline		Screening phase	Detailed Phase				
Country	total number of sites	reference year	identified	contaminated	use-dependent contaminated	not contaminated	remediated to multifunctional use	remediated to limited use
Austria	80 000	1999	33 300	17	132	27	10	6
Belgium	9 000	1998	6 000	8 000		2 000		
Denmark	30 000	1999	?	1 830	4200		1 900	1 600
Finland	25 000	1999	18 000	n.a.			1 000	
Germany	?	1998	304 091	56 000				~ 3 000
Liechtenstein	100	1999	30	10			9	
Netherlands	175 000	1997	60 000	10 000			5 000	
Spain	18 142	?	4 910	368		2	6	17
Sweden	22 000	1998	12 500	2 000				

Note: Belgium: data refer to Flanders.
Source: EEA

13.4. References and further reading

EEA, 2000. *Management of contaminated sites in western Europe.* Topic report No 13/1999. European Environment Agency. Copenhagen.

EEA, 1999. *Environment in the European Union at the turn of the century*. European Environment Agency. Copenhagen.

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EEA-UNEP, 2000. *Down to earth: soil degradation and sustainable development in Europe.* Environmental Issues No 16. European Environment Agency. Copenhagen

MST, DANCEE, 2000. Ministry of Environment and Energy. Danish Environment Protection Agency – Danish Cooperation for Environment in Eastern Europe. *Management of contaminated sites and land in central and eastern Europe. Ad Hoc International Working Group on Contaminated Land.* Jens Nonboe Andersen (editor). Copenhagen, 2000.

End note 1: Diffuse contamination and local contamination are often treated as distinct soil problems. Diffuse contamination is generally caused by contaminants transported over wide areas, often far from the source. Local contamination (contaminated sites) is a problem in restricted areas (or sites) around the source, where there is a direct link to the source of contamination. This distinction has an historical origin and it is made mainly in relation to the different management, legal and liability aspects involved. Both types of degradation may be present within the same problem area.

End note 2: The figure refers to the estimated number of industrial or waste disposal facilities which could be potential sources of soil contamination. Once potential sources of contamination are identified, preliminary surveys and site investigations are carried out in order to assess whether a single site is contaminated and to what extent. The figure gives an indication of the effort needed to identify the actual contamination and the requirements for remediation.

14. Waste

policy issue	indicator	assessment
progress in decoupling waste generation from economic activity	total waste generation	😐
progress towards 5EAP target for municipal waste/capita	waste generation from household and commercial activities	☹
progress towards Directive target on landfilling of biodegradable municipal waste	landfilling of biodegradable municipal waste	☹
disposal route for sewage sludge	volume and treatment of sewage sludge	☹

Waste generation in the EU continues to increase and remains closely linked to economic growth. In many countries, large amounts of biodegradable waste are still being landfilled and the continuing increase in quantities of waste produced is making it difficult to reach targets to reduce this. Improvements in wastewater treatment are resulting in growing volumes of sewage sludge for disposal and concern about the contaminants, such as heavy metals, that this may contain.

The 1989 Community Strategy for Waste Management sets out, in order of importance, the four priorities for dealing with waste: prevention including re-use, recycling, energy recovery, optimisation of final disposal and regulation of transport. It also sets out a number of recommended actions. The Waste Framework Directive, the Directive on Hazardous Wastes, and a series of more specific Directives or Regulations govern EU policy. Some specific targets were set in the fifth environmental action programme (5EAP). The limited data available suggest that some of these targets are not being met.

A relatively new and growing concern is the quantities of waste that arise from attempts to solve other environmental problems such as air and water pollution – such as acid wastes from the cleaning of flue gases and sewage sludge from wastewater purification.

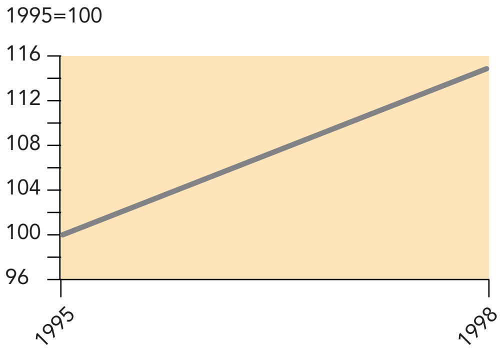
Because of the lack of new data since Environment Signals 2000 and EEA 1999, no specific indicator information is provided on hazardous, packaging, industrial, construction and demolition waste or on waste transport, and the trends that are presented are estimated from data from only a few countries. In addition to providing an overview of total waste quantities and sources and the link between quantities and economic activity, this chapter therefore concentrates on the problems of biodegradable municipal wastes going to landfill, and the options available for dealing with sewage sludge.

Many Accession countries face problems of a legacy of poor waste management and increases in waste generation. Priority issues include the improvement of municipal waste management through better separation of waste and the introduction of recycling initiatives. Incentives have been provided by national governments, in the form of waste charges and taxes aimed at encouraging recycling, re-use and waste minimisation.

Waste generation		
Households	● ↗	Municipal waste 18%
Fisheries		
Tourism	● ↗	(See municipal waste)
Transport	● ↗	Scrapped cars 8-10 million per year
Energy	●	Energy production 5%
Agriculture	●	Manure etc.
Industry	●●	Manufacturing 29%
Tertiary sector		
Military		

Figure 14.1a. **Index for total waste generation 1995 to 1998**

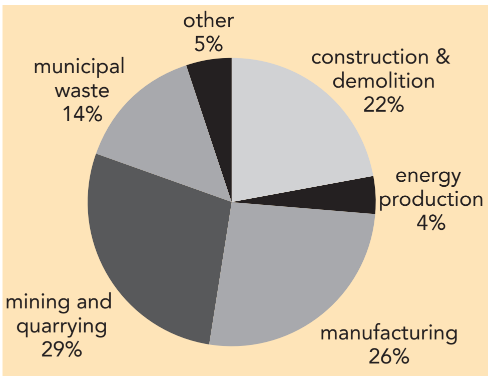
Note: Based on a selection of illustrative national trends (Denmark, Ireland and Italy.)
Source: Eurostat; EEA on specific waste streams



Data from a limited number of countries suggest that total waste generation in the EU is increasing. This goes against the general policy target of waste prevention.

Figure 14.1b. **Total waste generation by sector – EEA Countries 1992-1997**

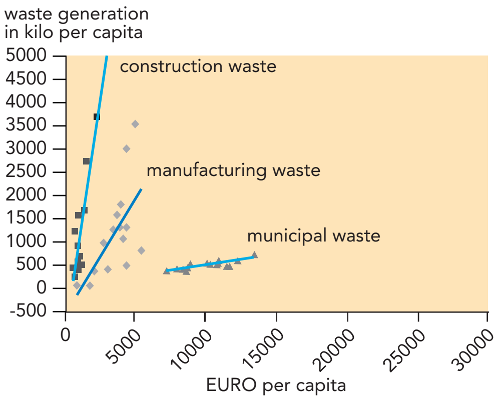
Note: Sewage sludge is included under other waste (in dry weight).
Source: Eurostat; EEA on specific waste streams



Total waste generation in the EU is 1 300 million tones per year. Construction and demolition and manufacturing industries generate half of total waste.

Figure 14.1c. **Is there still a correlation between economic growth and waste generation?**

Note: The figure shows that the generation of municipal and construction waste seems to relate to the economic activity behind waste generation, whereas such a relation does not seem to exist for manufacturing waste. A good correlation is assumed if the correlation factor is above 0.7. In relation to municipal waste the economy is stated as final consumption from households in Purchasing Power Standard (PPS).
Source: Eurostat; EEA on specific waste streams



14.1. Trends in total waste generation

Total generation of waste in the EU amounts to 1 300 million tonnes a year. Manufacturing, and mining and quarrying remain the main sectoral contributors. On the basis of the limited data, waste quantities from manufacturing seem to be constant or in some cases falling, while those from all other sources are increasing.

As with many other environmental issues, the challenge is to de-couple waste generation from economic growth. Some indication of the closeness of the coupling can be gained by plotting, for a number of different countries, the amount of waste produced by a sector against the value of the output of that sector. Valid conclusions can only be drawn if the structure of the sector is similar in the various countries. For example, one should not compare waste generation from the energy sector in a country that uses mainly hydropower with one that uses mainly fossil fuels such as coal.

There appears to be a close link between economic activity and the generation of construction and demolition waste. For manufacturing waste the apparent correlation is not statistically significant. There are large variations between Member States, with some making extensive use of 'cleaner technologies' (including internal recycling). Furthermore, major changes in industrial structure from traditional heavy goods to more advanced products might result in a reduction in waste generation per unit of production. It appears on the basis of field studies, however, that reductions in waste generation per unit of production in some countries through the use of cleaner technology are being overwhelmed by growth in the quantity of goods consumed. Municipal wastes are discussed in the next section.

14.2. Waste from household and commercial activities

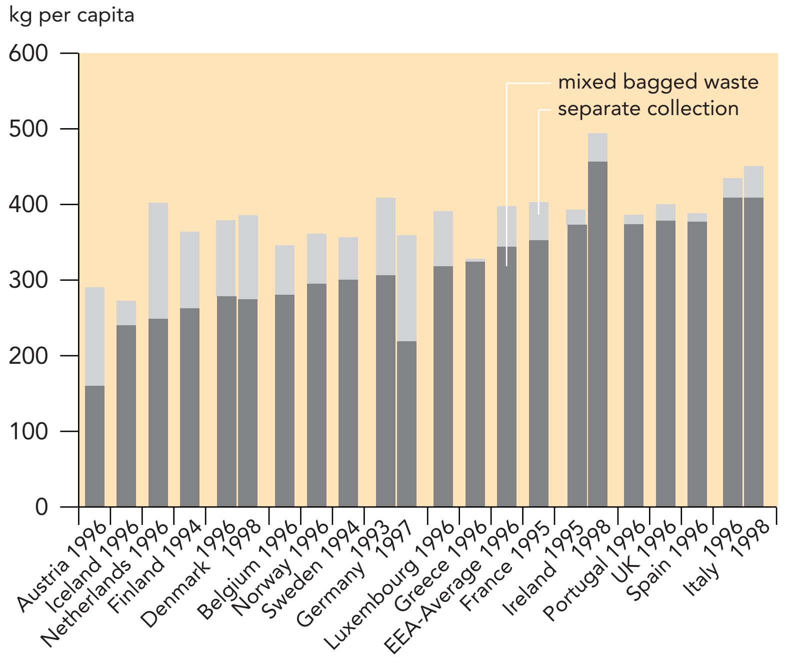
Waste generation per capita from daily household and commercial activities (unlike the term 'municipal waste') is a well-defined category that can be compared between all EEA countries. It includes bagged waste (mixed waste from households and other sources) and separately collected waste such as paper, glass and food/organic waste, but excludes bulky and garden wastes.

One of the targets set in 5EAP was to stabilise the generation of municipal waste at the average EU level of 300 kg per capita by the year 2000. The 400 kg per capita of waste from daily household and commercial activities generated in 1996, which constitutes only part of the total amount of municipal waste generated in that year, together with the increasing waste generation in countries for which data are available, suggest that the target is far from being reached.

There does not, however, appear to be any correlation between household expenditure and the generation of this category of wastes, suggesting that increasing incomes will not necessarily lead to the generation of more such waste. The differences between countries are probably due to differences in lifestyles and consumption patterns (Chapter 3). It is likely that increases in income will in most cases be used for long-term commodities and services, which will lead to more bulky wastes and wastes from construction and demolition.

Waste generation from daily household and commercial activities

Figure 14.2.



Note: The variations in waste generated from daily household and commercial activities between member countries are small, except for Austria and Iceland, which have considerably less than average waste generation. The correlation between private consumption and waste generated from daily household and commercial activities does not exist; the level of generation is less dependent on income than on differences between member countries.
Source: EEA

☹ Waste generation per capita from daily household and commercial activities is more than the target for the year 2000 set by the 5EAP and the quantities are still increasing.

Making use of waste in Denmark

Waste recycling projects are unlikely to be viable unless there is a strong market for the recycled products.

The built environment is a source of large quantities of mixed waste. Buildings that have been demolished can represent both a large waste problem and a large potential resource.

On the corner of Carlsgade and Georgsgade in Odense, Denmark stands a building with 14 flats. It was built almost entirely out of recycled products. The housing cooperative that raised the building thus closed the loop. They achieved a double environmental benefit by minimising the use of new resources and supporting recycling through creating a market for its products.

Source: http://www.idebanken.no

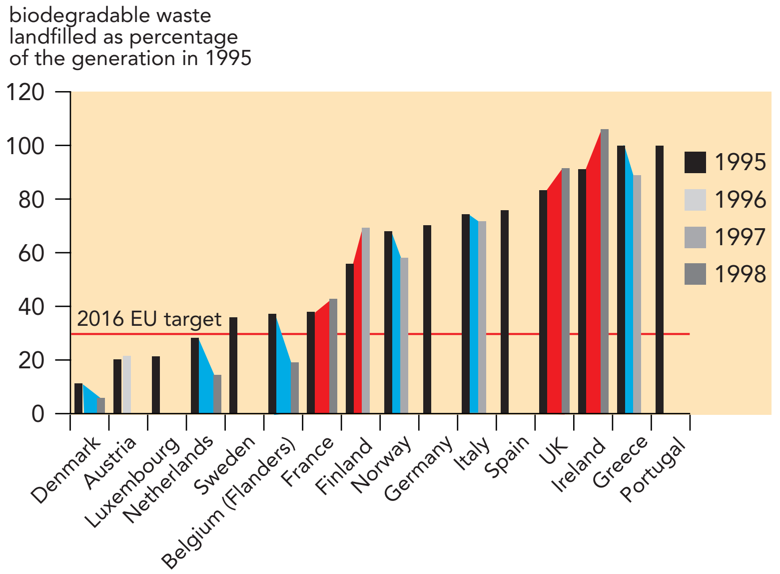
14.3. Biodegradable municipal waste to landfill

About 107 million tonnes of biodegradable municipal waste (BMW) were produced in the EU plus Norway in 1995, of which 70 million tonnes (66 %) were landfilled. There are large differences between countries and only limited data on trends since 1995.

Among countries with relatively high landfilling rates (more than 35 % of BMW produced), the fractions of BMW being landfilled are increasing in the United Kingdom, Ireland and Finland, and falling in Italy and Norway; no data are available for the other countries.

Of the countries with low landfilling rates (less than 35 % of BMW produced), there have been significant reductions in the fractions being landfilled in Denmark, the Netherlands and the Flemish region of Belgium, and a small increase in Austria.

Figure 14.3. **Biodegradable municipal waste landfilled as a percentage of total generation of biodegradable municipal waste, EU countries or regions, 1995–1998**



Note: 100 % is the generation of biodegradable municipal waste in 1995 (this is the reason for the possibility of values over 100 %)
Source: EEA

☹ Too much biodegradable municipal waste goes to landfill. There has been no improvement in the countries that make the most use of landfilling.

There are clear environmental benefits from reducing the quantities of BMW going to landfill: its decomposition produces landfill leachate and greenhouse gas emissions; it can be recycled and reused, for example by composting; and the amount of land needed for landfill can be reduced.

The Council Directive on the Landfill of Waste (1993/31/EC) therefore set targets for the fractions of BMW going to landfill by 2006, 2009 and 2016. The targets are set as a percentage of the total amount of BMW produced in 1995; reaching them will become more and more difficult if total volumes of BMW continue to increase. Reaching the targets will require integrated measures at the national level, including the separate collection of relatively uncontaminated materials and the availability of markets and outlets for materials diverted away from landfills.

One key question for waste management policy is whether economic instruments can contribute to achieving environmental targets. Without any regulation, landfilling is the most cost-efficient disposal method for most of the waste; a landfill tax could therefore encourage other methods such as incineration and recycling. Environmental Signals 2000 (p. 73) reported that in 1998 'Taxation of landfill disposal favours incineration only in Austria, Denmark and Sweden.' Since then a few more countries have introduced a landfill tax or increased the level of an existing landfill tax, but there have been no dramatic changes in the overall situation concerning use of the tax instruments to influence the management of waste.

14.4. Sewage sludge

The total amount of sewage sludge produced in the EU increased from 5.2 million tonnes of dry matter in 1992 to 7.2 million tonnes in 1998. The large differences in the generation of sewage sludge between countries (up to 30 kg per capita) reflect differences in the degree of wastewater treatment.

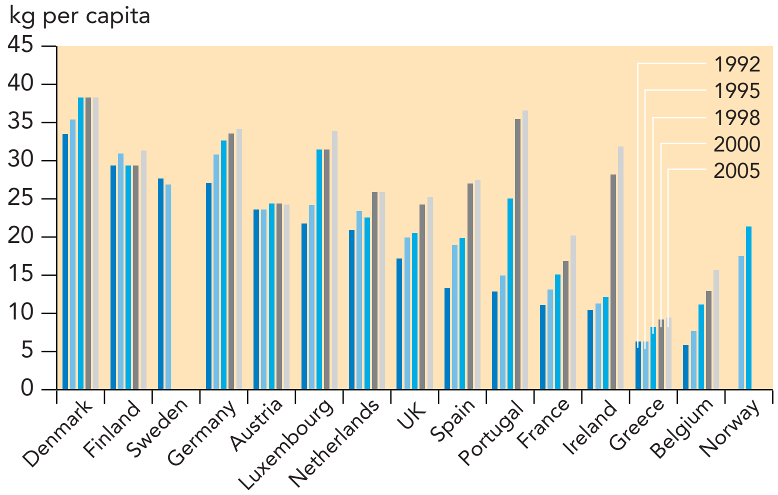
The more stringent demands for treatment in the Council Directive on Urban Wastewater Treatment (91/171/EEC) will result in many new treatment plants coming into operation by 2005 and the total amount of sewage sludge is expected to increase to at least 9.4 million tonnes of dry matter. The relative increases in some countries are expected to be much larger.

Treated sludge can be a valuable fertiliser and can also help to improve soil structure. But sludge is contaminated with heavy metals, micro-organisms and a number of organic substances. EU and national regulations set limits on concentrations of these contaminants for the protection of humans and soils. More stringent limits have been set by some countries and are being considered at the EU level.

Restrictions on the agricultural use of sewage sludge could have considerable economic consequences, with costs rising from EUR 75 per tonne for agricultural use to EUR 400 or more for incineration. Reductions in the use of heavy metals and other potentially polluting materials in general – desirable on a number of environmental grounds – could reduce the level of contamination and increase the agricultural usefulness of sewage sludge.

Currently (1998 figures), 50 % of sewage sludge is used as fertiliser, mainly in agriculture or forestry, 25 % goes to landfill, 18 % is incinerated and 7 % is discharged to surface waters or in unspecified ways.

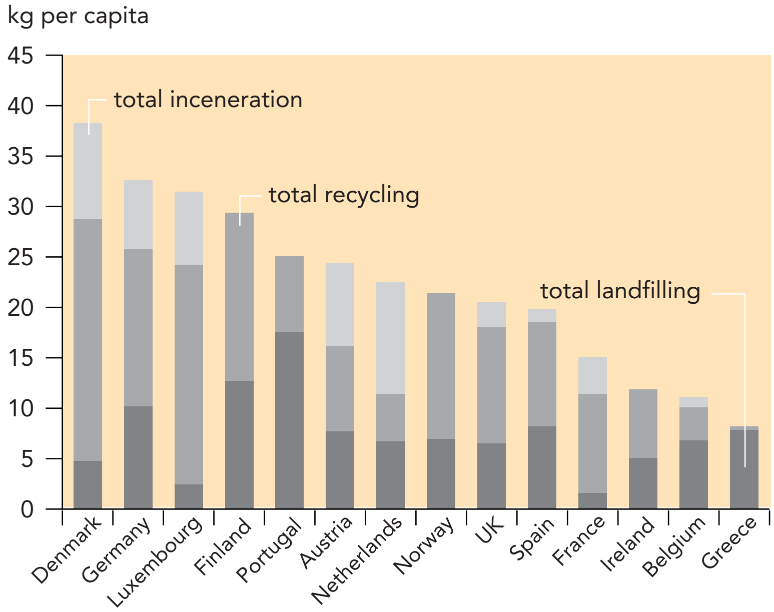
Sludge from wastewater treatment, 1992–1998 and forecast for 2000 and 2005 — Figure 14.4a.



Notes: Member States sorted by the level of generation in 1995.
Source: European Commission

The increase in the total generation of sewage sludge is a side-effect of an environmentally positive development in treating wastewater. Despite an expected increase in recycling, the total amount of sludge for disposal is expected to increase by 50 % by 2005.

Treatment of sewage sludge: selected EEA member countries, 1998 — Figure 14.4b.



Source: EEA

The corresponding figures in 2005 are projected to be 54 %, 19 %, 24 % and 3 %. However, continuing or increased use of sewage sludge as fertiliser requires better assurance that this will not lead to environmental damage through nitrogen surpluses and that the quality of food will not be affected by the presence of contaminants. Increased consumer awareness in large supermarket chains in France and Germany has already led to rejection of products from farms using sewage sludge.

14.5. References and further reading

European Environment Agency. *Biodegradable municipal waste management in Europe: strategies and instruments*. Topic report to be published in 2001.

European Environment Agency. *Household and municipal waste: comparability of data in EEA member countries*. Topic report No 3/2000. Copenhagen, April 2000.

Eurostat/OECD questionnaire 2000. *Waste generated in Europe*. Luxembourg.

European Commission. *Report on implementation of Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment, as amended by Commission Directive 98/15/EC of 27 February 1998, 15 January 1999*. Brussels.

European Commission. *Report from the Commission to the Council and the European Parliament on implementation of Community waste legislation Directive 75/442/EEC on waste, Directive 91/689/EEC on hazardous waste, Directive 75/439/EEC on waste oils and Directive 86/278/EEC on sewage sludge. For the period 1995–1997*. Brussels.

Table 14.1. **Biodegradable municipal waste for EU & Norway**

Notes: *Total excluding Flanders.
Source Eurostat
1: estimate
2: Figures relate to 1995 and earlier years, due to separate data collection for Flanders, Walloon and Brussels.
3: Figures relate to waste from households only and figures for Germany based on an estimate of the biodegradable fraction by the national focal point.
Source EEA: Topic report to be published 2001, 'Biodegradable municipal waste management in Europe: strategies and instruments', comments from national focal points of Germany, Greece and the United Kingdom

Country/Region	Baseline year			Latest year	
	Year	BMW Produced	BMW Landfilled	Year	BMW Landfilled
		Ktonnes	Ktonnes		Ktonnes
Austria	1995	1 495	302	1996	322
Belgium[1]	1995[2]	4 055	2 132		
Flanders	1995	1 671	623	1998	322
Denmark	1995	1 813	205	1998	106
Finland	1994	1 664	928	1997	1 155
France	1995	15 746	5 988	1998	6 742
Germany[3]	1993	12 000	9 200	-	-
Greece	1997	2 613	2 324	-	-
Ireland	1995	990	903	1998	1 049
Italy	1996	9 170	6 821	1998	6 586
Luxembourg[1]	1995	160	34	-	-
Norway	1995	1 572	1 069	1997	915
Portugal[1]	1995	3 301	3 301	-	-
Spain[1]	1995	11 633	8 823	-	-
Sweden[1]	1994	2 656	956	-	-
The Netherlands[3]	1995	4 830	1 365	1998	700
U.K. (England & Wales)	1995/6	15 120	12 625	98/99	13 836
Total		**88 818***	**56 976***		-

15. Grasslands with focus on dry grasslands

policy issue	indicator	assessment
what are the pressures on grasslands?	pressures on grasslands	😐
what influence have land use policies?	change in area and use of grasslands	☹
distribution and existence of species	species in dry grasslands	☹
progress in protection policies	protection of grasslands	😐

The overall extent of permanent grasslands in Europe has been gradually falling for several decades. Grasslands have been converted to other forms of land use or intensified, although there is also movement in the opposite direction in some areas. Some national permanent grassland programmes or legislation seem to have slowed, but not halted or reversed, the rate of disappearance of natural and semi-natural grasslands. When fully implemented, the NATURA2000 Network will conserve a significant proportion of the most important of these grasslands in the EU, but it cannot stop the general decrease or the deterioration of grasslands.

Permanent grasslands are found all over Europe, the most important for nature protection normally being the natural and semi-natural types. Grasslands range from the driest, almost desert-like types, to steppe-like, mesic (neither very dry nor very wet) and humid types, depending on the biogeographic context, local soil conditions and exposure. They are important habitats for a wide range of species, including the ancestors of many widespread crop, garden and medicinal plants. They are the key habitats for many herbs, wild-grazing mammals (including deer and rodents), butterflies, reptiles and birds. They are also hunting grounds for large carnivores and birds of prey.

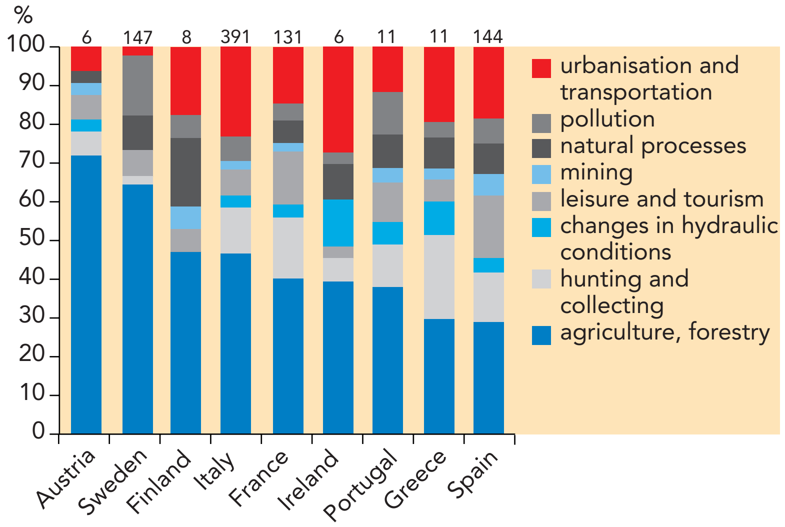
Almost all existing European grasslands depend on management. It is the intensity of grazing or cutting and improvement through fertilisers, pesticides and seeding that determines the content and importance for biodiversity. Intensification normally favours robust widespread species and is detrimental to specialised species. In addition, species composition is being influenced by nutrients spread by the wind, acting as extra fertiliser.

Climate change is expected to be a major influence, and could lead to expansion of dry and arid grasslands - and even to desertification - in southern Europe, and to the spread of humid grasslands in the north.

The Convention on Biological Diversity (CBD) recognises the importance of grasslands for their societal (production, employment, recreation) and environmental functions as well as their importance for the conservation of biodiversity.

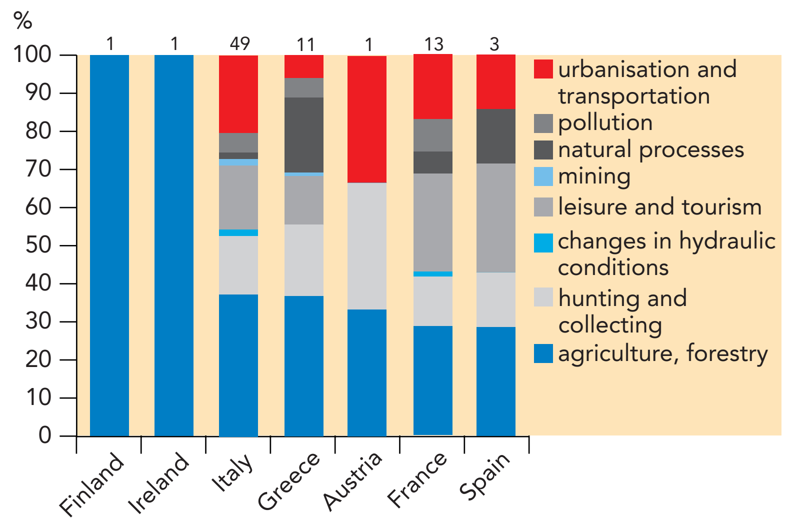
The main EU regulations for protecting grassland habitats and species, in addition to the Habitats Directive, are the Birds Directive and the Environmental Impact Assessment Directives and Regulation (EC) No 1467/94 on Conservation, Characterisation, Collection and Utilisation of Genetic Resources in Agriculture. Since 1981, the Council of Europe has identified grassland habitats, particularly dry grasslands, as a priority for conservation and encouraged countries to include such habitat types in the network of European Biogenetic Reserves. Grasslands are also considered as highly important in the Bern Convention. Many countries have included permanent grassland considerations in sustainability programmes, regulations and action plans to implement the CBD, and some have general protection for all permanent grasslands.

Figure 15.1a. **Main impacts and activities in lowland areas with more than 30 % dry or mesic grassland habitat coverage in potential sites of Community interest**



Notes: Number on top indicates number of pSCIs analysed per country. Data as reported in NATURA2000 forms by end 1999 by nine countries.
Source: EEA

Figure 15.1b. **Main impacts and activities in mountain areas with more than 30 % dry or mesic grassland habitat coverage in potential sites of Community interest**



Notes: Number on top indicates number of pSCIs analysed per country. Data as reported in NATURA2000 forms by end 1999 by seven countries.
Source: EEA

😐 Except for very limited areas of special natural grassland types, all European grasslands are maintained through grazing or cutting, the continuation and intensity of which are crucial for protection of the grasslands and the species they harbour.

15.1. Pressures on permanent grasslands

The main types of pressures to permanent grasslands have been indicated by Member States in their proposals for candidate Sites of Community Interest (pSCIs) for further designation as Special Areas of Conservation as part of the NATURA2000 Network under the EU Habitats Directive. An analysis of 1999 data on 984 pSCIs (91 mountain and 893 lowland sites), where dry or mesic grassland covered more than 30 % of the area, confirmed that such areas were subject to a wide range of pressures which vary significantly depending on biogeographic context and country.

How grassland areas evolve will depend on the implementation of a number of legal and financial instruments. These may have conflicting objectives, and local property-related factors may result in neighbouring farmers taking completely opposite decisions.

In the EU, grasslands have been heavily affected, directly and indirectly, by implementation of the Common Agricultural Policy (CAP), mainly through more intensive maintenance and use of grasslands, abandonment, change to other crops or complete change of land use.

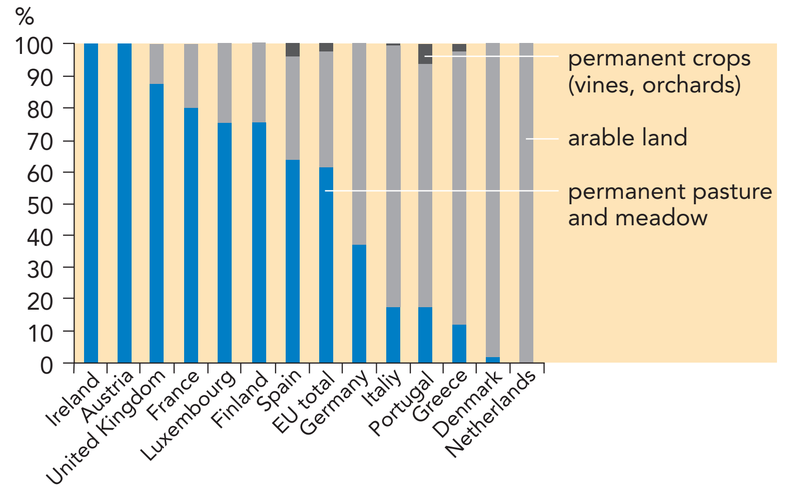
Since the CAP changes of 1992, implementation of the accompanying agri-environmental measures (covering about 20 % of the EU agricultural area) have been directed at reducing the negative pressures of farming on the environment, in particular on water quality, soil and biodiversity, and promoting farm practices necessary for the maintenance of biodiversity and landscape, including the avoidance of degradation and fire risk resulting from under-use. Of particular interest for the maintenance of permanent grasslands are the opportunities for low intensity maintenance, farming with environmental improvements, non-productive land management, and training and demonstration projects.

However, only 4 % of the CAP agriculture budget has been used for accompanying agri-environmental measures, including those related to water, soil and biodiversity (Section 7.2.1).

Other accompanying measures to CAP, for example those intended to promote reafforestation of agricultural land, have had large negative impacts on the total area of permanent grasslands: 60 % of the area afforested was formerly permanent grasslands (pastures and meadows).

The prospects for grasslands in the short and the longer term may, however, change dramatically, for example as a result of widespread outbreaks of cattle diseases and subsequent impacts on the meat market (as with BSE) and a more rapid change towards organic farming. Such changes could result in the long term in fewer cattle per ha and less intense farming, thus supporting semi-natural grasslands, but they could also lead to more afforestation or intensive crop farming and in some areas to long-lasting abandonment.

Previous land use of land afforested between 1993 and 1997, EU15 — Figure 15.2.



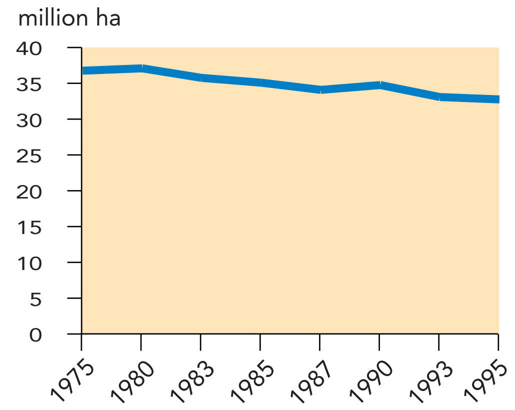
Source: European Commission

☹ Pressure on grassland habitats is increasing steadily. Sixty percent of the newly afforested area in the EU was formerly permanent pasture or meadows, 37 % was arable land and only 3 % was permanent cropland.

15.2. The area of permanent grassland

Following the enlargement from EU9 to EU15, the total EU area of permanent grasslands and pastures in 1995 was about 44 000 000 ha. However, the total grassland area in the average EU9 country fell by 12 % between 1975 and 1995, with only some areas of increase. The decline is expected to continue. The data does not allow the increase or decline of the various types of grasslands to be followed in detail. The total EU area of permanent grassland will increase significantly with further enlargement, since the Accession countries contain large areas of highly valuable and vulnerable permanent grassland; these areas will be under great pressure with the expected increase in agricultural intensification.

Permanent grassland area, EU9 — Figure 15.3a.



Note: Includes permanent grassland and pasture.
Source: European Commission

☹ The total grassland area in the EU9 fell an average by 12 % between 1975 and 1995, with only some areas of increase. The total area of permanent grassland will increase significantly with further enlargement of the EU.

Figure 15.3b. **Area under permanent grassland in utilised agricultural area (UAA) in EU15 in 1995**

Source: EEA

Restoring grasslands in Germany

Grasslands contain a high diversity of species and play an important role in sustaining the cultural landscape. However, the remaining areas are threatened by infrastructure development and intense production of animal fodder.

The authorities in Lower Saxony, Germany, decided to address this problem by initiating a project that aimed to prevent further damage and re-establish the meadows and grasslands that used to border the river Ise.

Land next to the river was bought, trees planted and river maintenance reduced. Meadow and pasturelands were rented out to farmers under restrictions designed to ensure production compatible with the conservation of nature. About 1 000 ha of land have been restored to a more natural state.

A marketing association was established, composed of farmers and two butchers. The high quality of the meat resulted in farmers being able to charge 30 % more for their meat than from other sources. The participating farmers thus have more than the average income for this type of production and do not need the governmental compensation normally paid to farmers moving towards less intensive production.

Source: Borggräfe, K. & Kölsch, O., 1998, Ise-Nederung, Low intensity management of meadows and pastures in the highly intensive agriculture of Lower Saxony, Faunus Issue 5. http://www.mluri.sari.ac.uk/~mi361/faunus5.pdf

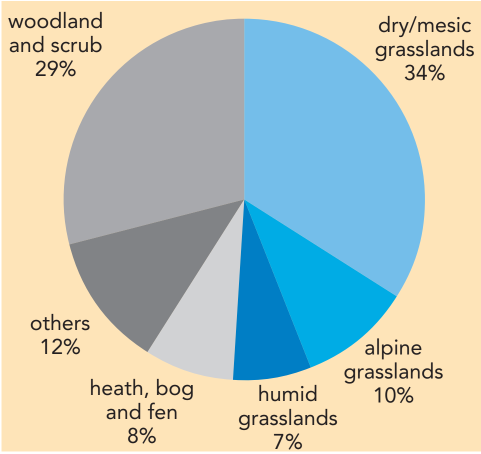
15.3. Species in dry grasslands

Dry grasslands are among the most threatened types of grassland. They contain many specialist species, for example of orchids and butterflies, which can survive only in dry, well-lit conditions. Around half of the orchid species in France, and between 35 % and 42 % in Belgium, the Netherlands and Luxembourg, occur in dry or mesic grasslands; a high proportion of these are either in a highly vulnerable state or close to being extinct (Sociéte Française d'orchidophilie, 1998).

15.4. Protection of permanent grasslands, including dry grasslands

Several national permanent grassland programmes or legislation, both in EU and Accession countries, seem to have slowed but not halted or reversed the rate of disappearance of natural and semi-natural grasslands. When fully implemented, the NATURA2000 Network will conserve a significant proportion of the most important EU-wide natural and semi-natural grasslands.

Threatened butterflies according to broad habitat types in European countries — Figure 15.4.



Note: The assessment covers all known butterfly species in all Europe, including Madeira, the Azores, the Canary Islands, Cyprus, the whole of Turkey and Russia east to the Urals (no information was received from the Caucasian Republics).
Source: Council of Europe, 1999. Red Data Book on European Butterflies (Rhopalocera)

☹ Seventy-one out of a total of 576 European butterfly species are threatened. Of these around 50 % occur in grasslands, and 34 % only in dry/mesic grasslands.

Examples of European Community LIFE fund projects for dry/mesic grassland areas — Table 15.1.

Country	Restoration and management projects including dry grassland habitat types and species	Projects 1992–1994	Projects 1995-1999
Austria	Pannonian sand dunes, alluvial flood plain		2
Finland	Grasslands and pastures in Archipelago		1
France	Dry grasslands, chalk and limestone grasslands, Xerotermic habitats, grassland species	2	7
Germany	Dune and meadow habitats, species	3	4
Greece	Dry grasslands		1
Italy	Various grassland habitat types and species		12
Portugal	Grassland habitat types, Montados, steppic birds	2	1
Spain	Steppic and dry grasslands and species	3	3
United Kingdom	Chalk grassland habitat types		1

Source: EEA, analysis based on European Commission LIFE-Nature Database

😐 National and international understanding of the importance of grassland habitats for nature conservation has resulted in an increasing number of projects to ensure conservation of dry and mesic grasslands and associated species.

Table 15.2. Surface area of sites with dry or mesic grassland habitat types, proposed for nature protection under the Flora, Fauna and Habitats Directive (pSCIs)

Lowland Sites.

number of sites	< 10 ha	10 to 99 ha	100 to 999 ha	1000 to 9999 ha	> 10000 ha	No data
Austria		4	1	1		
Belgium	1	7	1			
Denmark	1	2	1			
Finland	7		1			
France	2	25	37	48	19	
Greece				2	9	
Ireland	1	5				
Italy	4	20	109	230	27	1
Netherlands				1		
Portugal					11	
Spain			5	51	88	
Sweden	48	69	28	2		
United Kingdom	2	8	11	2	1	
Total (13 countries)	66	140	194	337	155	1

Mountain sites.

number of sites	< 10 ha	10 to 99 ha	100 to 999 ha	1000 to 9999 ha	> 10000 ha
Austria			1		
Belgium	1				
Finland	1				
France			2	6	5
Greece				5	6
Ireland			1		
Italy	1	7	16	23	2
Spain		1	1		1
Sweden		3		1	
United Kingdom			3		
Total (10 countries)	3	11	24	35	14

Note: The analysis is based on data by end 1999 from 984 pSCI sites (91 mountain sites, 893 lowland sites) where dry or mesic grassland covered more than 30 % of the area. Sites with coverage less than 30 % grassland were not analysed.
Source: EEA

The Bern Convention Emerald Network will parallel this in countries outside the EU.

The sites proposed for conservation under the Habitats Directive (pSCIs) vary in number and size, depending on the climate and character of the landscape and the historic and current land use. For example, the highest proportion of proposed large sites with significant dry grassland habitat is in the Mediterranean biogeographic region, with more than 80 sites between 1 000 ha and 10 000 ha. Spain has two sites of about 25 000 ha, one of 52 000 ha and one of 75 000 ha. Although several countries have still not completed their national proposals under the NATURA 2000 process (for example, none from Germany), there are many sites larger than 1 000 ha in the Continental biogeographic region, including extensive dryland areas in France and Austria. The large areas of drylands generally correspond to low-intensity farming areas, with biodiversity maintained through extensive grazing and hay cutting. The growing national and international understanding of the importance of grassland habitats for nature conservation has resulted in an increasing number of projects in European countries to ensure the conservation of dry and mesic grasslands and associated species through restoration and management.

The EC LIFE-Nature projects show the trend in European Community interest: starting with a few dry grasslands projects around 1992 there has been a clear increase in the number of projects since 1995-1996. Several other projects related to large carnivores or raptors involve large areas of grasslands under extensive management in a mosaic of other habitat types.

However, data limitations preclude the development of indicators to monitor the specific impacts or effectiveness of nature protection measures, or to capture detailed links with climate change and desertification issues. Unlike data based on agricultural statistics, nature conservation data as yet include very limited temporal information.

15.5. References and further reading

European Commission LIFE-Nature Database: http://europa.eu.int/comm/life/nature/databas.htm

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Acronyms and abbreviations

BAT	Best available technology
BOD	Biochemical oxygen demand
CAFE	Clean Air for Europe Programme
CAP	Common Agricultural Policy (EU)
CCE	Coordinating Centre for Effects (UNECE)
CEE	Central and Eastern Europe
CFCs	Chlorofluorocarbons
CHP	Combined Heat and Power
CLRTAP	Convention on Long Range Transboundary Air Pollution (UNECE)
DPSIR	Driving forces, Pressures, State, Impact, Responses
EEA	European Environment Agency
EFTA	European Free Trade Association
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollution in Europe
EU	European Union
Eurostat	Statistical Office of the European Union
FAO	Food and Agriculture Organisation (UN)
FCCC	Framework Convention on Climate Change (UN)
GDP	gross domestic product
GWP	global warming potential
HCFCs	hydrochlorofluorocarbons
HELCOM	Helsinki Commission
HFCs	hydrofluorocarbons
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control (EU Directive)
ktonnes	thousand tonnes
MSC-W	EMEP Meteorological Synthesising Centre-West (UNECE)
NECD	National emission ceilings Directive
NMVOCs	non-methane volatile organic compounds
NOx	Nitrogen oxides, including nitric oxide (NO) and nitrogen dioxide (NO_2)
OECD	Organisation for Economic Cooperation and Development
OSPAR	Joint Oslo and Paris Commissions
PCBs	polychlorinated biphenyls
PFCs	perfluorcarbons
PM	particulate matter
POPs	persistent organic pollutants
ppb	parts per billion
RIVM	National Institute of Public Health and Environmental Protection, the Netherlands
TEN	Trans-European transport network
TERM	Transport and Environment Reporting Mechanism for the EU
toe	tonnes of oil equivalent
TON	Total oxidized nitrogen
UAA	utilised agricultural area
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VOCs	volatile organic compounds
WHO	World Health Organization
WTO	World Tourism Organization

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