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Environmental pressure indicators for the EU

Data 1985–98

8

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The team behind the indicators

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and further consisted of:

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For further information please contact:

Rosemary Montgomery,
Environment Statistics
Tel: (+352) 4301 37292
Fax: (+352) 4301 37316
e-mail: Rosemary.Montgomery@cec.eu.int

or consult the Eurostat website at : www.europa.eu.int/comm/eurostat/

†*Lars Knudsen of DHI, responsible for producing many of the indicators related to water and the marine environment, died suddenly in January 2001. We extend our sincere sympathy to his wife and children.*

Cataloguing data can be found at the end of this publication.

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Foreword

Indicators are widely used in economic and social policy making. A few, for example, GDP and the unemployment rate, are taken as indicators of the health of the whole economy, even though they may mask wide regional or social disparities.

No equivalent key indicators exist for the environment, which given the diversity of environmental issues and pressures is hardly surprising. However it is important to try to distill the vast amount of information about the environment and what human activities are doing to it into a relatively small set of indicators that are readily understood and that give an indication of whether for that issue things are getting better or worse. This second publication on environmental pressure indicators attempts to do this by presenting a small number of indicators for nine environmental policy fields.

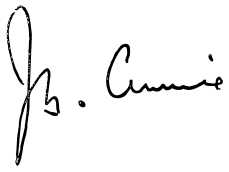
The state of the environment is of course the underlying concern, but the focus here is on environmental pressures, i.e. pressures resulting from human activities which bring about the changes in the state of the environment. Changes in pressures can often be identified long before a corresponding change is seen in the environment itself. Moreover pressures are most readily influenced by policy measures, and therefore pressure indicators are more responsive and more policy relevant in many cases than pure environmental state indicators.

The Amsterdam Treaty requires the different policy sectors, e.g. agriculture, energy, transport, industry, etc. to integrate environmental concerns into sectoral policies. The so-called 'Cardiff process' has asked for indicators to monitor the effectiveness of this integration. Therefore in this publication an effort has been made to identify the contribution of the different policy sectors to the overall pressures. While not a substitute for the full set of 'integration indicators' being developed by the different sectors, this breakdown can give a first indication of the importance of the different sectors in the main pressures for each of the pollicy fields, and thus act as a pointer to where additional information may be needed.

The Commission's Communication[1] on a Sixth Environment Action Programme, 'Environment 2010: Our future, Our choice' published early 2001, highlights the importance of having sound knowledge of current environmental problems. This publication, part of a suite of publications on environmental indicators covering different topics, is an important contribution to creating a strong basis for our future environmental policies.

We look forward to working with the Member States and all other stakeholders to improve and refine the information provided through the environmental pressure indicators, in the common interest of effective environmental policy making.

Yves Franchet
Director-Gerneral of the statistical
Office of the European Communities



James Currie
Director-General of the Environment
Directorate General

[1] COM (2001) 31 final

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Introduction

Environmental Pressure Indicators for the EU

This publication presents the results of the latest phase of the project to develop a comprehensive set of environmental pressure indicators for the EU. The project reflects some of the efforts undertaken by the Commission to provide decision-makers and the general public with information necessary for the design and monitoring of an adequate environment policy for the European Union. It should be seen as part of a suite of indicators being developed for policy purposes, and which also includes sectoral 'integration' indicators and sustainable development indicators, and inevitably many of the indicators will be included in more than one set of indicators. This of course is not a shortcoming of the process, but rather a confirmation that the issues and pressures identified here are significant pressures on our environment, and deserve attention.

The framework for this work was set out in the Communication from the Commission to the Council and the European Parliament on 'Directions for the EU on Environmental Indicators and Green National Accounts'. The results presented here are the tip of the iceberg, the visible part of a lot of background work, identifying the most important issues and related indicators, peer review, developing methodologies, tracking down data, etc. These early phases of the project, including the indicator selection process, are briefly described in the previous publication[1] and in more detail on the web site maintained by the international team of consultants working on the project: http://e-m-a-i-l.nu/tepi/. This site provides a general introduction to the Environmental Pressure Indicators Project, with background documents, technical, methodological, and current issues and many useful links to related activities in other Directorates General of the Commission and national statistical services.

The policy fields

This publication shows the most important trends in a number of indicators for nine policy fields: *Resource Depletion, Waste, Dispersion of Toxic Substances, Water Pollution, Marine Environment & Coastal Zones, Climate Change, Air Pollution, Ozone Layer Depletion, Urban Environmental Problems.* These policy fields are based on the themes of the European Community's Fifth Environmental Action Programme. While the Commission has now made a proposal for a Sixth Environmental Action Programme, these policy fields still remain areas of concern and have been maintained in the current publication.

The previous publication included a further policy field: *Loss of Biodiversity.* While this remains an important issue, it has not yet been possible to improve on the rather weak indicators presented previously, so it was reluctantly decided to drop this chapter for this edition. Nevertheless, the issue is not forgotten and will be revisited in the next edition, in 2003.

Overview of the 48 indicators presented in this second edition of the publication

The experience gained in the production of the first edition of this publication[1] enabled us to refine and improve many of the early indicators, for example by improved modelling, by use of additional data sources, or by including sectors or contributors not previously covered.

The titles of some of the indicators have been modified to better reflect the data presented.

In a very few cases, scientific knowledge has moved on since the first publication, and issues originally identified as important are now seen to be irrelevant. For example, emissions of nitrogen oxides by aircraft was previously thought to be an important contributor to ozone layer depletion, but this has now been discounted. This indicator is no longer included in the set.

Political importance also intervened, so that the chapter on Climate Change now covers the 'Kyoto' gases.

Occasionally indicators have been dropped: some were shown to be of lesser importance than previously thought, some were found to be duplication in another form of another indicator, others have proven to be non-operational, either because little or no relevant and reliable data is available, or because the definitions or methodologies are not sufficiently clear.

New indicators have been introduced to replace some of those dropped. These are sometimes proxy indicators, close to the original pressure to be illustrated, but with better or more data available, or clearer concepts. Some are totally new, in that the issue is presented here for the first time, but all had been identified by the indicator selection procedure as one of the top ten most important issues in their field.

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[1] Towards environmental pressure indicators for the EU, Eurostat 1999 (ISBN 92-828-4978-3)

Some 22 indicators come directly from Eurostat, while several others are based on Eurostat data together with data from other sources, coefficients and models constructed by an international team of consultants. Other indicators make use of data gathered and processed by other inter-national bodies, including other services of the Commission[1], the European Environment Agency, the OSPAR and HELCOM conventions, ITOPF, etc.

Sectoral breakdown

The main indicators show the pressures which human activities place on the environment. New in this edition is an intensified focus on sectoral aspects of environmental pressure, to meet the increasing demand for information concerning the degree to which the various economic sectors contribute to these pressures. This is particularly true in the context of the so-called integration process, a legal obligation derived from the Maastricht and Amsterdam Treaties to integrate the environmental aspect into other policy areas.

Where possible, an attempt has been made to quantify the contribution of the different sectors to the overall pressure. Depending on the data available this can take several forms, ranging from a single pie-chart, giving the sectoral breakdown for one or a few countries, to a number of extra pages, with full EU-15 coverage for a number of years.

Because of the wide variety of indicators and data sources used in compiling the indicators, the definitions of the sectors may differ from one indicator to another, as does the reliability of the data presented. However, this does not take away from the utility of providing an *indication* of the importance of the different sectors, as added information to help the policy maker to identify where more information and, perhaps, action is most needed to prevent deterioration of the environment.

Data quality and transparency

The indicators presented here come from a variety of data sources, many of which have not been fully harmonised. Furthermore the methodologies used are not always fully transparent nor well-established, with the result that the quality of the indicators varies, as does their reliability. In order to provide guidance on the status of the indicators, a 'traffic light' coding, or 'semaphore' for the indicators has been adopted. The quality of the indicators was assessed for four categories, using several criteria for each category:

- **Relevancy** refers to the closeness of the operational definition of the indicator to the environmental problem to be measured, the methodology chosen and the relevancy of the breakdown published.
- **Overall accuracy** represents issues such as comparability of data, reliability of data sources, coverage of the indicator, reliability of the methodology used and whether the results could be validated (e.g. sensitivity analysis; confirmation through other data or approaches).
- **Time representation** deals with the completeness of the time series and the consistency of methodology used over time.
- **Spatial representation** relates to the number of Member States that are represented in the indicator, the use of the same or similar methodologies by countries, the geographical coverage and reliability of data within the countries.

For each of the indicators, a quality 'semaphore' is presented as below:

Relevancy: Red	Accuracy: Yellow	Time Rep.: Green	Spatial Rep.: Green

Green indicates no significant problems with the indicator and Red means there are major reservations about this indicator. Many of the 'semaphores' have seen some improvement since the first publication, reflecting better data availability, or new, improved methodologies. Other data sources are presently still under development. Harmonisation of methodologies and data sources in the EU is one of the serious challenges for the beginning of the new millennium, especially in the light of the EU enlargement process.

Call for comments and proposals

The project team has put much effort into finding relevant data sources and initiatives. Many initiatives that looked promising and relevant had to be disregarded because they covered only a few of the fifteen EU Member States. Others were not yet at a stage where their results could be used in this publication, but will hopefully contribute to the next edition. Eurostat welcomes your observations and suggestions for future development, in particular information on data sources or initiatives which may have been missed.

[1] Including the Commission's Joint Research Centre

List of indicators and changes compared to previous edition

Resource Depletion	**Water consumption**	**Use of energy**	**Increase in territory permanently occupied by urbanisation; infrastructure...**	**Inputs of phosphate to agricultural land** (changed from Nutrient balance of the soil)	**Electricity production from fossil fuels**	**Timber balance**
Waste	**Waste landfilled**	**Waste incinerated**	**Hazardous waste**	**Municipal waste**	**Industrial waste** (replacing Waste per product during a n° of products entire lifetime)	**Waste recycled/material recovered**
Dispersion of Toxic Substances	**Consumption of pesticides by agriculture**	**Emissions of persistent organic pollutants (POPs)**	**Consumption of toxic chemicals**	**Index of heavy metal emissions to water**	**Index of heavy metal emissions to air**	***No indicator*** (formerly Emissions of radioactive material)
Water Pollution	**Emissions of nutrients by households** (changed from Nutrient use)	**Emissions of nutrients by industry** (changed from Ground water abstraction)	**Pesticides used per hectare of utilised agriculture area**	**Nitrogen used per hectare of utilised agriculture area**	**Emissions of organic matter by households** (replacing Water treated/water collected)	**Emissions of organic matter by industry** (changed from Emissions of organic matter as BOD)
Marine Environment & Coastal Zones	**Eutrophication**	**Fishing pressure**	**Development along shore**	**Wetland loss in coastal zones** (previously LB-2 Wetland loss)	**Discharges of heavy metals**	**Oil pollution at coast & at sea**	**Tourism intensity** (replacing Discharges of halogenated organic compounds
Climate Change	**Emissions of carbon dioxide (CO_2)**	**Emissions of methane (CH_4)**	**Emissions of nitrous oxide (N_2O)**	**Emissions of HFCs, PFCs and SF_6** (replacing Emissions of CFCs)	***No indicator*** (formerly Emissions of NO_x)	***No indicator*** (formerly Emissions of SO_x)
Air Pollution	**Emissions of nitrogen oxides (NO_x)**	**Emissions of volatile organic compounds (VOCs)**	**Emissions of sulphur dioxide (SO_2)**	**Emissions of particles**	**Consumption of gasoline & diesel oil by road vehicles**	**Primary energy consumption**
Ozone Layer Depletion	**Emissions of bromofluoro-carbons (halons)**	**Emissions of chlorofluoro-carbons (CFCs)**	**Emissions of hydrochloro-fluorocarbons (HCFCs)**	**Emissions of chlorinated carbons** (formerly OD-5)	**Emissions of industrially produced CH_3Br** (formerly OD-6)	***No indicator*** (former OD-4 Emissions of NO_x by aircraft deleted)
Urban Environmental Problems	**Urban energy consumption** (changed from Energy consumption)	**Non-recycled municipal waste**	**Non-treated urban wastewater** (changed from Non-treated wastewater)	***No indicator*** (formerly Share of private car transport)	***No indicator*** (formerly People endangered by noise emissions)	***No indicator*** (formerly Urban land-use)

RESOURCE DEPLETION

Introduction

In 1972, the first report to the Club of Rome, 'The Limits to Growth', was published. It marked the beginning of modern environmental policy. The report highlighted the impossibility of sustaining exponential economic growth and its associated *Resource Depletion.*

Better management and conservation of natural resources is one of the priorities of the proposed Sixth Environmental Action Programme for 2001-2010.

The emphasis on resources of petroleum during the first and second oil crises has been replaced by a wider picture of resources including (in the order of importance expressed by the expert panel) groundwater, energy, land, fertile soil, forests and fish stocks. Pressure on fish stocks is covered by the chapter on the *Marine Environment*, and is therefore not included here.

The indicators presented in this chapter portray the use of some key resources by the citizens of the European Union. In contrast to many other pressure indicators, their message is relatively clear and non-controversial. The main policy issue behind them is the depletion of resources or, putting it in a positive perspective, the efficient use of available natural resources.

Pressure on resources comes from different sectors, depending on the resource. Industry is the major consumer of timber (pulp and paper industry and wood industry) and it shares with other sectors a significant role in energy and water use and in land consumption. Agriculture is an important contributor to the pressure on water resources and soil fertility, the transport and energy sectors on non-renewable fossil fuels and households are final consumers of significant resources, such as water, energy, and land through the extension of urbanisation.

Apart from a general updating of the data, several changes have been introduced into this chapter since the previous publication. RD-1 now presents surface and ground water abstraction separately, and thus incorporates the indicator on ground water abstraction previously found in the WP chapter. RD-4 now presents the phosphate inputs to agricultural soils, as this is more closely linked to soil eutrophication, and associated fertility problems, than nitrogen.

RD-1: Water consumption

Definition and purpose

This indicator is intended to assess the degree to which available water resources are exploited. It is defined as the annual gross freshwater abstraction (from both ground and surface water resources). The indicator is expressed in cubic metres per capita to permit direct comparison between countries. A more meaningful indicator would compare abstraction of water to the rate at which water, and in particular ground water, is renewed, but the necessary data is not available.

When water resources are limited and renewal rates low, consumer demand for freshwater of a high quality exerts a major pressure on resources, and may lead to groundwater depletion, collapse of aquifers, and disturbance to the natural flow of rivers. This over-exploitation affects the water cycle as a whole and, as a consequence, the biological resources that depend on it.

Water demand arises from different economic and human activities: household demand, industry, agriculture, energy, urban amenities, tourism, etc.

The quantity of freshwater used per capita is directly related to individual and industrial water consumption patterns. It also directly reflects any precautionary measure taken, such as promotion of water-saving behaviour.

Surface water abstraction [1)]

m^3 per capita

	1980	1985	1990	1995	1999
B	:	:	:	737	666
DK	9	:	:	:	4
D	:	:	487	438	:
EL	362	317	576	442	477
E	934	1 065	809	712	897
F	:	521	556	597	:
IRL	279	:	:	264	:
I	:	707	:	:	:
L	:	60	:	69	68
NL	581	570	453	227	:
A	293	290	333	284	309
P	875	:	426	:	:
FIN	736	752	420	437	243
S	423	281	277	235	:
UK	213	184	201	162	217
IS	22	33	28	22	15
NO	:	391	:	:	:
CH	264	262	258	239	237

Source: Eurostat

Ground water abstraction [1)]

m^3 per capita

	1980	1985	1990	1995	1999
B	:	:	:	67	63
DK	226	:	246	170	138
D	:	:	98	93	:
EL	164	152	198	299	338
E	137	141	142	138	:
F	:	112	110	104	103
IRL	37	:	:	63	:
I	:	212	:	:	:
L	:	123	:	71	74
NL	72	77	70	75	:
A	150	154	153	135	132
P	206	:	309	:	:
FIN	40	65	48	57	53
S	72	75	71	73	:
UK	45	45	47	45	41
IS	454	432	630	592	551
NO	:	98	:	:	:
CH	146	148	141	127	123

Source: Eurostat

1) Some of the values presented refer to the closest year available (limits + / - 2 years).
B: refers to Flanders and Wallonia. Data for 1995 and 1999 are provisional.
EL: totals are Eurostat estimates (sum of the data available). Partial totals: Agriculture (only irrigation) + production of electricity.
E: 1995: data represent an average hydrological year, except for data on cooling of thermal and nuclear plants in 1995.
L: 1995 refers to annual average for the period 1990-1999.
A: for ground water (1995 onwards) and for total water (all years): partial totals including data on public water supply, agriculture, manufacturing industry and production of electricity
FIN: data for 1995 and 1999 are provisional.
UK: refers to England and Wales. Data for 1999 are provisional.

Methodology and data problems

This indicator should be interpreted with extreme caution. Sets of data are far from homogeneous so that for some countries caution is needed even in drawing conclusions about trends.

Comparison of water abstraction data between countries is very difficult, as there are important differences in sources used, definitions applied, and activities included. For example, some countries provide data only for the public water supply, so that no data is available for consumers with a private supply, e.g. irrigation water taken directly from a river or lake. It should also be noted that water abstracted from surface water to be used for cooling in electricity generation or in industrial processes is generally returned to the water body and therefore does not contribute to depletion. This fraction should not be included in the indicator, but the available statistical data do not always allow for such precision.

Information on use by the different sectors of the economy also varies widely.

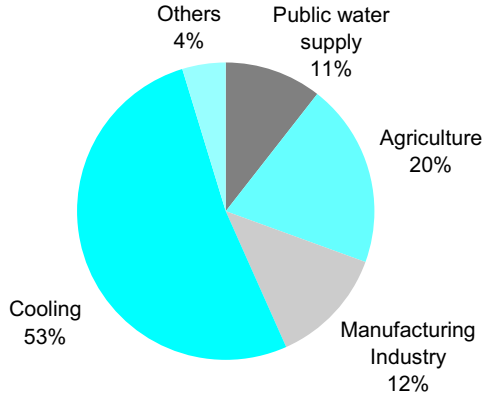
RD-1: Water consumption

Relevant Sectors: Agriculture, Industry, Services, Households

Targets

The purpose of the proposed Water Framework Directive (COM (97) 49 Final)[1] is to establish a framework in order to achieve the following four main objectives of a sustainable water policy: sufficient provision of drinking water, sufficient provision of water for other economic requirements, protection of the quality of the water, and alleviation of the adverse impact of floods and droughts. According to the proposal, Member States should examine the state of fresh and ground waters and among other elements, include estimations on water abstractions no later than 31.12.2001.

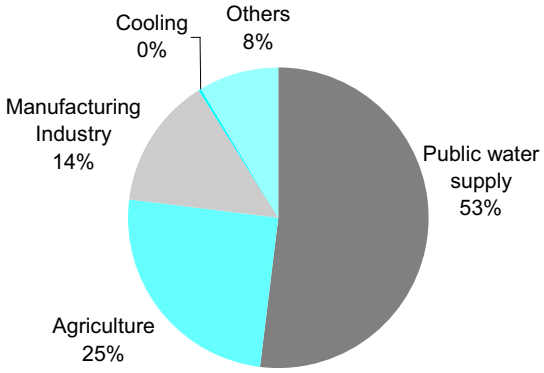
Sectoral use of surface water abstraction in EU-15 (mid-1990s) 1)



Source: Eurostat

1) EU-15 excludes EL, I and P.

Sectoral use of ground water abstraction in EU-15 (mid-1990s) 1)



Source: Eurostat

1) EU-15 excludes EL, I and P.

Relevance: Green	Accuracy: Red	Time rep.: Red	Spatial rep.: Red

Comments

Surface water is the dominant source of freshwater in the EU, supplying over 80% of total demand in two-thirds of the countries. The major use of surface water is for cooling purposes (51%), mainly in electricity generation, followed by agriculture and industry. Cooling water is generally returned to the water body from which it was extracted.

Public water supply puts an important demand on freshwater, especially groundwater, in many EU countries. This is mainly explained by the increase in domestic water use due to the growth of population and to changes in living standards. Moreover, demand for household water is increasing in Mediterranean countries due to tourism. In fact, the per capita figures in countries with a large tourist industry, e.g. the Mediterranean countries, are well above the EU average as they are calculated using the normal population, and do not include the massive influx of tourists each summer, which temporarily, but regularly, inflates the population adding extra pressure to sometimes scarce water resources.

Water demand by industry decreased throughout the 1980s and 1990s due to the decline in industrial production, improvements in water use efficiency and increased recycling.

[1] OJ L 327, 22/12/2000, Officially adopted by the European Parliament and Council in September 2000.

RD-2: Energy use

Definition and purpose

This indicator is defined as gross inland consumption of energy (GIC), i.e. the total amount of primary energy and imports of refined petroleum products and electricity needed to meet the national demand for energy. It is calculated as follows:

Primary production + Imports ± Stocks changes - Exports - Marine bunkers

This demand for energy is met mainly by non-renewable resources such as coal, oil, natural gas and uranium, resources of which are limited. Only a very small percentage of the resources currently used are semi-renewable energy sources such as biogas, wood and waste and renewable sources such as water and wind.

Much of this primary energy is transformed, e.g. converted into electricity *(see RD-5)* or refined into petroleum products, before being used by the final consumer. These transformation processes result in important losses, up to 65% in conventional power stations burning fossil fuels. These losses are the reason why the energy needed to meet the national demand (GIC) is much higher than the final energy consumed by the end user *(presented in UP-1).*

The indicator is presented as gross inland consumption of energy per capita, in tonnes of oil equivalent, to allow comparison between countries.

Gross inland energy consumption [1)]

toe per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	% change 1985-98
EU-15	3.5	3.5	3.6	3.6	3.6	3.6	3.7	3.6	3.6	3.6	3.7	3.8	3.8	3.8	16
B	4.4	4.6	4.6	4.6	4.7	4.8	5.0	5.0	4.9	4.9	5.0	5.3	5.4	5.5	28
DK	3.8	3.8	3.9	3.7	3.5	3.5	3.9	3.7	3.8	3.9	3.9	4.4	4.1	4.0	8
D	4.6	4.6	4.7	4.7	4.6	4.5	4.3	4.2	4.2	4.1	4.1	4.3	4.2	4.2	- 4
EL	1.8	1.8	1.9	2.0	2.2	2.2	2.2	2.2	2.2	2.3	2.3	2.4	2.4	2.6	47
E	1.9	1.9	2.0	2.2	2.3	2.3	2.4	2.4	2.3	2.5	2.6	2.6	2.7	2.8	50
F	3.7	3.7	3.8	3.8	3.9	3.9	4.1	4.1	4.1	3.9	4.1	4.3	4.2	4.3	23
IRL	2.5	2.6	2.7	2.7	2.7	2.9	2.9	2.9	2.9	3.1	3.1	3.2	3.4	3.5	48
I	2.4	2.5	2.5	2.6	2.7	2.7	2.8	2.8	2.7	2.7	2.8	2.8	2.9	3.0	27
L	8.6	8.4	8.3	8.5	9.1	9.4	9.8	9.7	9.7	9.4	8.2	8.2	8.0	7.7	4
NL	4.3	4.4	4.5	5.0	4.4	4.5	4.7	4.6	4.7	4.6	4.8	4.9	4.8	4.8	21
A	3.1	3.2	3.3	3.2	3.2	3.3	3.5	3.3	3.2	3.2	3.3	3.5	3.5	3.6	23
P	1.2	1.3	1.4	1.5	1.7	1.7	1.7	1.9	1.9	1.9	2.0	2.0	2.1	2.3	85
FIN	5.5	5.7	6.1	5.7	5.9	5.7	5.8	5.7	5.8	6.0	5.7	6.0	6.4	6.4	24
S	5.6	5.9	5.8	5.8	5.6	5.5	5.7	5.3	5.4	5.6	5.7	5.9	5.7	5.4	3
UK	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.8	3.8	3.7	3.9	3.8	3.9	13

Source: Eurostat

1) % change 1985-98 refers to change in gross inland energy consumption in absolute figures expressed as a percentage of the 1985 figure.

Methodology and data problems

No problems were encountered for this indicator.

RD-2: Energy use

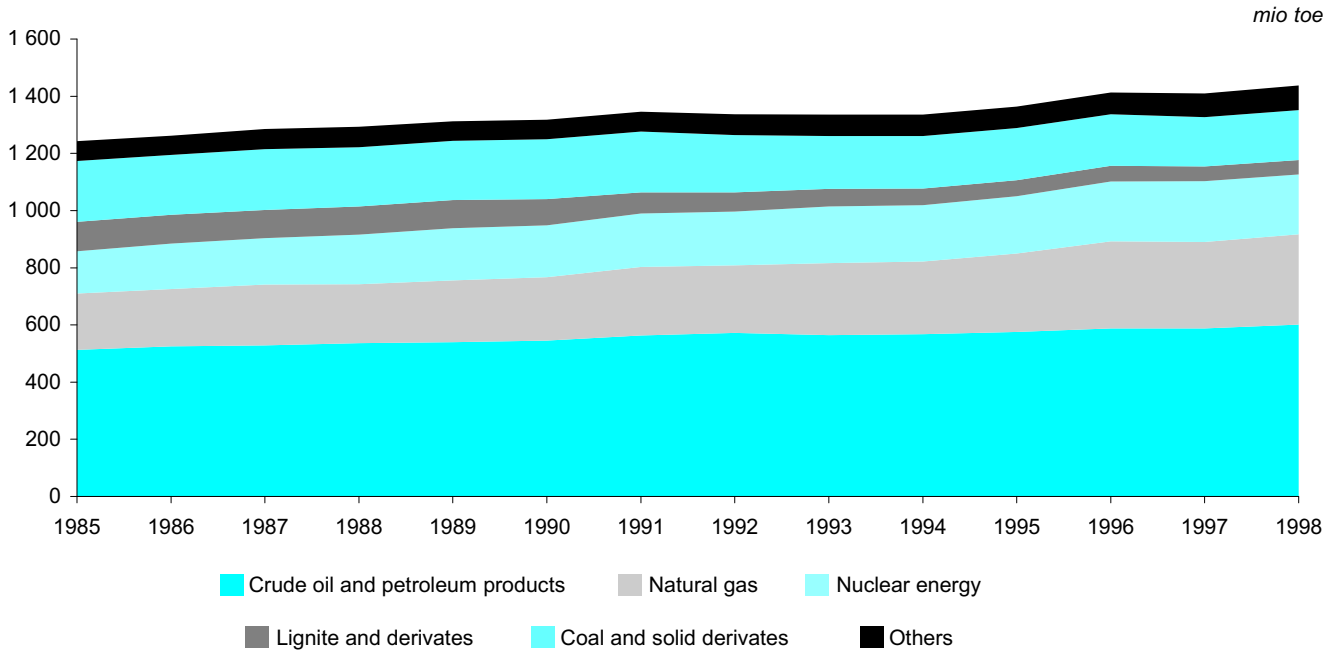
Relevant Sectors: Agriculture, Energy, Households, Industry, Services, Tourism, Transport

Targets

There are no fixed targets for energy use. Existing texts refer to the use of energy in general terms: for example, the European energy charter aims to enhance energy efficiency, Article 130 of the Treaty on the European Union calls for prudent and rational utilisation of natural resources, and the Energy Protocol of Lisbon (1994) calls for energy efficiency. Targets for CO_2 can be used as a proxy to define energy use strategies.

In December 2000 EU energy ministers agreed to increase use of renewable sources of energy from the present level of 6% to 12% community-wide by 2010 and 22% in the long term. The targets are non-binding and vary considerably for each of the Member States.

Gross inland energy consumption by resource - EU-15



Source: Eurostat

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

Gross inland consumption in EU-15 increased by 15.7 % between 1985 and 1998. Petroleum consumption has grown by 17.5 % since 1985 and provides for the major share of GIC (41.8 %) in the EU-15. Natural gas showed the largest increase, up 59.4 %. Its share increased from 15.9 % of total GIC in 1985 to 22 % in 1998. Nuclear energy increased by 42 % over the same period, with a share of 14.6 % in 1998, compared to 12 % in 1985.

Use of lignite has fallen considerably, with consumption now less than half of the 1985 level, due to the move away from this type of fuel in the new German Länder. Over the same period overall consumption of coal fell by 18.1 %, due to major reductions in coal mining activities in the EU, particularly in the UK and Germany. Their relative shares are now 3.5 % and 12.2 % respectively.

Also worth noting is the increase in other forms of energy, mainly from (semi)-renewable sources, by 25.8 %. However, these sources still only account for 6 % of the total GIC.

RD-3: Increase in territory permanently occupied by urbanisation

Definition and purpose

The area of land in a country or region is a fixed resource. No new land is being created. Building upon land is a long-term, almost irreversible, change that effectively removes that land from the pool available for other purposes, in particular for agriculture, forests and recreation, as a carbon sink and as a habitat for flora and fauna. It also seals the land, preventing the replenishment of aquifers, and in some cases can contribute to flooding. These effects are worse when the built area is large, as is the case for urban areas, roads, etc. Therefore urbanisation and infrastructure are considered the major causes of pressure on land resources.

The indicator shows the change in territory permanently occupied by urbanisation, infrastructure, waste-tipping and quarrying, over a period of twenty years, expressed in square kilometres and shown also in terms of population. The definition includes land used for residential purposes, roads, technical infrastructure, industrial and commercial premises and recreational sites, but excludes scattered farm buildings, yards and annexes.

Built-up land [1) 2)]

	Built-up land (1 000 ha)							Built-up land (ha/1000 people)				
	1980	1985	1990	1995	1999	% built-up	% annual growth	1980	1985	1990	1995	1999
B	434	484	507	534	552	18.08	1.27	44.0	49.1	51.0	52.7	54.0
DK	314	:	:	362	:	8.40	0.95	61.3	:	:	:	:
D	2 700	2 933	3 090	4 118	4 298	12.04	:	44.0	48.0	49.0	50.0	52.4
EL	:	489	:	:	:	:	:	:	49.3	:	:	:
E	:	:	:	453	507	:	2.86	:	:	:	11.6	12.9
F	:	3 245	3 515	3 916	4 098	7.46	1.68	:	58.8	62.1	67.5	69.5
IRL	:	:	:	:	:	:	:	:	:	:	:	:
I	:	:	:	:	:	:	:	:	:	:	:	:
L	:	:	22	:	:	8.51	:	:	:	58.0	:	:
NL	509	535	539	561	575	15.41	0.65	36.1	37.0	36.2	36.4	36.5
A	:	:	311	341	397	4.73	2.75	:	:	40.4	42.4	49.1
P	:	:	1 414	:	1 637	17.79	1.64	:	:	142.5	:	164.0
FIN	773	:	939	956	:	2.83	1.43	162.0	:	add	add	:
S	1 089	:	1 172	:	:	2.59	0.74	131.2	:	137.4	:	:
UK	:	:	:	:	3 613	14.80	:	:	:	:	:	60.9
IS	110	:	125	135	140	1.36	1.28	484.7	:	492.5	505.7	507.8
NO	:	:	:	:	:	:	:	:	:	:	:	:
CH	:	246	:	279	:	7.00	1.10	:	38.1	:	40.0	:

Source: Eurostat and various national sources

1) D: data refer to 'settlement areas', including housing, industrial sites, traffic areas, and adjacent non built-up areas. Data for 1980-1990 do not include the former GDR.

2) EL and E: residential land only.

Methodology and data problems

The definitions and methods used for collection of data on built-up land vary from one country to another. Similarly the frequency of the collection of this data is not harmonised between countries. In fact, as land use is often the responsibility of local authorities, the definitions, etc. may even differ within a country. The result is that it is very difficult to compare the data for the different Member States. Normally one would expect the built-up area per 1000 people to show some sort of similarity between the countries, but the range from 36.5 ha in the Netherlands to 164 ha in Portugal suggests some fundamental problems in the underlying data, even taking into account that more of Portugal will be built up to provide for the tourist industry.

In 2001 Eurostat launched a harmonised survey of land use, based on a standardised manual of concepts on land cover and land use. Although intended primarily for data on agricultural land use, the survey will cover all uses of land. However, it will be many years before a time series allowing analysis of the increase in built-up land is available.

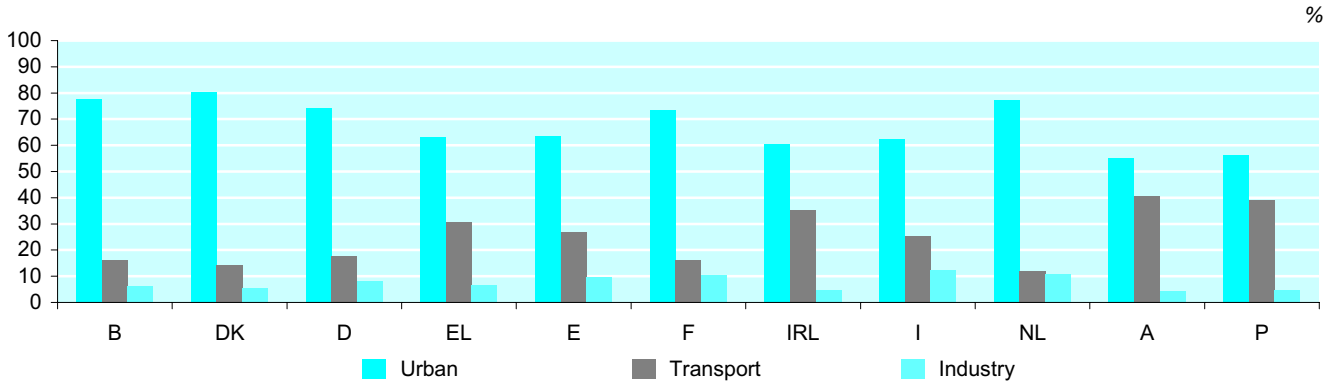
RD-3: Increase in territory permanently occupied by urbanisation

Relevant Sectors: Households, Services, Transport, Industry

Targets

The European Spatial Development Project adopted in May 1999, provides for a coordinating framework for EU and national sectoral policies, aiming to control 'land use pressure' by reducing the physical expansion of towns and ensure the re-use of previously developed 'brown-field' sites. UK, D, DK have already set specific targets for use of brown-field sites. Moreover specific action plans are being implemented by several European cities and regions.

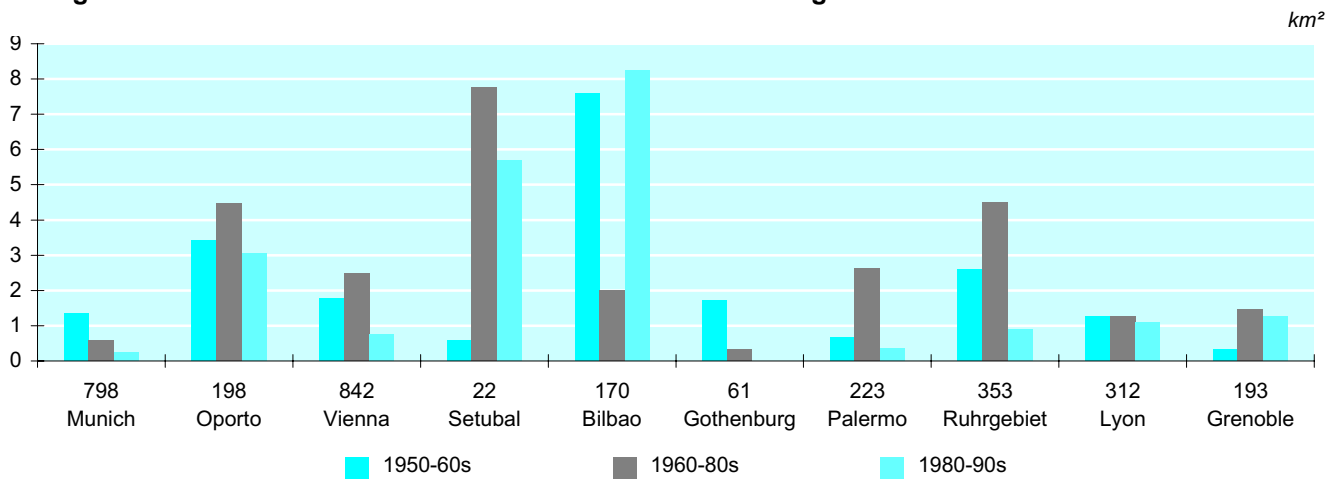
Urbanised area by sectors [1)]



Source: CORINE Land Cover (100 m size) and TRAINS transformed

1) A, FIN: CORINE land cover 250 size ; CORINE land cover data period for 1989-1997 and data TRAINS for 1992.

Change from natural to artificial land in selected EU cities or regions [1)]



Source: JRC (Moland project)

1) The figures on the x axis refer to the area of the city or region considered.

Relevance: Yellow	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

In spite of considerable gaps in the data on land use there is evidence that in the last two decades the area of built-up land increased at a relatively important rate in EU countries. The extent of built-up land varies among the different Member States, more or less in relation to their population densities, with B, D, NL, P and UK recording the highest levels (from 12-18% of their territory). The least built-up countries are the Nordic countries, A and IS (between 1 and 5%).

The Moland project collects information on a range of parameters for a small number of cities or urban areas within the EU. The graph above represents a selection of these cities. It is interesting to note the relatively important expansion in smaller cities like Bilbao, Setubal and to a lesser extent, Oporto, with the more moderate expansion recorded for bigger cities such as Munich or Vienna for instance. However, the project did not cover a sufficient number of cities to justify the assumption that this is a general trend.

RD-4: Inputs of phosphate to agricultural land

Definition and purpose

A fertile soil is an important resource for agriculture and thus for food production. Soil fertility depends on an adequate but not excessive level of nutrients in the soil: nutrients are taken up by crops and may need replacing if fertility is to be maintained. The most important nutrients taken up from the soil by crops and other plants are nitrogen, phosphorus and potassium. In agriculture these are normally replaced by the use of organic and mineral fertilizers. Other secondary nutrients are also required but in smaller amounts. Over-fertilization can lead to eutrophication of the soil and a reduction in fertility. Over-supply of phosphorus is the most important cause of eutrophication of soil. Phosphate is less mobile in soils than nitrogen and surpluses (i.e. supply minus uptake) tend to accumulate from year to year *(see also WP-4 on nitrogen inputs)*.

This indicator presents the average amount of phosphate spread on agricultural land in the 15 EU countries, shown as kg per hectare.

Phosphate inputs to agricultural land [1)]

kg per hectare of agricultural land

	1993			1995			1997		
	Phosphate inputs from manure	Phosphate inputs from fertilizers	Total inputs of phosphate	Phosphate inputs from manure	Phosphate inputs from fertilizers	Total inputs of phosphate	Phosphate inputs from manure	Phosphate inputs from fertilizers	Total inputs of phosphate
EU-15	22	29	59	22	28	50	22	27	49
B	84	34	118	84	34	118	82	29	111
DK	37	20	56	36	18	53	37	19	55
D	29	24	54	28	23	52	28	24	52
EL	16	36	52	16	38	54	16	38	54
E	10	20	30	10	20	30	10	21	31
F	21	36	56	21	37	57	20	37	57
IRL	36	32	68	36	33	68	37	26	63
I	17	40	57	16	37	53	16	34	50
L	41	39	80	42	39	81	41	32	73
NL	98	33	132	90	35	125	79	30	109
A	:	:	:	23	15	39	22	17	39
P	14	19	33	14	18	33	15	18	32
FIN	:	:	:	14	33	47	14	26	40
S	:	:	:	16	16	32	16	16	32
UK	25	23	49	25	24	49	25	25	50

Source: Eurostat

1) Agricultural land refers to arable land, permanent crops and permanent meadows and pastures.

Methodology and data problems

As presented here, this indicator does not estimate the uptake of phosphate by plants, nor does it take into account the fertility of the soil before application of phosphate. It must therefore be seen as a rough indicator, indicating where a more detailed investigation into soil fertility may be needed, rather than an indicator of fertility itself.

Soil fertility is a rather localised issue, and presenting data for the whole country can hide large differences between the regions of the country. In particular, animal manure is normally spread on the land of the farm to which the animals belong. Therefore inputs of phosphate to these soils will be higher than the national average. This is especially the case in large countries where the agriculture system is not homogenous. At this stage it is not possible to present regional data.

RD-4: Inputs of phosphate to agricultural land

Relevant Sectors: **Agriculture**

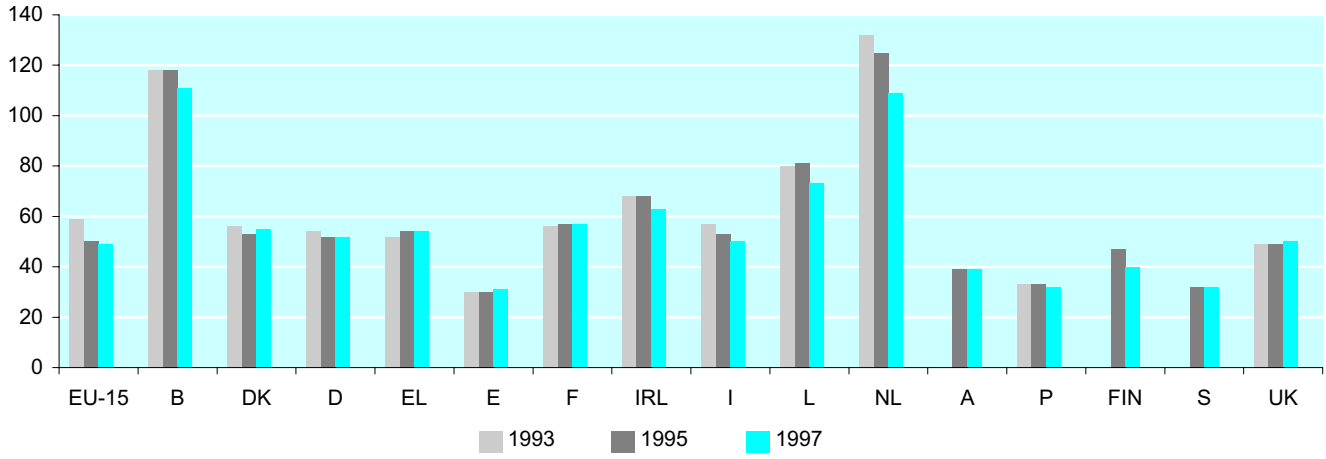
Targets

The 1999 CAP reform seeks to reinforce and encourage environmental awareness and sustainable practices among farmers. The Codes of Good Agricultural Practice proposed by the Commission address a series of issues including the conditions of fertilizer applications and animal effluent storage. The Nitrate Directive aims at a 'balanced fertilization' in which inputs should not exceed the needs of crops, to reduce losses to soil.

The EU is also a party to the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) and to the Convention on the Protection of the Marine Environment of the Baltic Sea (HELCOM). One of the aims of both Conventions is to reduce pollution from nutrient inputs from land-based sources.

Phosphate inputs to agricultural land [1)]

kg per hectare of agricultural land



Source: Eurostat

1) Agricultural land refers to arable land, permanent crops and permanent meadows and pastures.

Relevance: Yellow	Accuracy: Yellow	Time rep. : Green	Spatial rep. : Green

Comments

In the EU as a whole, phosphate inputs from both types of fertilizers decreased during the period 1993-1997, though the picture varies from one country to another. In most countries animal manure is the most important source of phosphate spread on agricultural land, and this input has tended to be stable from one year to the next, though a significant decrease is recorded in the Netherlands, one of two countries with a particularly high level of phosphorous input from manure. The other country is neighbouring Belgium.

The implementation of the Nitrates Directive should lead to a reduction in applications of both nitrogen and phosphate, particularly from animal manure. For the purposes of the Directive, the Netherlands, Luxembourg, Germany, Denmark and Austria have declared their whole territory as vulnerable zones.

The new focus in the Common Agricultural Policy on environmental concerns should see an increase in mandatory codes of good agricultural practice and in linking support to farmers to their environmental behaviour. This should lead to an increased use of soil analysis to assess the need for phosphate, and to fertilizer advice programmes to encourage more reasoned fertilization processes.

[1] Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources: Official Journal L 375, 31/12/1991 p. 0001 - 0008

RD-5: Electricity production from fossil fuels

Definition and purpose

This indicator is defined as the total amount of electricity produced from fossil fuels (oil, coal, lignite and gas). The indicator represents the overall pressure on non-renewable sources of fuel caused by the production of electricity.

Non-renewable fuels such as coal lignite, oil, natural gas (and uranium) are by far the most important source used for electricity production. Approximately half of the electricity produced in the EU is derived from fossil fuels. Most of the other half is derived from nuclear or hydro-electrical sources.

The production of electricity is an important pressure, as the increased consumer demand for electricity is mainly met by increased burning of fossil fuels. Production of electricity in conventional power stations results in transformation losses of around 65%.

The indicator is presented as electricity production from fossil fuels per capita, to allow comparison between countries.

Net electricity production from fossil fuels [1)]

kWh per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	% in 1998		
															Fossil	Nuclear	Hydro
EU-15	2 490	2 502	2 566	2 507	2 659	2 734	2 915	2 826	2 788	2 858	2 960	3 058	3 007	3 062	50.1	34.4	13.7
B	2 015	1 660	1 852	1 955	2 352	2 524	2 578	2 515	2 535	2 767	2 882	2 856	2 733	3 246	41.6	55.2	1.9
DK	5 304	5 589	5 338	5 038	4 046	4 547	6 461	5 374	5 861	6 904	6 232	9 197	7 325	6 604	89.2	0.0	0.1
D	3 988	4 066	4 011	3 944	4 005	4 106	4 239	4 016	3 904	3 896	3 922	4 031	3 915	4 034	63.9	29.5	4.1
EL	2 313	2 290	2 494	2 799	2 931	2 980	2 912	3 094	3 144	3 309	3 303	3 312	3 427	3 681	90.5	0.0	9.0
E	1 592	1 541	1 529	1 258	1 712	1 701	1 715	1 955	1 783	1 833	2 050	1 813	2 313	2 331	49.0	30.3	19.0
F	929	714	652	613	886	780	1 000	824	555	538	616	694	618	869	10.5	75.7	13.5
IRL	2 911	3 007	3 140	3 180	3 425	3 615	3 775	3 945	4 034	4 159	4 403	4 716	4 864	5 028	92.8	0.0	5.9
I	2 164	2 239	2 564	2 588	2 803	2 929	2 836	2 913	2 867	2 954	3 211	3 164	3 273	3 373	78.8	0.0	19.0
L	1 032	1 136	1 129	1 183	1 280	1 281	1 407	1 337	1 334	1 005	814	848	610	415	14.2	0.0	82.6
NL	3 904	4 136	4 248	4 272	4 449	4 367	4 489	4 590	4 508	4 627	4 648	4 829	4 937	5 087	91.1	4.1	0.1
A	1 415	1 407	1 491	1 312	1 489	1 944	2 014	1 546	1 578	1 758	1 899	2 047	2 087	1 978	28.6	0.0	68.6
P	720	1 049	967	894	1 805	1 763	1 909	2 320	2 072	1 891	2 274	1 775	1 897	2 361	62.7	0.0	34.3
FIN	3 500	3 391	3 789	3 967	2 685	3 116	4 723	3 421	4 014	5 145	4 599	5 893	5 133	4 334	33.1	31.2	21.9
S	588	589	537	479	360	374	563	663	768	893	848	1 336	790	738	4.2	45.8	47.8
UK	3 841	3 925	4 007	3 949	3 882	4 029	4 037	3 836	3 716	3 754	3 888	4 027	3 759	3 836	:	27.9	1.9

Source: Eurostat

1) D and EU-15 data before 1991 do not include the former GDR.

Methodology and data problems

No methodological problems were encountered for this indicator. However, data for 1985 - 1990 for Germany are for the old Bundesländer only, whereas for 1991 onwards, data refer to the united Germany. Therefore between 1990 and 1991 there is a break in the time series for Germany and thus for the total EU-15.

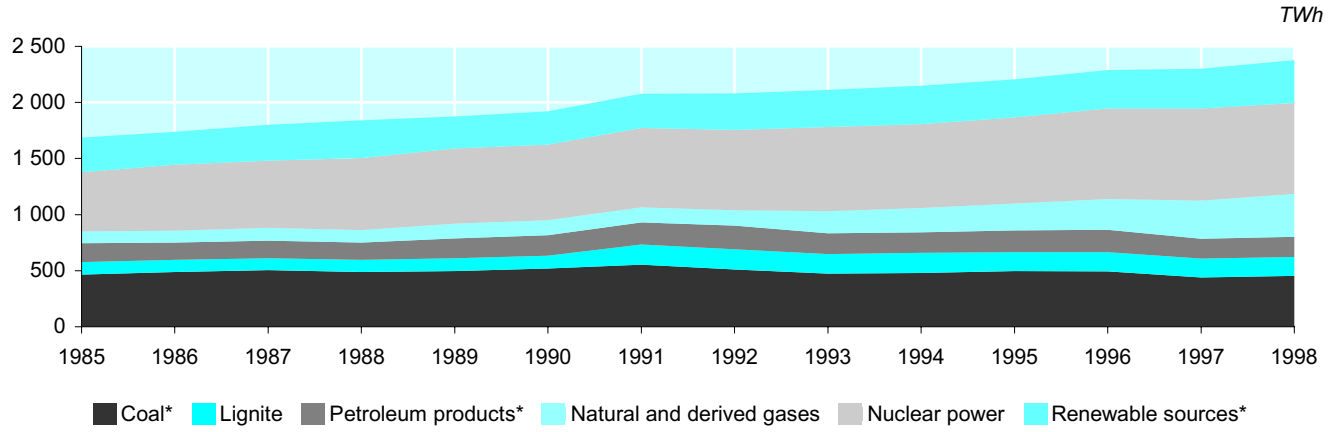
RD-5: Electricity production from fossil fuels

Relevant Sectors: **Energy**

Targets

In December 2000 EU energy ministers agreed to double use of renewable sources of energy, to 12% community-wide by 2010 and to 22% in the long term. The electricity production sector is the most important user of renewable energy sources such as wind, water, biomass, etc. and any expansion in use of these sources is expected to take place mainly in this sector. The targets are non-binding and vary considerably for each of the Member States.

EU production of electricity - all sources [1)]



Source: Eurostat

1) Renewable sources = hydropower, geothermal power, wind power, biomass, and other sources.

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

The fuels used to produce electricity are often decided by geography as much as by political or economic decision. The geography of flat countries rules out hydroelectric plants, whereas for countries with a suitable topography, hydropower is more or less fully exploited, reducing scope for increases from this source. Moreover, hydro-electricity is vulnerable to weather: a dry winter can result in a shortfall and the need to increase electricity generation from other sources. Rejection of nuclear power in some countries means that increased demand for electricity is normally met by increased use of fossil fuels.

Net electricity produced in the EU in 1998 amounted to 2.36 million GWh, with 50% coming from fossil fuels (coal 19.2%, lignite 7.1%, petroleum products 7.6%, natural gas 15%), 34.4% from nuclear power stations, 13.7% from hydropower and less than 2% from 'alternative' sources (biomass, wind and geothermal heat). This represented an increase of some 13% compared to 1991. The largest increases were seen in Ireland (+40%), Portugal and Greece (both +30%) and Spain (+26%). This reflects the growth in the economies of these countries. Production of electricity from natural gas increased by 230% over this period, mainly due to the UK, which invested heavily in the 90s in combined cycle gas turbines, which are more efficient than conventional power stations, and which now account for a third of the electricity produced from gas.

On the other hand, generation from coal, lignite and petroleum all fell by 17%, 8% and 7% respectively, between 1991 and 1998. This move away from coal is strongest in the UK, where coal-based power stations produced 65% of electricity in 1991, but only 34% in 1998. Germany, Spain, Ireland, the Netherlands and Portugal all increased generation from coal over the same period. Only seven EU countries burn lignite to produce electricity, the most important of which is Germany, due to the large use of lignite in the new Bundesländer, followed by Greece. A sharp decline was seen in all countries except Greece, which increased its generation of electricity from lignite by 38%. Lignite now supplies almost 70% of Greece's electricity.

RD-6: Timber balance

Definition and purpose

Wood is an economically valuable natural resource, renewable in the long term, provided conditions remain the same. However, if more wood is continually being removed than is replaced by new growth, this puts a pressure on both natural and production forests. This indicator therefore shows the ratio of new growth to fellings and is defined as the ratio of fellings to net annual increment (NAI). Both fellings and NAI are measured as volumes overbark, and they are averages over a certain period of time. They include wood from production forests as well as from natural forests.

The concepts are defined as follows: Net annual increment is the gross increment minus natural losses. *Gross increment* is the average volume of increment of all trees (all diameters, down to a stated minimum diameter) over a given period, and includes small trees, which have just reached the minimum diameter and are thus included for the first time. *Fellings* refer to the volume of all trees, living or dead, which are felled during a given period, whether or not removed from the forest or other felling sites.

Averages over several years are a better indicator than actual figures, as annual fellings can be influenced by weather (a major storm can bring down a large number of trees, providing enough wood for several years needs) and by a downturn in the economy (reduction in the need for wood, or availability of cheaper supplies from abroad). Thus the figures below are the averages for 1980-1990 and for 1990-1999.

Timber balance

	1 000m^3 fellings		1 000m^3 net annual increment (NAI)		Wood harvesting ratio %	
	Average 1980-1990	Average 1990-1999	Average 1980-1990	Average 1990-1999	Average 1980-1990	Average 1990-1999
EU-15	228 131	309 553	332 484	487 770	69	63
B	3 426	4 400	4 457	5 176	77	85
DK	2 535	2 444	3 515	3 200	72	76
D	42 716	48 584	:	90 649	:	54
EL	3 376	:	3 648	3 813	93	:
E	18 530	15 863	33 488	30 092	55	53
F	:	60 174	67 649	93 211	:	65
IRL	1 568	2 330	3 363	3 500	47	67
I	:	10 101	:	30 507	:	33
L	:	400	:	667	:	60
NL	1 520	2 150	2 419	2 328	63	92
A	17 402	20 041	23 972	27 837	73	72
P	11 245	11 500	11 793	14 312	95	80
FIN	57 460	54 300	71 735	73 666	80	74
S	60 218	67 766	95 357	94 122	63	72
UK	8 135	9 500	11 088	14 690	73	65
IS	:	0	:	58	:	0
LI	:	16	:	25	:	64
NO	12 765	11 632	18 546	24 391	69	48
CH	5 760	7 451	6 070	8 848	95	84

Source: UN-ECE; extracted from EFIDAS, EFI (European Forest Institute, Joennsu, Finland)

Methodology and data problems

These figures are for national production of roundwood only and make no distinction between wood from managed forests and from natural forests, though the effect on natural forests is of more concern than forests maintained specifically for wood production.

To truly represent the pressure put on world forest resources by consumers in the EU, this indicator should also include information on imports of timber and timber products such as sawnwood, plywood, fibreboard, paper and pulp, furniture, etc. However such detail is not available.

RD-6: Timber balance

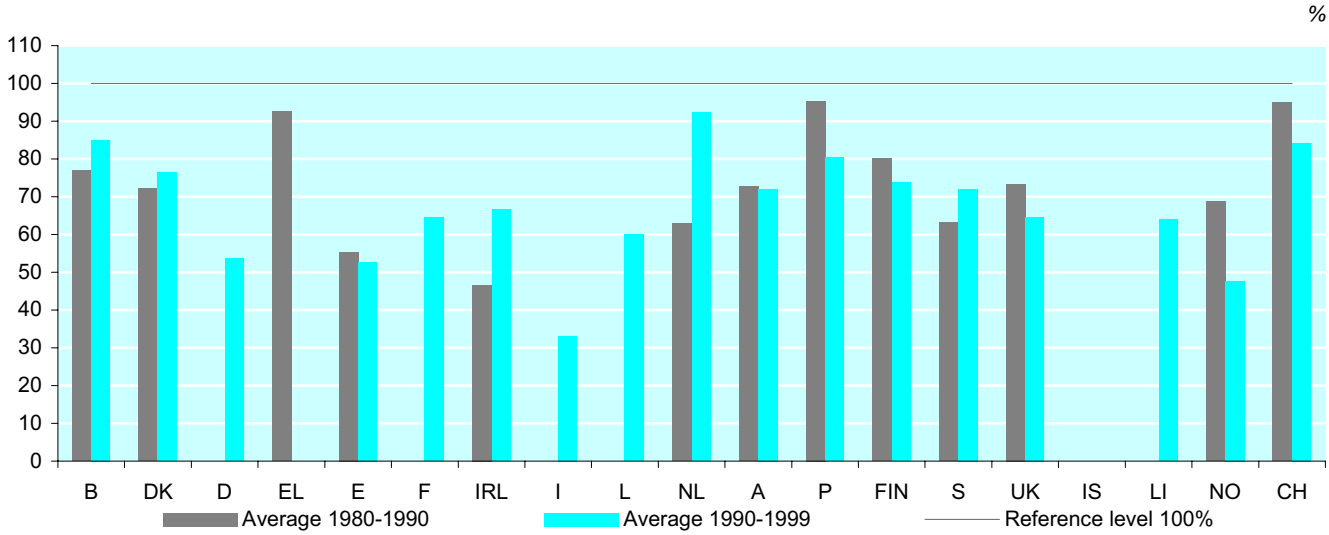
Relevant Sectors: **Agriculture**

Targets

Reference levels for this indicator should be the 100 % mark. This would mean that the Net Annual Increment is equal to the volume of felled timber. Values *below* that level indicate more growth than removals, and thus represent a sustainable management of renewable resources.

The 6EAP calls for better management of key natural resources, including forests.

Wood harvesting ratio (fellings divided by net annual increment)



Source: UN-ECE; extracted from EFIDAS, EFI (European Forest Institute, Joennsu, Finland)

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep: Green

Comments

For several decades now, EU forest resources have been expanding slightly and this trend is expected to continue. Fellings have remained well below increments, and losses through road building and other developments are counterbalanced by expansion elsewhere into agricultural and other land. Over the period 1980-1990, the total NAI in EU forests averaged 334 million m³, while total fellings amounted to 228 million m³, 68 % of the net annual increment. For the period 1990-1999, both NAI (488 million m³) and total fellings (310 million m³) increased, but the harvesting ratio fell to 63 % of the NAI.

In 1998, the total volume of growing stock available for wood supply in Community forests was estimated at around 13 419 million m³, of which two thirds are coniferous species. As a result of the enlargement in 1995, EU growing stock rose by 80 %. Removals and fellings almost doubled, while the NAI grew by approximately 44 %. The NAI is therefore about 3.5 % of the growing stock, while fellings represent about 2.3%, meaning that EU forests are increasing by approximately 1 % per year.

The EU produced 90% of its roundwood needs in 1998, indicating that approximately 10 % of EU needs had to be imported.

WASTE

Introduction

Waste is defined in Article 1 of Directive 75/442/EEC[1] as any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard.

As a result of economic growth, waste from many sources has increased over the last decades. The waste management sector, in charge of waste collection and treatment, has become an independent economic sector, as waste becomes an environmental problem of growing concern.

Both hazardous and non-hazardous waste exert pressures on the environment. The environmental impacts that have been most closely associated with waste are, for example:

- pollution of ground and surface water,
- soil contamination and nature deterioration,
- health impacts from emission of hazardous gases, dust and odour,
- greenhouse effect (e.g. methane emissions from landfill sites).

The approach outlined in the proposed Sixth Environmental Action Programme is to prioritise waste prevention, followed by recycling, waste recovery and incineration, and as a last resort, landfilling. The target is to reduce the quantity of waste going to final disposal by around 20% on 2000 levels by 2010 and in the order of 50% by 2050. To achieve this, the 6EAP proposes to make producers responsible for collecting, treating and recycling their waste products; to promote recycling and markets for recycled materials; and to develop an Integrated Product Policy approach.

Important instruments for the implementation of the European Waste Policy are waste management plans at local, regional or national level, according to Article 7 of Directive 75/442/EEC. The EU strategy for waste management is defined in Council Resolution 97/C 76/01[2].

The Basle Convention on the control of transboundary movements of hazardous waste and its disposal has also had a major influence on the waste management policies of Member States. A further development of the Convention introduced a ban on exports of hazardous waste to non-OECD countries. This was transposed into Community legislation by Council Regulation 97/120/EC[3].

This theme describes the different types of waste generated, i.e. municipal waste, hazardous waste, industrial waste (new in this edition), as well as the destination of the waste, i.e. waste landfilled, incinerated or recycled. Some overlap is unavoidable, for example, the industry sector is the most important sector in the generation of hazardous waste. (These characteristics do not cover the total in- and output in the waste sector).

Although most of the data used in this policy field comes from the bi-annual Eurostat/OECD joint questionnaire to Member States, compilation of these waste statistics at Community level has shown that the sets of data in the Member States are very heterogeneous. To remedy this situation, a Regulation on Waste Statistics including a system of statistical surveys in industry, local authorities and the processing sector, has been submitted by the Commission. The proposed methodology was tested via four pilot studies undertaken by Denmark, the Netherlands, Portugal and the United Kingdom. The main conclusion was that a common classification system is crucial for the comparability of data between Member States.

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1 OJ L 194 of 25.7.1975, p. 39 as amended by Council Directive 91/156/EEC of 18.3.91

2 of 24 February 1997, OJ C 076 of 11.3.1997, p.1-4

3 OJ L 22 of 24.1.1997, p. 14.

WA-1: Waste landfilled

Definition and purpose

The indicator covers all waste landfilled on sites adapted or not adapted to minimum standards concerning protection of soil and groundwater. This includes landfills for hazardous waste, municipal and non-hazardous waste and landfills for inert waste. The amount of waste landfilled depends on the national policy on waste management, i.e. on the role that is given to waste avoidance, incineration and recycling, and its scope. Illegal dumping is an example of an insufficient scope of waste management policy.

The indicator measures the amount of waste landfilled, a practice that may lead to several environmental problems such as leaching of nutrients, heavy metals and other toxic compounds, emission of greenhouse gases (basically CH_4 and CO_2), land use (including loss of natural areas) and increased heavy transport. Hence, landfill should be the last option for waste disposal and should only be used when all other possible waste treatment methods have been exhausted.

Environmental pressures from landfilling vary depending on the type of waste landfilled, the construction of the landfill and the hydrological conditions.

Municipal and hazardous waste landfilled [1)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Municipal waste landfilled										Hazardous waste landfilled								
B	:	223	212	219	215	208	186	162	145	:	:	:	53	44	52	52	:	:	62
DK	:	:	:	90	98	96	82	65	67	:	:	:	:	:	12	10	11	9	11
D	560	:	:	344	:	:	:	:	:	:	58	:	:	40	:	:	:	:	:
EL	296	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	22	:
E	241	:	301	309	304	310	297	:	:	:	25	:	:	:	:	:	:	:	:
F	:	:	:	:	:	:	:	:	398	:	12	11	14	12	13	13	12	12	14
IRL	:	:	:	:	:	398	:	:	:	:	:	:	:	:	:	1	9	:	11
I	:	:	:	:	:	419	377	370	361	:	:	5	:	:	:	11	:	14	
L	:	:	:	185	167	158	161	142	144		306	:	:	51	110	42	0	0	0
NL	:	240	:	:	187	:	109	:	82	72	18		28	12	13	11	8	9	24
A	:	205	190	172	153	149	137	:	:	:	:	:	:	:	:	:	:	:	:
P	:	:	:	315	365	342	353	384	408	:	:	:	:	:	:	:	:	:	:
FIN	482	:	389	333	248	268	:	314	:	:	:	:	:	:	:	:	:	46	:
S	164	:	:	:	137	:	:	:	147	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	26	16	:	:	:	:	:
IS	:	:	485	484	472	472	481	511	518	533	:	:	:	:	:	:	:	:	:
NO	:	:	403	381	402	456	425	383	417	:	:	:	0	:	:	:	:	:	:
CH	192	191	181	180	171	162	154	153	151	150	:	21	25	25	29	25	24	31	31

Source: Eurostat

1) B:NSI estimates; Municipal waste refers only to household waste. Hazardous waste includes all types of waste according to national definitions.
D: Source: Statistisches Bundesamt, Germany, Abfallbeseitigung im Produzierenden Gewerbe und in Krankenhäusern für 1993, Fachserie 19, Reihe 1,2, 1997.
F: refers to the amount of industrial hazardous waste disposed of in treatment installations. The amounts of industrial waste, treated or stocked inside industry are mostly unknown.
L: municipal waste figures for 1995-1997 are provisional. Hazardous waste figures for 1990, 1993 and 1994 include non-hazardous waste.
NO: municipal waste: excluding residuals from incineration that have been landfilled.

Methodology and data problems

Sets of data are only available for municipal and hazardous waste, though overall the data situation is not very good, particularly for hazardous waste. This leaves a large section uncovered by data. There is no true link between waste types and treatment procedures in most countries, and the different landfill sites for *hazardous waste, non-hazardous waste, municipal waste or inert waste* can receive other types of waste than those for which they have been designed.

As statistical data collection is always limited to legal activities, thus if a significant percentage of illegal activities is suspected, the reported data will be insufficient (and the environmental pressure will of course be very high).

Moreover, as the indicator does not specify to what extent a landfill is equipped with technical systems (isolation from soil and groundwater, drainage system and gas collection system) and to what extent nuisance and nature deterioration is prevented, the indicator can only lead to a first estimation of the environmental pressure from the landfill of waste.

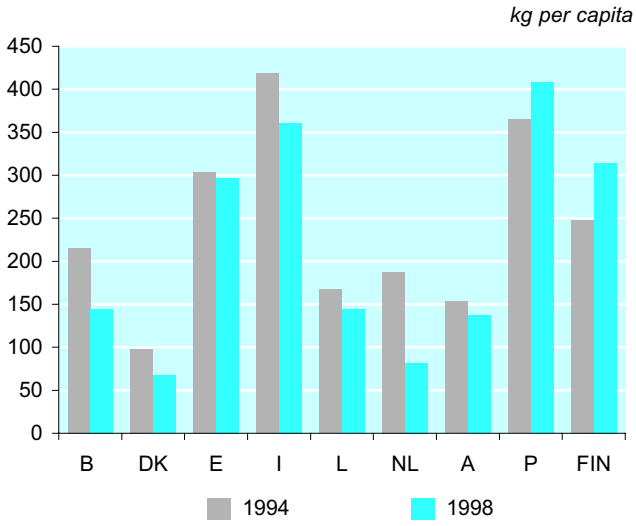
WA-1: Waste landfilled

Relevant Sectors: **Industry, Households, Services**

Targets

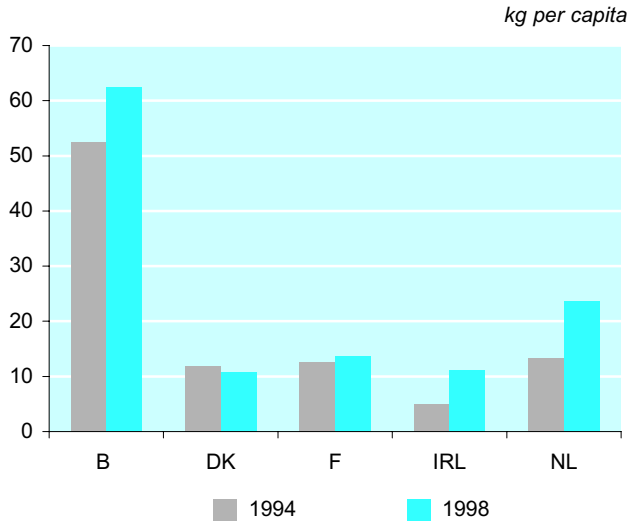
Council Directive 1999/31/EC[4] on the landfill of waste, which came into force in July 1999, regulates and restricts landfilling in Europe. It identifies waste types excluded from landfilling, defines application and permission rules, lists the control and monitoring procedures for the operational and after-care phase of a landfill and the technical waste acceptance procedures to be established. It is expected that with this Directive the activity of landfilling will become highly regulated. The environmental burden from landfilling will decrease and the economic importance (costs and benefits) will increase.

Municipal waste landfilled 1)



Source: Eurostat

Hazardous waste landfilled 2)



Source: Eurostat

1) Municipal waste landfilled: E: 1998 is 1996 data, I: 1994 is 1995 data, A: 1998 is 1996 data, FIN: 1998 is 1997 data.
2) Hazardous waste landfilled: IRL: 1994 is 1995 data.

Relevancy: Green	Accuracy: Yellow	Time rep.: Yellow	Spatial rep.: Yellow

Comments

The overall data situation is not very good, especially for hazardous waste. This makes it difficult to evaluate the trend in landfilling in most countries.

The definition of *municipal waste* can vary from one country to another, depending to some extent on the organisation of waste collection. However, there appears to be a general decrease in the amounts of municipal waste landfilled in the EU, while in EFTA countries the amounts have increased, except in CH. Landfill is still the cheapest and most commonly used option for disposal of this type of waste, except in Denmark, Luxembourg, Netherlands and Switzerland.

The quantities of *hazardous waste* sent to landfill are considerable smaller than for municipal waste, at less than 30 kg per capita except in Belgium. Again landfill appears to be the preferred method of disposal of this type of waste. It should be pointed out that every country has its own list of what constitutes a hazardous waste, so these figures conceal a wide range of different types of waste.

It would also be useful to know more about the generation of hazardous waste itself and about the treatment methods which have been developed. In particular little data exists on hazardous waste which is treated inside the industry which generated it.

4 OJ C 182 of 16.7.1999, p.1

WA-2: Waste incinerated

Definition and purpose

The main purpose of this indicator is to show the total amount of waste incinerated. Therefore the indicator covers the total amount of all types of incinerated waste (hazardous/non-hazardous, industrial/commercial/household). It does not differentiate between different types of facilities, e.g. whether they are fitted with equipment to reduce pollution or to recover energy. Wastes which are incinerated via co-combustion in special industrial furnaces such as cement ovens, blast furnaces and kilns are included. The indicator thus reflects the total amount of waste incinerated in special waste incineration plants or co-combusted. In order to evaluate environmental pressure from waste incineration the following factors would need to be taken into account: the incineration capacity, pollution abatement facilities attached to incinerators, energy recovery potential and actual energy recovery at incinerators and residuals (including gaseous emissions).

Municipal and hazardous waste incinerated [1)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	1990	1991	1992	1993	1994	1995	1996	1997	1998
	Municipal waste incinerated										Hazardous waste incinerated								
B	:	157	159	152	152	147	137	143	134	:	:	:	11	7	7	10	:	:	11
DK	:	:	:	290	298	294	308	315	312	:	:	:	:	:	-	:	:	:	:
D	105	:	:	106	:	:	:	:	:	:	31	:	:	25	:	:	:	:	:
EL	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		:
E	16	:	17	16	16	18	18	:	:	:	:	:	:	:	:	:	:	:	:
F	:	:	:	:	:	:	:	:	184	:	16	16	17	18	21	21	22	21	23
IRL	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	14	13	:	18
I	:	:	:	:	:	:	27	30	34	:	:	:	:	:	:	2	:	5	:
L	359	369	364	342	329	307	301	295	284	:	-	-	-	-	-	-	-	-	-
NL	:	155	:	:	143	:	176	:	236	245	12	:	11	10	11	12	10	10	16
A	41	44	51	51	50	54	61	:	:	:	8	:	13	12	12	11	13	:	:
P	:	:	:	1		1	1			:	:	:	:	:	:	:	:	:	:
FIN	10	:	:	:	10	:	:	16	:	:	:	:	9	:	:	:	:	11	:
S	152	:	:	:	149	:	:	:	158	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	3	3	:	:	:	:	:
IS	:	:	50	57	57	56	56	56	55	54	:	:	:	:	:	:	:	:	:
NO	:	:	73	79	81	84	81	84	85	:	:	:		:	:	:	:	:	:
CH	337	326	313	307	293	288	282	281	280	299	:	33	37	37	42	40	42	47	52

Source: Eurostat

1) B: NSI estimates, not validated by regions. Municipal waste only covers household waste;'hazardous' includes all hazardous waste (national definitions).
F: refers to the amounts of industrial hazardous wastes disposed of in treatment installations for that purpose. The amounts of industrial waste which are treated or stocked inside the industries are mostly unknown.
L: municipal waste: provisional data.
CH: municipal waste 1990-91 estimates

Methodology and data problems

The data situation is similar to WA-1. The quantities of waste incinerated depend on the growth in waste levels caused by services, consumption and production of goods, the efficiency of recycling systems and the availability and use of appropriate incineration technology. Therefore the sets of data are insufficient to carry out a sectoral analysis. The data on the incineration of hazardous waste may not include all waste incinerated at co-combustion plants within industry itself.

Waste incineration is a highly ambiguous topic because it leads both to positive effects (destruction of hazardous substances, reduction in the volume of hazardous waste to be landfilled, energy recovery, replacement of primary resources via co-combustion) and to negative effects (hazardous residues, emissions of hazardous gases, polluted water from flue gas cleaning). Waste incineration competes with other waste treatment methods. As a result, the environmental pressure and the environmental benefit from incineration should be related to alternative methods of treatment, e.g. a waste treatment system including separate collection or sorting followed by material recovery, composting of biodegradable components and final disposal. Data sets on the amount of waste incinerated alone are insufficient to accurately describe environmental pressure.

WA-2: Waste incinerated

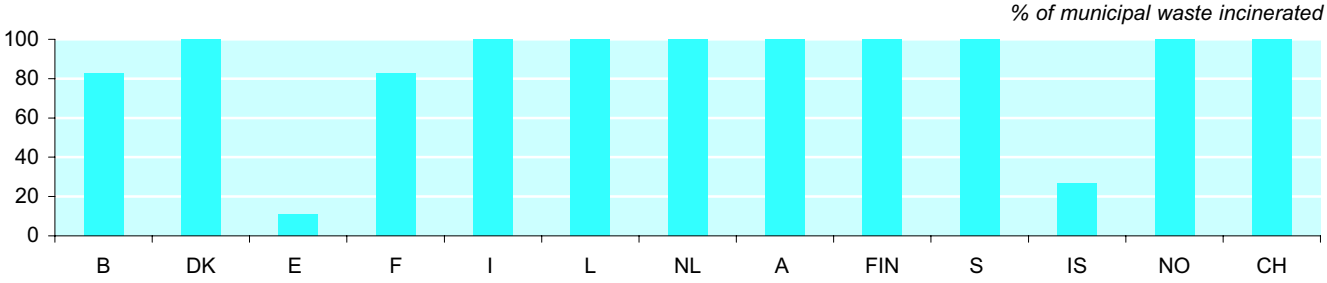
Relevant Sectors: **Households, Industry, Services, Tourism**

Targets

The objectives of Directive 2000/76/EC of 4 December 2000 (OJ L 332, 28/12/2000 P. 0091 - 0111) is to prevent or to limit as far as practicable negative effects on the environment, in particular pollution by emissions into air, soil, surface water and groundwater, and the resulting risks to human health, from the incineration and co-incineration of waste. This aim shall be met by means of stringent operational conditions and technical requirements, through setting emission limit values for waste incineration and co-incineration plants within the Community. Municipal waste incineration and all other types of incineration, namely co-combustion, are included.

Incineration of municipal waste with energy recovery (1998) 1)

% of municipal waste incinerated

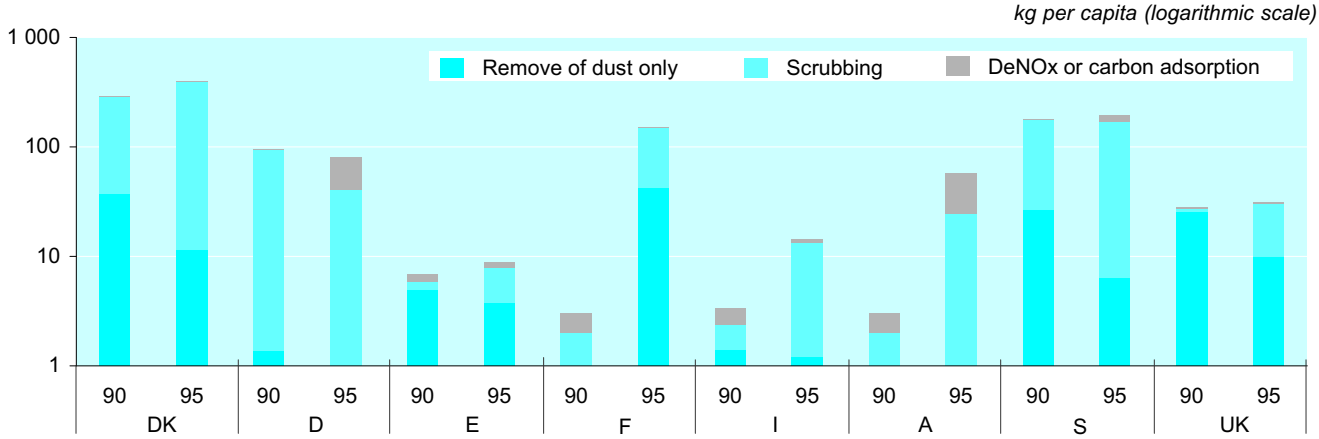


Source: Eurostat

1) B: NSI estimates, household waste only; L: provisional data; E: 1996 data; A: 1996 data; FIN: 1997 data.

Use of flue gas treatment systems by municipal waste incineration plants - selected Member States

kg per capita (logarithmic scale)



Source. ISWA reports

Relevance: Yellow	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Green

Comments

Several countries, B, L, CH, have reduced the amount of municipal waste incinerated during the nineties, while others, DK, NL, A, IS and N have increased this type of incineration. Although overall levels of incineration of municipal waste vary from one country to another, depending on the number and location of suitable incinerators, the recovery of energy from the process, mainly for heating or for generating electricity, is widespread.

The environmental effects of waste incineration are strongly linked to the flue gas scrubbing technology that is used. According to the information from ISWA, the state of scrubbing technology at municipal waste incineration plants in Europe differs greatly. In DK and F large quantities of waste are incinerated in systems fitted only with dust removers, or scrubbing systems. In E, P, FIN and I, where very little waste is incinerated, similar systems are in use. Only D, A and S have a large number of plants equipped with additional special equipment to remove nitrogen oxides or dioxins and mercury from the flue gas. These are some of the problems which Directive 2000/76/EC is intended to tackle.

In general the amount of hazardous waste incinerated is about the same as the amount landfilled, though incineration seems to be on the increase.

WA-3: Hazardous waste generated

Definition and purpose

The purpose of this indicator is to show the trend in the amount of hazardous waste generated in EU Member States and how far society has progressed in changing consumption patterns and technologies resulting in less hazardous material and products. Council Decision 94/904/EC[1] establishes a list of hazardous waste (HWL) pursuant to Article 1(4) of Council Directive 91/689/EEC[2] on hazardous waste. Within the EU, a waste type is considered hazardous if it is included in this list. Annex III of the Directive lists 14 properties of waste types which render them hazardous. At national level, waste types may be additionally declared hazardous if, in the opinion of a Member State, they display any of these properties.

Hazardous waste generated and recovered [1)]

% of waste generated or recovered

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	Hazardous waste generated										Hazardous waste recovered									
B	:	:	:	:	77	:	:	:	:	:	:	:	:	:	68	:	:	:	:	:
DK	:	:	:	:	37	48	51	48	53	:	:	:	:	:	:	79	76	81	80	:
D	165	:	:	112	:	:	213	:	:	:	:	:	:	:	:	:	:	:	:	:
EL	44	:	44	:	:	34	:	:	:	:	27	:	20	:	:	:	:	:	:	:
E	44	:	:	:	:	87	:	:	:	:	18	:	:	:	:	:	:	:	:	:
F	124	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
IRL	:	:	:	:	:	69	91	:	100	:	:	:	:	:	:	42	42	:	41	:
I	57	60	:	:	:	47	27	59	:	:	:	:	:	:	:	5	:	26	:	:
L	306	:	:	218	202	485	383	339	:	:	:	:	:	:	:	:	:	:	:	:
NL	70	:	95	57	58	65	66	82	92	:	4	:	3	9	10	14	15	11	16	:
A	:	:	51	60	64	72	75	78	107	:	:	:	:	:	:	:	:	:	:	:
P	:	:	:	:	:	67	:	60	:	:	:	:	:	:	:	:	:	:	:	:
FIN	:	:	111	:	:	:	:	94	:	:	:	:	:	:	:	:	:	13	:	:
S	18	:	:	:	16	:	:	:	91	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	42	36	:	:	:	:	:	:	:	:	7	9	:	:	:	:	:	:
IS	:	:	:	:	23	22	26	26	26	29	:	:	:	:	83	83	86	86	86	75
NO	:	:	:	:	148	149	149	149	148	:	:	:	:	:	13	:	:	:	18	:
CH	:	108	119	120	123	118	124	134	147	:	:	5	5	7	4	6	5	5	7	:

Source: Eurostat

1) B: NSI estimates In practice, it is not possible to apply the Basel classification.
D: 1996 preliminary data, break in time series after1993 due to new methodologies.
IRL: including recovery on site.
L: provisional data.
A: comprises only primary waste documented by the national consignment note system as having been reported by the national producer.
S: between 1993 and 1998, changes in methodology.
NO: data on hazardous waste generated are estimates.

Methodology and data problems

Ideally the data should correspond to the HWL derived from the European Waste Catalogue. However the main source currently available is the Eurostat/OECD Joint Questionnaire on waste, which classifies hazardous waste according to the Y-codes of the Basel Convention[3]. Most of the data provided are based on the national definitions of hazardous waste types. Data availability should change in the near future when the HWL is applied by the Member States and the reporting obligations of the European Commission become applicable.

1 OJ L356 of 31.12.1994, p. 14
2 OJ L377 of 31.12.1991, p. 20
3 Convention on the control of transboundary movements of hazardous waste and their disposal (1994)

WA-3: Hazardous waste generated

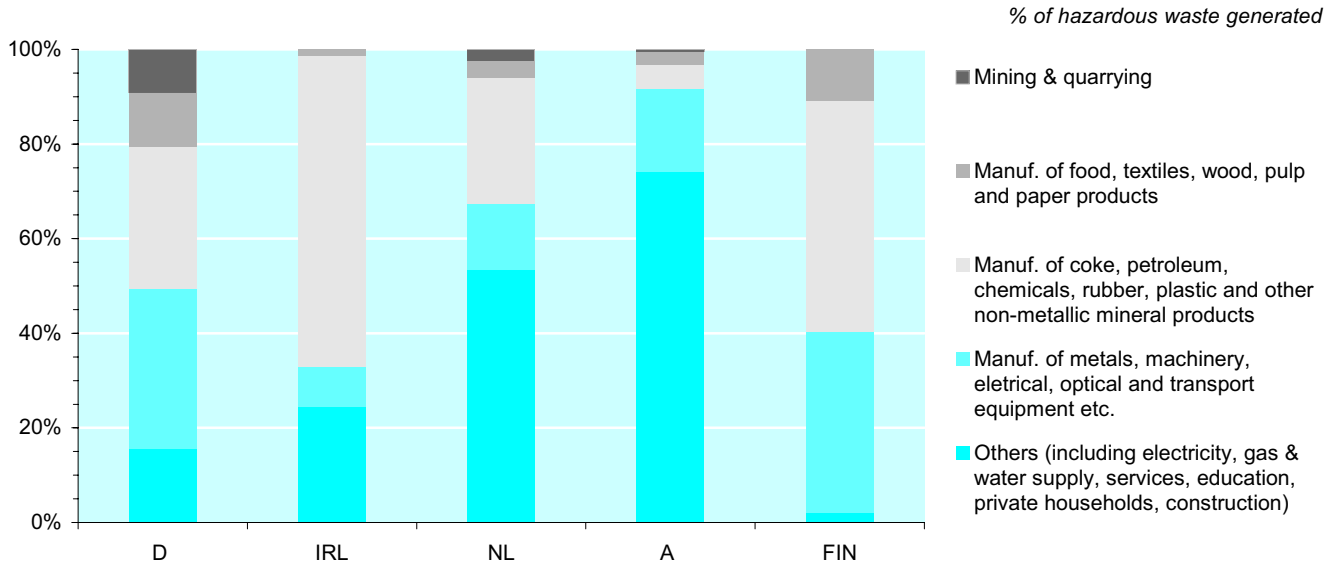
Relevant Sectors: Industry, Services, Energy, Agriculture, Households

Targets

Directive 91/156/EEC[4] of 18 March 1991 (amending Directive 75/442/EEC on waste) lays down the basic principles for waste, including hazardous waste, management. Articles 3 and 4 state that Member States shall support the reduction of the generation of hazardous wastes, the reduction of their hazardous properties and their recovery. They must ensure that wastes are recovered, recycled or disposed of without danger to human health or harm to the environment. Article 5 aims to make the EC self-sufficient in waste disposal and requires Member States to move towards their own self-sufficiency in disposal by making available adequate waste disposal installations.

Regulation 259/93 EC[5] lays down a policy of reduction of waste shipments to the absolute minimum for waste destined for disposal and adopts the OECD control system. Since 1 January 1998, an amendment to the Regulation has prohibited all exports of hazardous waste from EC to non-OECD countries.

Generation of hazardous waste - sectoral breakdown (mid 1990s)



Source: National statistics

1) D, A and FIN: limited data on services, education and private households.

Relevance: Yellow	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

Currently only a restricted interpretation of the data is possible. The data is mainly based on national definitions of 'hazardous waste' some of which have changed over time, causing breaks in time series. The data on the recovery of hazardous waste should be interpreted with care, because some Member States include waste recovered on site while others do not.

Landfill is the most important method of disposal for hazardous waste. Hazardous waste sent to landfill has decreased in all the Member States which reported. A second important method of disposal, except for DK and IRL, is the incineration of hazardous waste. The data reported show no uniform trend in the use of incineration as a method of disposal.

4 OJ L078, 26/03/1991 P. 0032 - 0037

5 OJ L030 of 06.02.1993, p. 1

WA-4: Municipal waste generated

Definition and purpose

The purpose of this indicator is to track the amount of municipal waste which is generated per capita and, by implication, the effects of measures to reduce waste.

Municipal waste is waste collected by or on behalf of municipalities. It includes waste from households, commercial activities, office buildings and institutions, as well as waste with similar properties from businesses and from municipal services. Household waste includes bulky waste and separately collected fractions of waste materials.

Municipal waste is classified according to the following main categories: paper, paperboard & paper products, plastics, glass, metals, food waste, garden waste & similar materials, and other similar waste.

Municipal and household waste generated [1)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	Municipal waste generated										Household waste generated									
B	:	430	444	464	485	495	498	530	527	535	:	380	391	407	422	424	417	429	434	439
DK	:	:	:	:	539	567	619	588	593	:	:	:	:	:	496	500	527	526	528	:
D	634	:	:	537	:	:	543	:	:	:	:	:	:	:	:	:	:	:	:	:
EL	296	304	311	:	:	:	:	372	:	:	:	:	:	:	:	:	:	:	:	:
E	323	:	355	:	365	381	390	:	:	:	:	:	:	:	:	:	:	:	:	:
F	:	:	:	586	:	598	:	:	644	:	:	:	:	426	:	436	:	:	453	:
IRL	:	:	:	:	:	514	:	:	557	:	:	:	:	:	:	273	:	:	315	:
I	:	:	:	:	:	450	453	463	466	:	:	:	:	:	:	:	:	:	:	:
L	591	565	503	509	489	465	462	437	427	:	:	:	:	:	:	352	343	316	297	:
NL	:	498	:	562	564	549	567	587	589	594	:	396	:	466	466	469	486	505	510	524
A	622	:	:	671	:	:	654	:	:	:	326	312	315	315	321	329	345	370	374	:
P	302	:	331	361	384	392	406	414	433	:	:	:	:	:	:	:	:	:	:	:
FIN	623	:	:	:	414	:	:	489	:	:	:	:	:	:	:	:	:	191	:	:
S	375	:	:	:	366	:	:	:	452	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	496	477	:	508	:	348	425	:	:	:	462	443	458	472	478
IS	:	:	612	617	615	622	631	645	661	685	:	:	243	244	241	240	243	248	250	258
NO	472	:	520	516	547	626	632	619	647	596	201	:	237	255	253	270	273	287	309	314
CH	613	612	599	599	597	598	601	606	616	640	408	:	402	:	401	:	404	:	425	:

Source: Eurostat

1) B: NSI estimates. Household waste includes waste from small enterprises in several regions.
D: municipal waste refers to household waste, similar waste from other sources, bulky waste and sweepings; 1996 preliminary data. Break in time series after 1993 due to new methodologies.
L: municipal waste: provisional data.
NL: municipal waste: 1991 underestimation of separately collected paper; household waste includes households and commerce including separate collection.
A: municipal waste: includes construction site waste; household waste: 1990-1996 excludes own deliveries to disposal sites.
UK: municipal waste:1998 is based on a survey in England & Wales; household waste:1991,1997-99 data refer to England & Wales only.

Methodology and data problems

The availability and quality of the data are the main obstacles in the formulation of this indicator. Currently there is no uniform definition of municipal waste applied by Member States. Most of the data come from the municipalities and some data sets may not include all separate collected materials for recycling because this type of collection can be carried out by private organisations or enterprises rather than on behalf of municipalities.

In order to increase the quality of data, more information on waste collected by private enterprises is required.

WA-4: Municipal waste generated

Relevant Sectors: Households, Services, Tourism, Industry

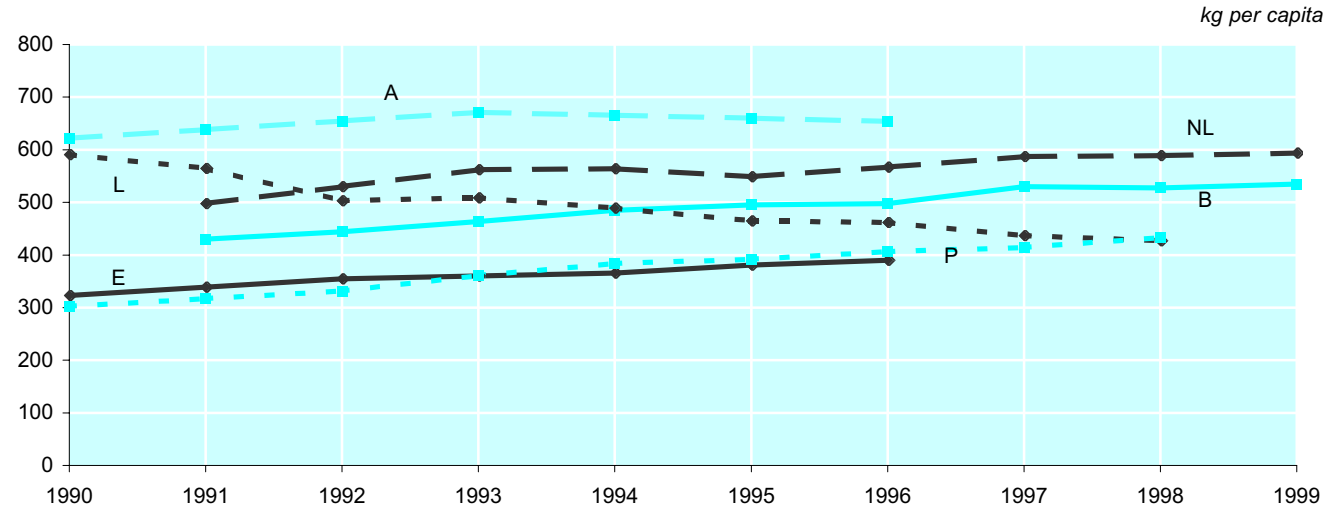
Targets

The 5EAP calls for a stabilisation by the year 2000 of the amount of municipal waste generated in Member States to levels not exceeding 300 kg per capita per year (1985 levels). Also, it calls for waste which cannot be recycled or reused to be disposed of, ideally, by combustion as a fuel; failing that, by incineration or, as a last resort, to be sent to landfill sites. Some countries have set national targets: for example Austria's target is to keep solid waste production at or below 1993 levels.

The 6EAP prioritises waste prevention and has set a target of a 20% reduction in the quantity of waste going to final disposal from 2000 levels by 2010.

Under Council Directive 94/62/EC[6] on packaging and packaging waste, by June 2001 all Member States (except EL, IRL, P) should be recovering at least 50% of packaging waste by weight. Agenda 21 recommends that by the year 2000 all industrialised countries should have a national programme for efficient waste reuse and recycling *(see WA-6)*.

Municipal waste generated - selected Member States



Source: Eurostat

Relevance: Green	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Green

Comments

Comparison of countries is difficult because the definitions applied differ from one country to another. However, the data provided show that more than half of the 18 countries (B, DK, D, F, IRL, NL, A, UK, IS, NO, CH) generate more than 500 kg per capita of municipal waste every year, while Greece and Spain generate less than 400kg per capita per year. Generally speaking, the levels have been relatively stable in recent years.

Trends should be interpreted carefully. In some Member States the increase per capita may be caused by the increase in the population served by municipal collection systems. In other Member States the decrease may be caused by the expanded activities of private waste collection enterprises.

Because the sets of data include separately collected and recycled waste these figures give no information on the trends in recycling activities.

The differences between municipal waste and household waste are caused by the different collection systems in Member States: in Belgium, Denmark and the UK municipal waste comes mainly from households; in France, Luxembourg, the Netherlands, Austria and Finland it includes considerable amounts of waste from commercial and industrial activities.

6 OJ L365, 31/12/1994 p. 0010 - 0023

WA-5: Industrial waste generated

Definition and purpose

The main purpose of this indicator is to monitor the total waste generated by the industrial sector. Industrial waste is a direct output of the industrial processes, and is strongly linked to the process technology that is used. Waste reduction usually cannot be achieved by using end-of-pipe technology. Given that the indicator tracks the generation of waste, the development of the indicator is linked to economic development.

This indicator shows the amount of industrial waste produced by the economic sectors corresponding to NACE sector D 'manufactured products'. This includes the food industry, textile industry, leather industry, wood & wood products, paper & paper products, printing & publishing, chemical industry, rubber & plastic, refineries, non-metallic mineral products, basic metal industry, fabricated metal products & machinery, and others. It does not cover construction waste, waste from electricity, gas & water supply and waste from mining & quarrying.

Industrial waste includes all types of waste, such as hazardous waste, non-hazardous waste and mineral waste. The main fraction is mineral waste. Industrial waste is subject to different types of waste treatment methods, such as incineration, landfill or recycling.

Industrial waste generated [1)]

1 000 tonnes

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
B	:	:	13 989	12 570	12 370	13 240	:	:	:	13 779
DK	:	:	:	:	2 309	2 563	2 632	2 736	2 783	:
D	84 051	:	:	65 119	:	:	:	:	:	:
EL	:	:	:	:	:	:	6 682	:	:	:
E	13 800	:	:	:	:	:	:	:	:	:
F	:	:	:	105 000	:	101 000	:	:	:	:
IRL	:	:	:	:	:	3 781	:	:	5 113	:
I	:	:	:	:	:	22 210	:	22 993	:	:
L	1 440	:	:	:	:	:	:	:	:	:
NL	7 665	:	8 049	:	8 208	:	8 893	:	9 779	:
A	12 955	:	:	12 315	:	:	14 284	:	:	:
P	:	:	:	:	:	13 316	:	10 989	:	:
FIN	:	:	15 500	:	:	:	:	15 910	:	:
S	:	:	:	13 990	:	:	:	:	19 780	:
UK	56 000	:	:	:	:	56 000	56 000	:	50 000	:
IS	:	:	10	10	10	10	10	10	10	10
NO	2 000	:	:	3 288	:	:	2 875	:	:	:
CH	:	:	:	:	:	:	:	:	:	:

Source: Eurostat

1) B: NSI estimates.
EL: industry covers only establishments with more than 30 persons.
F: estimates.
I: 1995: may include some mining and quarrying waste.
L: estimates, special industrial waste.
A: 1993, 1995: total BAWP (Bundes Abfallwirtschaftsplan) minus construction waste, municipal waste, medical or other waste, excess manure and half of the waste generated from water purification & distribution and from waste water treatment.
S: 1998: excluding recycling8) NO: estimates.

Methodology and data problems

Availability and quality of data vary from country to country. In contrast with other types of waste, data availability is poor. Some of the data are based on estimations. The definition of industrial waste also varies from country to country. A large portion of industrial waste generated is mineral and is used as a substitute for construction materials. This fraction is often classified as a by-product rather than waste. A similar remark can be made for the organic residuals from the food industry. In this sense a comparison of data between countries is of limited scope.

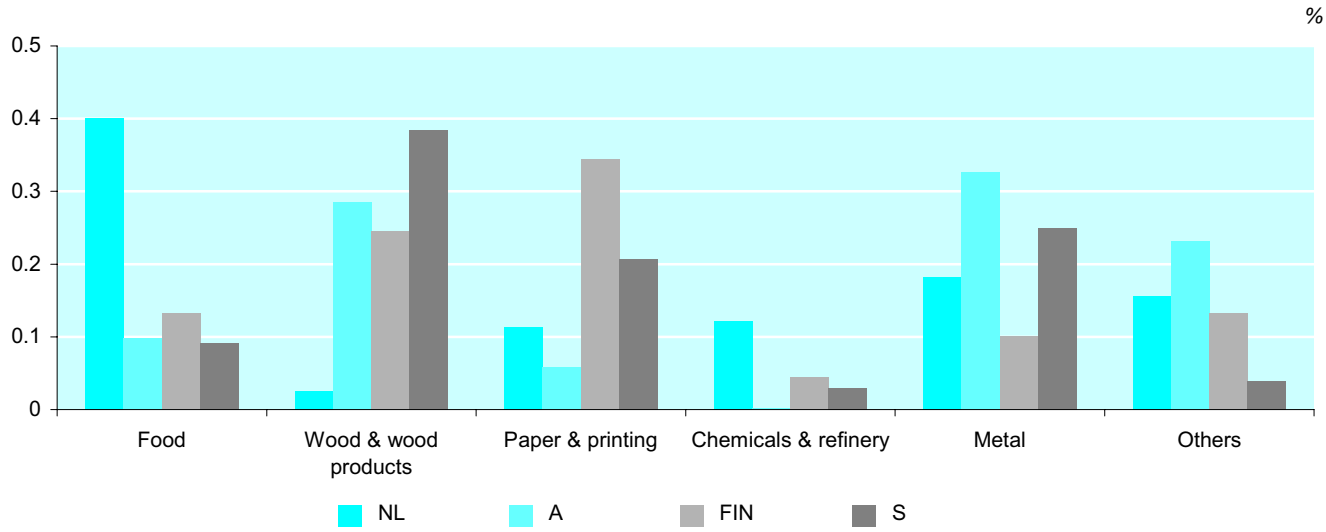
WA-5: Industrial waste generated

Relevant Sectors: **Industry**

Targets

The 6EAP has set a target to reduce the quantity of waste going to final disposal by around 20% on 200 levels by 2010 and in the order of 50% by 2050.

Industrial waste generated by industrial sectors 1) - selected Member States (mid 1990s)



Source: Eurostat

1) Food = food, beverages, tobacco industry;
Paper & printing = paper & paper products plus printing & publishing;
Chemicals & refinery = chemical industry plus rubber & plastic plus refinery;
Metal = basic metal industry plus fabricated metal products;
Others = textile industry plus leather industry plus non-metallic mineral products plus others.

Relevance: Green	Accuracy: Yellow	Time Rep.: Red	Spatial Rep.: Yellow

Comments

The indicator illustrates the waste intensity of the industrial sector, which can be roughly estimated to be 300 tonnes per million EUR of gross value added (EU-15 average). In general, the amount of industrial waste generated has remained fairly stable in the EU, though significant reductions can be seen in Portugal and in Germany, which may be largely attributed to restructuring following the German re-unification.

Data for the different branches of manufacturing industry are not available for each country. For the sectoral breakdown presented in the graph, data for the most recent year available have been used for the Netherlands, Austria, Finland and Sweden. The graph shows significant differences among countries which is largely dependent of the structure of industry within the country. The main contributor to total waste in the Netherlands is the food industry, whereas in Austria, Sweden and Finland the wood & wood products industry together with the paper & printing industry are the sectors mainly responsible for the generation of waste.

WA-6: Waste recycled/material recovered

Definition and purpose

Recycling is defined in Directive 94/92/EC[1] on packaging and packaging waste as 'the reprocessing of waste materials in a production process for the original or for other purposes including organic recycling but excluding energy recovery.' Three types of recycling can be distinguished: 1) recycling during production, 2) recycling during product use (product recycling) and 3) recycling after product use. The definition applied to this indicator refers to recycling of waste and therefore to recycling after product use, and refers to recycling of materials, which are traditionally metals, glass, paper & cardboard and textiles. A relatively new branch of material recycling is recycling of plastics. The separate collection of these different waste fractions is the most important contributor to the reduction of municipal waste.

The indicator is defined as the amount of packaging material recycled as a percentage of apparent consumption. The larger the percentage of packaging waste recycled, the smaller the need for resources and for disposal (e.g. incineration, landfill).

Packaging glass and paper, board & paper products recycled [1)]

% of apparent consumption

	1990	1991	1992	1993	1994	1995	1996	1997	1990	1991	1992	1993	1994	1995	1996	1997
	Glass recycled								Paper & cardboard recycled							
B	:	55	54	55	67	67	66	75	33	33	34	38	36	37	38	:
DK	:	35	48	64	67	63	66	70	35	35	36	46	43	44	52	50
D	54	61	60	65	75	75	79	79	44	47	50	55	59	67	71	70
EL	15	22	20	27	29	35	29	26	28	29	32	31	33	32	29	29
E	27	27	27	29	31	32	35	37	39	38	37	37	36	41	41	42
F	:	41	44	46	48	50	50	52	34	34	34	36	36	39	42	41
IRL	23	23	27	29	31	39	46	38	:	:	12	12	13	11	11	12
I	:	53	53	52	54	53	53	34	27	28	28	30	28	28	31	31
L	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
NL	67	70	73	76	77	80	81	82	50	54	51	55	55	74	65	62
A	60	60	64	68	76	:	:	88	52	54	56	68	66	66	71	69
P	27	29	31	29	32	42	42	44	40	39	39	38	40	37	39	40
FIN	36	31	44	46	50	50	63	62	43	46	48	49	43	57	:	:
S	:	44	58	59	56	61	72	76	46	46	50	50	60	59	57	62
UK	21	21	25	27	27	26	26	26	33	34	34	32	35	35	39	40
IS	70	75	75	:	:	:	:	:	10	30	:	:	:	:	:	:
NO	:	22	44	67	72	75	75	76	20	23	26	29	34	37	40	44
CH	65	71	72	78	84	85	89	91	49	51	54	54	58	61	67	63

Source: OECD

1) D: packaging glass: recycling rate is based on total sales; 1990 excludes former East Germany.
F: amount of packaging glass collected as a percentage of apparent consumption.
NL: glass collected in bottle banks as % of sale of products in disposable glass on domestic market.

Methodology and data problems

The collection systems for waste packaging materials are used for households but also for commercial and industrial activities. This may cause an overestimation of the recycling for some Member States when amounts of materials collected by these services are compared with amounts of packaging materials placed on the market.

The analysis of waste recycling activities via the recycling rate (% of apparent consumption) may lead to some confusion, as the calculation of apparent consumption is likely to be approximate due to the difficulties in calculating the exact amounts of materials contained in products which are imported or exported. Up to now sets of data compiled at EU level are insufficient for the development of indicators covering the different aspects of recycling.

[1] OJ L 365 of 31.12.94, p. 1

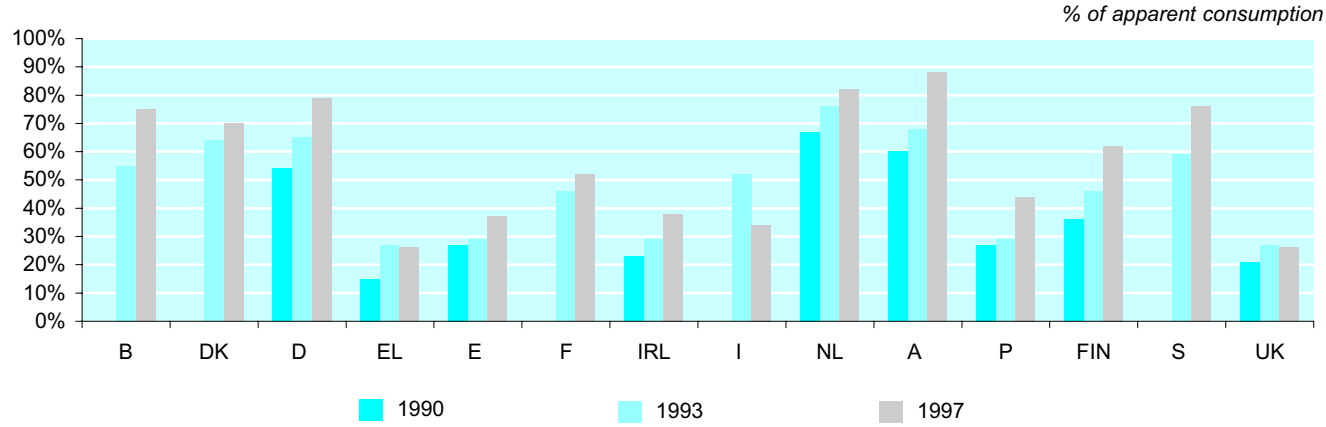
WA-6: Waste recycled/material recovered

Relevant Sectors: **Households, Transport, Services, Industry, Tourism**

Targets

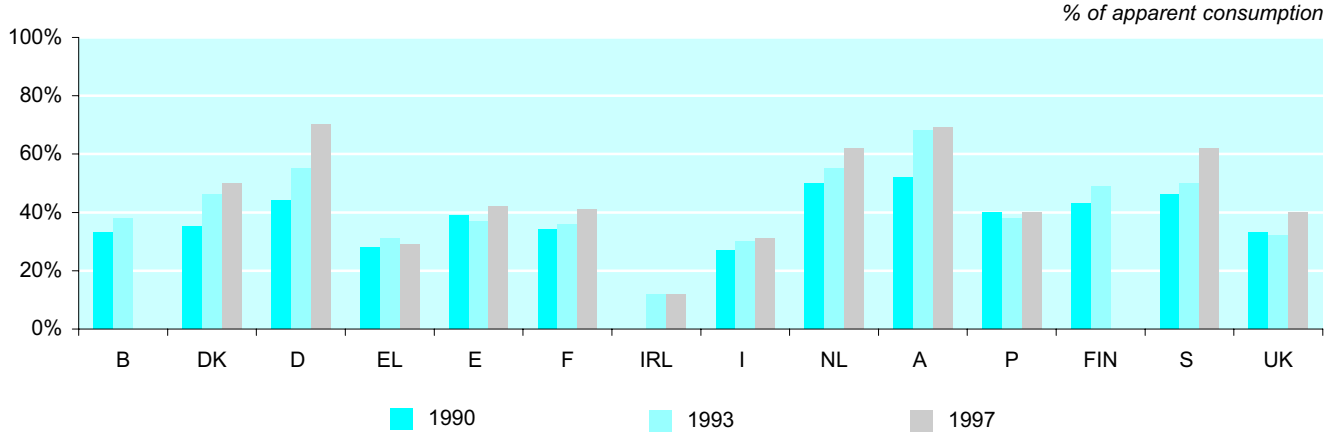
Directive 94/62/EEC on packaging and packaging waste sets a target for Member States, to be reached by June 2001, of recovery of at least 50% of packaging waste by weight (except Greece, Ireland and Portugal). Agenda 21 recommends that by the year 2000 all industrialised countries should have a national programme for efficient waste reuse and recycling, and that some developed countries should establish voluntary targets for the proportion of recycled waste. Several countries have already set national recycling targets for the packaging industry.

Packaging glass recycled



Source: OECD

Paper, board & paper products recycled



Source: OECD

Relevance: Yellow	Accuracy: Green	Time Rep.: Yellow	Spatial Rep.: Green

Comments

For both paper and glass the trend is towards more recycling. Nevertheless the figures provided show large variations in the amount of recycled materials from one country to another, and depend largely on the availability of collection facilities as well as proximity to recycling facilities (NACE 37).

In 1997, five Member States B, D, NL, A and S, and EFTA countries recycled 75% or more of glass, and eight countries met the 50% target. The lowest recycling rates are seen in Greece and UK at 26% of apparent consumption.

For paper the figures are often lower, ranging from 12% (IRL) to 70% (D). Five Member States (DK, D, NL, A and S) met the 50% target for paper and paper products.

INDEX

DISPERSION OF TOXIC SUBSTANCES

Introduction

The issue of *Dispersion of Toxic Substances* covers a wide range of concerns, from human health issues to slow poisoning of whole ecosystems. Toxic substances may be manufactured as a normal part of the economy or may arise as by-products of processes, or as a result of incineration or degradation of other products. However, toxicity is not the only characteristic of harmful substances. Other properties such as persistence and the ability to accumulate in a food chain should also be considered.

The world economy produces approximately 400 million tonnes of synthetic chemicals a year (1995 data). Much remains unknown about their role in the complex metabolisms of plants, animals and human beings. A new EU Chemicals Strategy is being prepared and is expected to address this issue. However, given the large number of chemicals in production, this is clearly a long term exercise.

Describing this complex policy field with a handful of indicators is an almost impossible task. Most of the indicators suggested by the panel of toxicologists refer to more or less heterogeneous groups of chemicals such as pesticides, heavy metals. Presented as 'tonnes per capita', this can only give a rough indication of the amount of key toxic substances present in our economy. Such indicators can rarely be weighted by toxicity, nor can they take account of accumulative effects. Problems of data availability and the lack of a consensus on weighting schemes do not yet allow indicators describing the risks posed to human health and ecosystems by these groups of chemicals to be calculated in a way that is beyond scientific debate. It is hoped that through the development of the indicators presented here, and the criticisms that these will inevitably trigger, progress will be made towards better statistical tools describing the risks of the *Dispersion of Toxic Substances* in our environment.

In this edition an attempt has been made to highlight the economic activities or sectors which are responsible for the toxic releases. The indicator on pesticides can easily be attributed to the agriculture sector, while industry is a relevant sector for POPs. The energy, industry and transport sectors contribute to the heavy metal emissions to air.

Some of the indicators have been further developed since the previous publication. Emissions of POPs to water and soil have been incorporated into the indicator TX-2. A more developed methodology has been introduced in the indicator TX-3 *Chemicals* and a greater number of chemicals are covered. New processes, which are highly relevant for some countries, have been included for heavy metal emissions to air *(TX-5)*. The indicator TX-6 *Emissions of radioactive material* has been deleted.

TX-1: Consumption of pesticides by agriculture

Definition and purpose

Pesticides refer to herbicides, fungicides, insecticides and other pesticides; insecticides include nematicides, acaricides, and molluscicides; fungicides include bactericides and seed treatments and herbicides include defoliants and desiccants. The 'other pesticides' category covers a wide range of products such as growth regulators, soil disinfectants, rodenticides, and varies from one country to another.

By definition, pesticides are designed to be toxic to target pests, whether fungi, insects or weeds. Therefore use of pesticides should be monitored to assess and limit the potential threat to human health and to ecosystems. Not all pesticides present the same risk, as toxicities vary from one active ingredient to another, as do other intrinsic properties such as persistence in the environment, accumulation, etc. Some are toxic only to certain species, others degrade quickly in the environment to pose little or no risk to non-target species.

This indicator represents the total amount of pesticide consumption by agriculture per year. Sales are used as a proxy for consumption and are assumed to equal the use on farmland *(see also WP-3)*.

The quantities below refer to active ingredients, i.e. those ingredients in a pesticide that have the desired effect on the fungi, weeds or insects targeted. There are significant differences in the underlying national definitions and the range of products used in the various countries, which limits possibilities for comparison.

Agricultural pesticide sales [1) 2) 3)]

kg of active ingredient per hectare of agricultural area

	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
EU-15	:	:	:	3.76	3.36	3.29	3.29	3.28	3.56	3.81	3.88	:
B	9.50	11.86	13.09	12.52	12.77	12.46	10.38	12.44	12.00	11.99	11.89	:
DK	:	2.63	2.20	1.81	1.79	1.63	1.56	1.92	1.44	1.43	1.43	1.14
D	:	:	2.71	3.14	2.87	2.43	2.48	2.87	2.91	2.88	3.21	2.94
EL	:	:	:	2.33	2.47	2.75	3.00	2.56	2.97	:	:	:
E	:	:	1.96	1.96	1.61	1.51	1.71	1.50	1.79	1.80	1.84	:
F	4.13	5.16	5.14	5.44	4.46	4.80	4.65	4.35	4.82	4.77	5.52	:
IRL	1.29	:	2.32	2.65	2.91	2.26	2.52	2.50	2.33	2.47	2.36	:
I	:	:	7.43	4.71	4.76	4.11	3.65	3.84	4.21	4.11	4.22	:
L	:	:	:	4.44	:	5.10	5.59	6.03	5.96	5.36	6.84	:
NL	:	23.43	19.93	18.78	17.15	12.63	11.98	11.46	10.36	10.77	10.97	10.20
A	:	3.46	2.86	2.98	26.03	2.70	2.45	2.30	2.41	2.51	2.27	:
P	:	:	:	2.89	1.94	2.86	3.05	3.82	4.05	4.16	4.99	:
FIN	:	0.81	0.80	0.69	0.56	0.55	0.56	0.49	0.44	0.48	0.54	:
S	:	1.25	0.82	0.66	0.55	0.53	0.70	0.46	0.57	0.58	0.60	:
UK	:	5.78	4.44	5.34	4.80	5.24	5.66	5.61	5.75	5.50	5.56	6.11

Source: Eurostat

1) Agricultural area = arable crops + permanent crops.
2) Pesticide data for B, F and P include non-agricultural pesticides.
3) D: 1990 refers to former Federal Republic of Germany.

Methodology and data problems

There are some underlying problems with the sales data. For several countries it is not possible to distinguish agricultural use and other types of use. However non-agricultural use is estimated to account for only 2% of total pesticide use. A more fundamental problem is the issue of what constitutes a pesticide; some countries include sales of sulphur, sulphuric acid and mineral oils used in agriculture, under the heading of pesticides. These are used in large quantities which can distort the overall figures.

The overall quantity of active ingredients per hectare gives only a very vague indication of the environmental risks associated with the use of pesticides. The real risks depend on factors such as type of product, toxicity, persistence, climate and soil conditions, type of cultivation and application practices. Ideally, a proper *pesticide risk indicator* would take into account all these factors. A basic ingredient for any risk assessment is a knowledge of the individual active ingredients used on each crop. Some data on this is becoming available *(see publication 'Plant Protection in the EU', Eurostat, 2001)*. The OECD Pesticide Forum is currently developing an international methodology for calculating pesticide risk.

TX-1: Consumption of pesticides by agriculture

Relevant Sectors: **Agriculture**

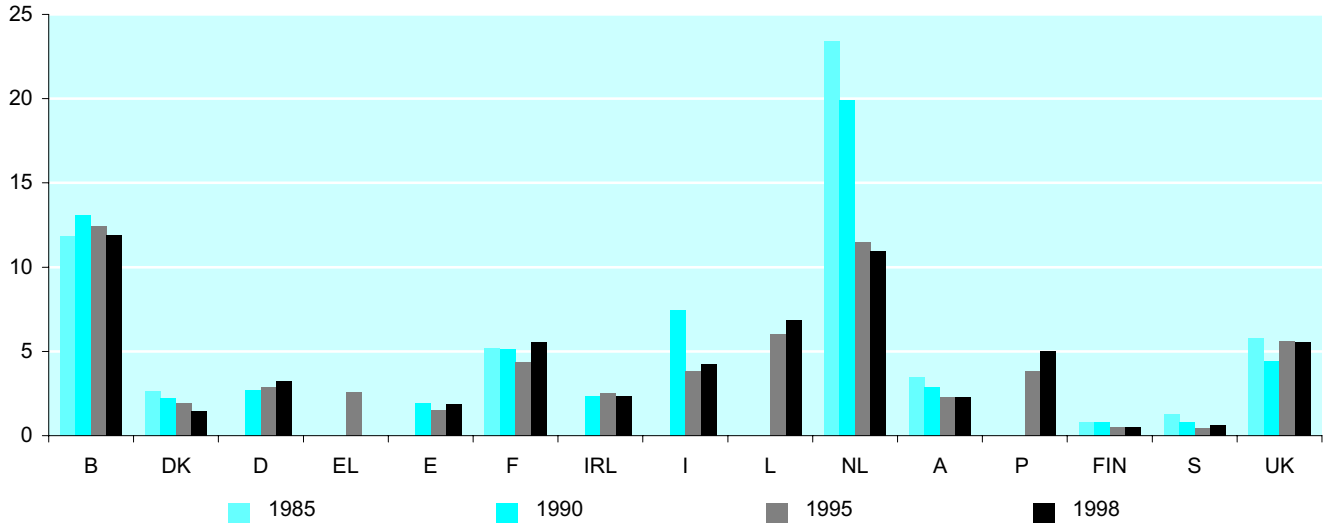
Targets

Directive 91/414/EEC[1] of 15 July 1991 on the authorisation, placing on the market and use of pesticides in the EU establishes the requirements which plant protection products must meet before they may be placed on the market in Member States.

Council Directive 98/83/EC[2] of 3 November 1998 on the quality of water intended for human consumption establishes limits for individual pesticides (0.10 µg/l) and for total pesticides (0.50µg/l) and the Integrated Pollution Prevention Control (IPPC) Directive[3] (96/61/EC of 24 September 1996) establishes a threshold value for selected pesticides.

Agricultural pesticide use 1)

kg per hectare of agricultural area



Source: Eurostat

1) EL, L, P and D: data for year 1990 refer to 1991.

Relevancy: Green	Accuracy: Green	Time rep.: Green	Spatial rep.: Green

Comments

The increasing trend in use of pesticides seen in the past has been reversed in recent years, partly in response to the 1992 changes in the CAP, but also due to increased use of new low dose pesticides. The Agenda 2000 reform of the CAP encourages a more reasoned use of inputs. But in the end, pesticide use is largely governed by outbreaks of fungi and plant diseases, plagues of insects, etc, which cannot be controlled by legislation. These tend to depend to a large extent on weather conditions.

Comparisons between countries are limited as the coverage of the data may vary from one country to another. Also a number of factors such as weather conditions, seasonal factors, prices of pesticides and land set-aside may affect figures from one year to the next. Nevertheless, some of the decrease in pesticide use (in kg/ha) in the EU during the early 1990s is the result of newer products, active at lower application rates (grammes instead of kilogrammes) and of specific policies developed for example in Denmark, the Netherlands and Sweden aimed at decreasing pesticide use. But since 1996 there has been a general increase in the use of pesticides in most EU countries.

1 OJ L 230, 19/08/1991 p. 0001 - 0032
2 OJ L 330, 05/12/1998 p. 0032 - 0054
3 OJ L 257, 10/10/1996 p. 0026 - 0040

TX-2: Emissions of persistent organic pollutants (POPs)

Definition and purpose

POPs are organic chemical substances which are toxic, degrade slowly and in many cases, accumulate in biological systems. The different POPs, which are monitored under several conventions (e.g. UNECE), can be divided into three categories: (1) pesticides, (2) (hydro-)chlorocarbons such as solvents, both of which are covered by their own indicators, *(see TX-1 and the chapter on ozone depletion)* and (3) POPs emitted from various processes.

The purpose of this indicator is to represent the emissions of persistent organic pollutants (POPs) to air, water and soil over a period of time. POPs are emitted locally but can be transferred over long distances or accumulated via the food chain. Due to the persistence of these substances, POPs ingested by humans through the food chain today result from economic activities in the past. The pressure indicator discussed here only reflects the primary sources of emissions and concentrates on the POPs that are toxic to humans. It does not attempt to describe the presence of POPs in the environment, which, given their persistence, may be much higher than emissions.

UNECE has adopted a list of POPs to be targeted. In the first edition of this publication, the 1990 TNO/UBA database was used to estimate emission figures for the EU Member States. The calculation showed that the most relevant POPs for human exposure via air are polychlorodibenzodioxins and -furans (dioxin). This indicator therefore focuses on the main dioxin emissions as a representative POP. In this second edition, emissions to water (wastewater discharge, leaching from landfills) and soil (compost, sewage sludge) have been included.

Emissions of dioxin to air, water and soil [1)]

µg I-TEQ per capita

	EU-15	B	DK	D	EL	E	F	IRL	I	L	NL	A	P	FIN	S	UK
1985	31	54	29	26	23	20	38	19	29	190	33	37	24	29	50	35
1990	17	45	12	12	14	11	24	11	19	184	12	21	15	19	16	18
1995	14	48	9	7	12	8	19	9	18	76	7	15	13	17	9	14
1996	13	53	9	7	12	8	18	9	17	64	7	15	13	13	9	13

Source: Oeko-Institute

1) I-TEQ = International Toxic Equivalent

Methodology and data problems

For this indicator the modelling approach and the core processes identified in the 'European Dioxin Inventory' have been adopted. Emissions are taken into account when they leave the technosphere and are released to the environment. According to this definition the dioxin in waste is not considered. Only the fraction of dioxin estimated as leaving landfill is taken into account. The same emission coefficients are applied to technical processes with similar techniques for the whole EU. Emission coefficients for the year 1995 are mainly based on the 'European Dioxin Inventory'. For the years 1985, 1990 and 1996 emission coefficients are estimated with the help of various databases. Time series *(see table)* are constructed using activity data from Eurostat's energy, waste and industrial production statistics.

Dioxin emissions are calculated on the basis of emission coefficients and activity rates of core processes. Neither are easily accessible. Even for the most relevant processes used in this indicator, detailed measurements of emissions are missing in many countries. The inventory is therefore based on estimates and the uncertainty is very high. For example, the total EU air emissions have been calculated at 5.75 kg I-TEQ per year; the possible deviations are given from a minimum of 1.3 kg I-TEQ per year to a maximum of 20 kg I-TEQ per year (European Dioxin Inventory, year 1994).

TX-2: Emissions of persistent organic pollutants (POPs)

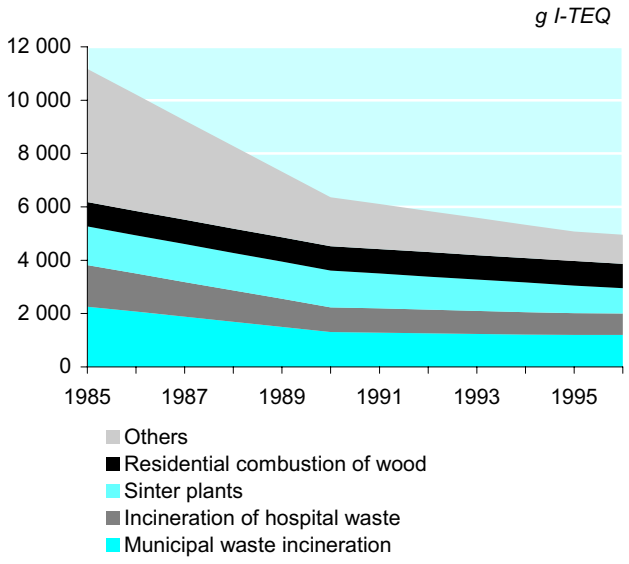
Relevant Sectors: **Industry, Households**

Targets

The 1998 CLRTAP Protocol on POPs and heavy metals obliges Parties to reduce their emissions of dioxins, furans, PAHs and HCB below their 1990 levels (or an alternative year between 1985 and 1995). In 1995 the Fourth Ministerial Conference of the North Sea States committed itself to end all discharges, emissions and losses of hazardous substances by the year 2020; this target was adopted in 1998 by OSPAR and HELCOM.

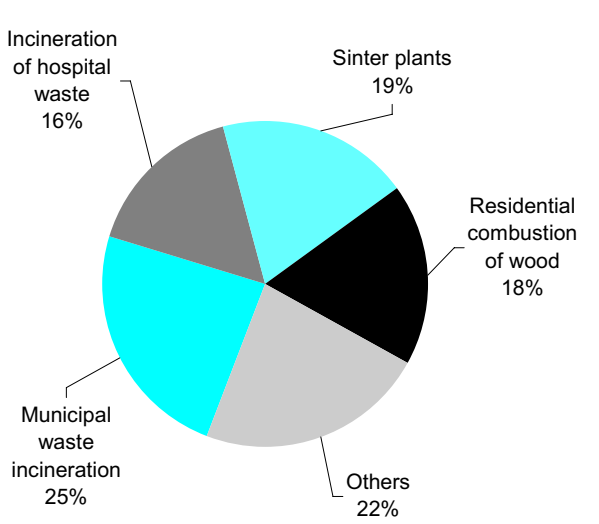
At EU level, dioxin emissions from hazardous waste incineration are regulated. Some countries (Austria, Germany, Sweden, the Netherlands) have also regulated municipal waste incineration. Within the 1998 CLRTAP Protocol on POPs the dioxin emissions from incineration of municipal waste and medical solid waste are limited. For the iron ore sintering process, the feasibility of reducing dioxin process emissions has been demonstrated (Austria, Germany).

Emissions of dioxin from core processes - EU-15



Source: Oeko-Institute

Breakdown by emission source (1996) - EU-15



Source: Oeko-Institute

Relevancy: Yellow	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

The main sources emit dioxins to air. Emissions to water or soil represented 2 % each of the total emissions in 1996. For 1985 emissions to water and soil are estimated at approximately 4 % (water) and 3 % (soil). Waste incineration, wastewater discharge, waste disposal and industry (sinter plants) are the main contributors. Some emission sources cannot be linked to (official) economic activities (residential combustion, illegal fires).

The dioxin uptake for humans is dominated by the food chain. Thus agriculture is a main actor, but not a primary source for dioxin within this indicator. Modelling cannot represent the toxic influence on humans under local conditions (in-door concentration etc.) nor cover all processes which emit dioxin. It is known that certain activities in the past had high dioxin emissions (e.g. cable/PVC burning) but it is not possible to calculate emissions for these processes. Therefore the amounts for the past may be underestimated.

Existing monitoring programmes cover many of the POPs and remarkable reductions in production or emissions have been achieved, for example, as a result of the Montreal Protocol. Programmes for POPs currently not covered by monitoring, such as chlorinated aliphates or musk derivatives, are at present under discussion.

TX-3: Consumption of toxic chemicals

Definition and purpose

The original intention of this indicator is to describe the 'chemicalisation' of society or the economy, e.g. the penetration of man-made chemicals in the human environment. The European Inventory of Existing Chemical Substances (EINECS) lists over 100 000 'existing' chemicals. A further 2 700 or so have been added since 1981. The threat which these chemicals may pose to humans and the environment cannot be stated precisely in most cases, due to the lack of adequate knowledge. Even attempts to set up a proxy indicator are fraught with difficulties. Chemicals show a complex behaviour; some undergo chemical change, some are bound tightly in consumer goods, while some may end up widely dispersed in the environment. An attempt to track their flow through the economy failed, for lack of data.

Therefore this indicator can only describe special issues. The indicator combines the definitions and qualitative aspects from Directive 67/548/EEC[1] with industrial production statistics. From this, toxic chemicals are defined as substances which are carcinogenic, mutagenic, teratogenic, very toxic, toxic, harmful, can cause other serious damage to health, are corrosive, irritant or have other toxicological properties. Based on these properties, the Directive attributes one or more 'R-phrases' to the chemicals *(see table)*. The R-phrases are taken as a proxy for a toxicity rating, and have been aggregated to 5 classes to allow easier presentation. Chemicals with multiple toxicological properties (i.e. several R-phrases) are only listed once in the classification starting in Class A.

The chemicals considered are 8 products from refineries and 80 basic chemicals (NACE 24.11 to 24.15), covered by statistics. The data on the production of the refinery products are taken from Eurostat's Energy statistics database and the data on the production of the basic chemicals are mainly from PRODCOM database.

Consumption of toxic chemicals - EU-15 1)

	1000 tonnes						*%*
	1997	**1998**	**Change**	**Chemicals 1997**	**Refinery products 1997**	**Chemicals 1998**	**Refinery products 1998**
All	754 512	772 062	2.3	12.9	87.1	12.5	87.5
among which							
Chemicals	97 420	96 639	-0.8				
Refinery products	657 092	675 423	2.8				
Class A	399 460	409 997	2.6	7.5	92.5	7.3	92.7
Class B	227 824	234 497	2.9	0.8	99.2	0.8	99.2
Class C	19 324	18 917	-2.1	100.0		100.0	
Class D	79 611	80 378	1.0	44.6	55.4	44.1	55.9
Class E	28 292	28 273	-0.1	37.2	62.8	37.3	62.7

Source: Eurostat, APPE, UN Industrial Statistics Yearbook, IUCLID 2000, Ullmann 2000

1) Class A: R45, R46, R49, R60, R61 (substances classified as carcinogenic, teratogenic, mutagenic, reprotoxic)
Class B: R40, R42, R43, R62, R63, R64 (substances classified as probably carcinogenic, teratogenic, reprotoxic or may cause sensitization).
Class C: R26, R27, R28, R32, R48/23, R48/24, R48/25, R35 (substances classified as very toxic, toxic and danger of serious damage to health or causes severe burns.)
Class D: R23, R24, R25, R29, R31, R33, R34, R41, R48/20, R48/21, R48/22 (substances classified as toxic, harmful and danger of serious damage to health, danger of cumulative effects, causes burns or risk of serious damage to the eyes).
Class E: R20, R21, R22, R36, R37, R38, R65 (substances classified as harmful, irritating or can cause damage to lungs when swallowed).

Methodology and data problems

Several international institutions are working on the assessment of chemicals. Several risk assessment schemes are under discussion but none are generally accepted. Available information on production volumes and toxicological properties is not sufficient to properly describe the risks to society. Moreover, further information is needed on the exposure and the dispersion of chemicals in the society. Even less information is available on the risk posed by substances included in low concentrations in goods or preparations.

This indicator is not designed as a risk assessment of individual chemicals. It reflects potential risks based on the known properties of basic chemicals and refinery products, which, in contrast to chemicals, are mixtures of substances. The toxicological classification is often related to only a fraction of these products; however the high volatility of some refinery products increases the likelihood of exposure to these toxic fractions. If only the toxic fractions were considered, the influence of refinery products on the indicator would still be significant but lower *(see graph)*.

[1] Directive on classification, packaging and labelling of dangerous substances, OJ B196, 16 August 1967

TX-3: Consumption of toxic chemicals

Relevant Sectors: **Industry**

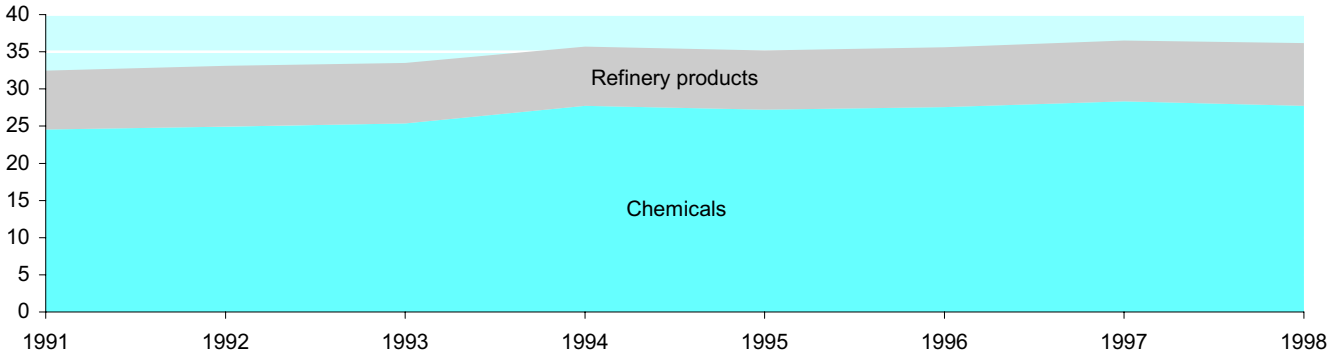
Targets

The Commission's white paper on the future EU chemical strategy (COM(2001)88 final) proposes a reassessment of Directive 67/548/EEC and its amendments. The main objective is to ensure a high level of protection for human health and the environment based on the precautionary principle. For 'existing' chemicals (99 % of the total market volume), there is still a general lack of adequate knowledge of their properties. The introduction of a step by step process to obtain this knowledge is proposed.

Chemical accident prevention and limitation of the consequences are the objectives of the so-called Seveso-II Directive (96/82/EC[2]), replacing the first Seveso Directive from 1982. Emissions of chemicals are limited by the VOC solvent Directive (1999/13/EC[3]). Furthermore the limit for benzene content in motor spirit is reduced from 5% to 1% *(see AP-5)* by January 2000.

Toxic substances - Class A 1) 2) 3)

million tonnes of toxic ingredients



Source: Eurostat, APPE

1) Only Class A substances (estimated) in refinery products are counted, see below.
2) See table for explanation of 'Class A'
3) Chemicals: only bulk chemicals, covering 94% of the 30 M tonnes, listed in the table (1997).

Relevancy: Red	Accuracy: Red	Time rep.: Red	Spatial rep.: Yellow

Comments

The available methodological tools and data are limited. Therefore the results of the indicator should be analysed very carefully. Class-A is dominated by refinery products such as motor spirit and heavy fuel oil, (92%, *see table*). This is because of the high volumes of these products used and the carcinogenic substances in these products (predominantly benzene). For the graph, the contribution from petroleum products is reduced by estimating the percentage of the Class-A ingredients contained in these products, giving a figure of 8.2 million tonnes (graph) for the year 1997, as opposed to 369 million tonnes (table). From 1999 onwards a reduction in Class-A ingredients in refinery products is foreseen as the new specification on benzene content in motor spirit is introduced.

The graph illustrates a steady growth in the production of Class-A chemicals for both refinery products and chemicals during the nineties. However it should be borne in mind that even within one toxic class, the toxic potency of two chemicals may differ by an order of magnitude. Physical properties such as vapour pressure, the possible exposure routes (air, water, direct contact) and the disperse use also play a determinant role. Residual fuel oil and gasoline, both aggregated as class A chemicals, are good examples of different properties and disperse use. Residual fuel oil has a low vapour pressure and is used only in industry, whereas gasoline has a high volatility and a widespread use. Therefore the risk to the general public posed by gasoline is higher than from residual fuel oil.

Further discussion is needed on the choice of chemicals to be included in this indicator.

[2] OJ L 10 of 14 January 1997
[3] OJ L 085 of 29 March 1999, p.1-22

TX-4: Index of heavy metal emissions to water

Definition and purpose

The indicator estimates the emissions of heavy metals to water. Heavy metals are persistent in nature; they can accumulate, e.g. in sediments and sewage sludge. Most heavy metals can also accumulate in organisms so that even small amounts in water or sediment layers may become significant threats to species at the end of the food chain. Heavy metals may appear in soluble form, bound in suspended matter or in chemical complexes each having different features, capacity for bio-accumulation and toxicity and thereby also different influence on the aquatic environment. Some heavy metals with limited toxicity can form complexes with organic materials to produce highly toxic compounds.

Eight heavy metals (arsenic, mercury, lead, cadmium, chromium, copper, nickel and zinc) are frequently found in discharged waste water and water overflows. All sectors contribute to emissions, but a very limited amount of reliable data from the different sources is available. It is therefore only possible to show a fraction of total emissions from different sources and only for a limited number of metals. The indicator presented is defined as emissions from households of mercury, cadmium and lead to water.

Modelling parameters of heavy metal discharge from household waste water after treatment

	% Reduction			Ecotoxicity
	Mechanical	Biological	Advanced	weighting factor
Mercury	20	40	60	39.2
Lead	75	90	90	0.4
Cadmium	10	20	60	3.3

Source: DHI

Emission estimates of heavy metals to water from households after treatment

g As-EEQ per capita

	1985	1990	1991	1992	1993	1994	1995
EU-15	5.4	2.7	1.9	1.7	1.5	1.4	1.2
B	6.4	3.5	2.4	2.1	1.9	1.7	1.6
DK	4.5	2.1	1.5	1.3	1.2	1.0	0.9
D	5.6	2.1	1.6	1.4	1.2	1.1	1.0
EL	6.8	3.7	2.5	2.3	1.9	1.7	1.5
E	6.4	3.3	2.2	2.0	1.8	1.6	1.4
F	5.3	2.9	2.0	1.8	1.6	1.5	1.3
IRL	6.6	3.6	2.4	2.1	1.8	1.6	1.4
I	6.0	3.1	2.1	1.9	1.7	1.6	1.4
L	4.6	2.5	1.8	1.6	1.5	1.3	1.2
NL	4.3	2.2	1.6	1.5	1.3	1.1	1.0
A	5.1	2.6	1.8	1.6	1.5	1.3	1.2
P	6.6	3.6	2.5	2.2	2.0	1.8	1.6
FIN	3.2	1.7	1.3	1.2	1.1	1.0	0.9
S	3.1	1.8	1.3	1.2	1.1	1.0	0.9
S	3.8	2.2	1.7	1.6	1.4	1.3	1.2
UK	4.6	2.6	2.0	1.7	1.6	1.4	1.3

Source: DHI, based on data from Eurostat, OECD, OSPAR (1995), Miljøstyrelsen, DK (1995 and 1997), Naturvådsverket S (1995)

Methodology and data problems

The model calculates emissions from households, based on emission coefficients for the three metals, the removal efficiency of waste water treatment in each country, and a weighting scheme based on eco-toxicity. The removal efficiency was calibrated based on measured values of heavy metal emissions from households and municipal waste water treatment plants in Denmark and Sweden. Emission coefficients have decreased during the last 10-20 years but at different rates from one country to another. However, as the number and comparability of data is low, only one set of trends in emission coefficients was applied to all countries, based on estimates from eight countries. To improve this part of the indicator, more reliable national emission coefficients and more country data on discharges and removal efficiency of heavy metals in municipal waste water treatment plants are needed.

TX-4: Index of heavy metal emissions to water

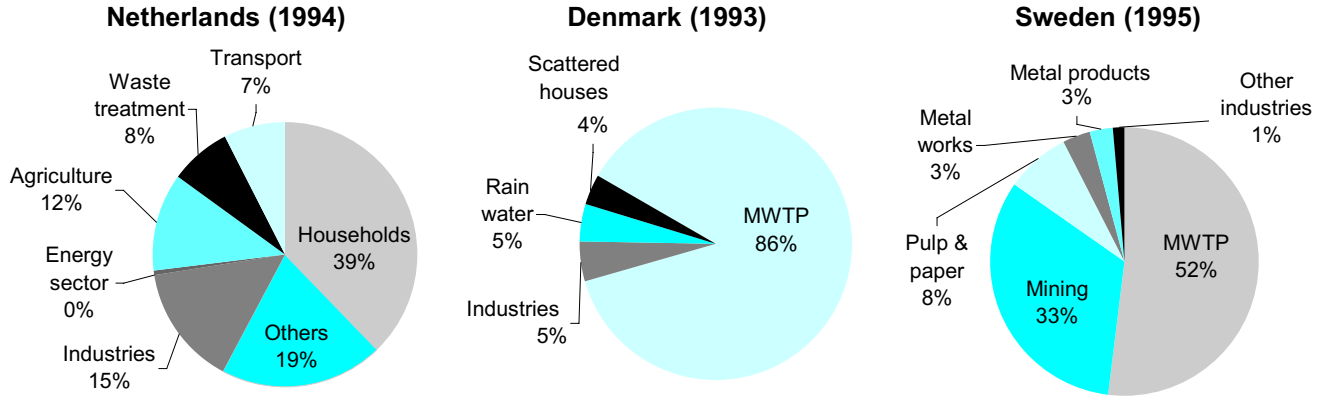
Relevant Sectors: Transport, Energy, Households, Industry

Targets

The Water Framework Directive[1] (2000/60/EC of 23 October 2000) identifies a list of priority substances including metals and arsenic and their compounds, and stipulates that 'the limit values and quality objectives established under the daughter Directives[2] of the Dangerous Substance Directive[3] (76/464/EEC of 4 May 1976) shall be considered emission limit values and environmental quality standards, respectively, for the purposes of this Directive'.

Emissions of heavy metals from various sources - selected Member States

% As-EEQ



Source: DHI, based on data from Ministerie van VROM, NL (1996), Milløstyrelsen, DK (1996) and Naturvådsverket, S (1997)

Relevancy: Yellow	Accuracy: Red	Time rep.: Red	Spatial rep.: Yellow

Comments

Due to lack of data, it was not possible to create time series to reflect the situation in the different sectors. Furthermore, only a few countries have carried out national surveys on discharges of heavy metals to water. It is therefore only possible to show the results for the Netherlands, Denmark and Sweden.

In some countries, discharges of heavy metals by the industry sector will dominate total emissions, for example, the mining and pulp and paper industries in Sweden. In other countries, the contribution from the industry sector is of minor importance, as is the case for the Netherlands and Denmark.

In Sweden and Denmark discharges from municipal waste water treatment plants (MWTP) include different sources of which households and industries are the most important. However, it is not possible at present to split the MWTP data into different sources. In Denmark most industries are connected to municipal treatment plants and only about 100 industries have separate discharge permits.

As shown for the Netherlands, many sectors have significant contributions of heavy metals to water. The energy sector is included in 'Others', as the contribution from this sector is less than 1% of the total.

In order to obtain a more satisfying presentation of the indicator in future, especially more detailed data on discharges from the different sources, harmonisation of methodologies and collection of data in the Member States is required.

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1 OJ L 327, 22/12/2000, COM (97) 49 final, officially adopted by EP and Council in September 2000

2 The Mercury Discharges Directive (82/176/EEC), OJ L 291, 24.10.1983, p. 1; the Cadmium Discharges Directive (83/513/EEC), OJ L 74, 17.3.1984, p. 49; the Mercury Directive (84/156/EEC), OJ L 81, 27.3.1982, p. 29; the Dangerous Substance Discharges Directive (86/280/EEC), OJ L 181, 4.7.1986, p. 16.

3 OJ L 129, 18/05/1976 P. 0023 - 0029

TX-5: Index of heavy metal emissions to air

Definition and purpose

The indicator describes the emissions of heavy metals into air. As they do not decay, all heavy metals emitted into air will eventually be deposited on land or water and will subsequently accumulate in soil, water and sediments. Traditionally arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium and zinc are depicted in emissions from key processes (e.g. combustion processes). In this index, copper, selenium and zinc are not included. The index was developed on the basis of human toxicity and the amounts of emitted metal.

The main purpose of this indicator is to present the total amounts of heavy metal emitted to air from the core sources in the EU-15. Within the group of heavy metals toxic to humans, it is useful to distinguish between substances with carcinogenic potential and substances with long-term toxicity but without carcinogenic potential. Within the group of carcinogenic heavy metals, individual substances are weighted according to their unit risk values. Within the group of heavy metals with long-term toxicity (but without carcinogenic potential), individual heavy metals are weighted according to their chronic toxicity. The heavy metal arsenic was used as a reference substance (1 g As = 1 g As-TEQ).

The TNO/UBA database was used to identify the relevant processes. The database includes the total emissions of heavy metals of EU-15 in 1990 and is based on the CORINAIR SNAP nomenclature. The following processes were taken into account in generating the indicator: public power and heat generation from hard coal, lignite and fuel oil, industrial combustion of hard coal, road transport and the iron and steel industry. Solid fuel combustion in households and waste incineration were also included.

As-TEQ weighted emissions of heavy metals to air

index (1995=100)

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
EU-15	234	207	198	190	175	165	152	138	121	109	100	88
B	230	174	161	162	155	143	143	136	121	117	100	81
DK	314	284	245	222	167	148	162	135	123	115	100	104
D	538	510	463	415	370	331	289	237	187	141	100	84
EL	157	114	114	111	114	113	114	110	104	99	100	93
E	143	141	145	148	151	153	135	118	105	104	100	82
F	218	211	214	214	174	159	137	123	109	98	100	99
IRL	180	174	163	143	137	132	132	122	115	107	100	102
I	134	103	106	107	110	108	106	110	102	101	100	88
L	125	129	105	98	95	84	82	75	60	75	100	97
NL	403	354	232	215	182	192	164	143	132	112	100	77
A	320	315	299	276	222	207	179	167	118	100	100	99
P	118	94	91	89	121	117	116	123	108	97	100	81
FIN	224	211	202	181	153	131	124	113	100	98	100	78
S	339	314	280	247	187	153	141	138	119	104	100	91
UK	222	169	168	169	157	152	148	136	123	111	100	86

Source: Oeko-Institute

The compilation of the index of heavy metal emissions was made on the basis of the core processes and fuels mentioned above. For 1985, 1990, 1995 and 1996, emission coefficients were estimated with the help of various databases. Emission coefficients for the years in between were obtained by interpolation. Time series *(see table)* were constructed using activity data from Eurostat's energy and production statistics.

Methodology and data problems

Single measured emission data for heavy metals can vary within a wide range for the same energy carrier and energy plant type. Even mean values can have a high deviation. Furthermore, information on heavy metal emissions for a time series at European level is limited, especially for the year 1985. To enhance data quality, other information sources related to heavy metal emissions have been used.

TX-5: Index of heavy metal emissions to air

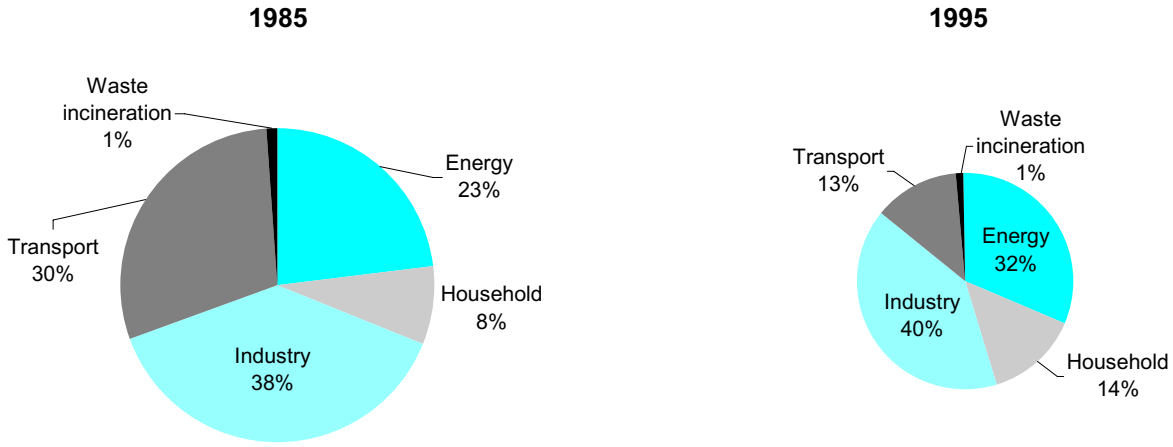
Relevant Sectors: **Industry, Energy, Households, Transport**

Targets

The 1998 CLRTAP Protocol on cadmium, lead and mercury, requires the Parties to reduce emissions of these three metals to below their 1990 levels (or an alternative year between 1985 and 1995). The Protocol targets emissions from industrial sources (iron and steel industry, non-ferrous metal industry), combustion processes (power generation, road transport) and waste incineration. It lays down stringent limit values for emissions from stationary sources and suggests best available technologies (BAT) to reduce these emissions, such as special filters or scrubbers for combustion sources or mercury-free processes. Moreover, the Protocol requires Parties to phase out leaded petrol, and it introduces measures to lower heavy metal emissions from other products.

The Fourth Ministerial Conference of the North Sea States committed itself in 1995 to end all discharges, emissions and losses of hazardous substances by the year 2020; this target was incorporated in 1998 to the OSPAR and HELCOM conventions.

Heavy metal emissions by sector (As-TEQ) - EU-15 [1)]



Source: Oeko-Institute

1) The areas of the pies are proportional to the total emissions (see table).

Relevancy: Yellow	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

The heavy metals index shows a significant reduction from 1985 to 1996 *(see table)*. The most important reduction has taken place in the transport sector where weighted emissions were less than one-fifth of the 1985 value. In 1985 road transport made up about one third of the index, but only 13% in 1995, due to the phasing-out of unleaded petrol. The reduction in emissions from the energy sector is due to a swing away from the use of lignite (brown coal) in the former East Germany and to the increased use of filters in power stations to remove particles, including heavy metals, from flue gases.

Heavy metal emissions from the industry sector mainly result from the industrial combustion of fuels and from processes in the iron & steel production. Within the iron & steel branch, weighted heavy metal emissions were reduced by 40% from 1985 to 1995. For other industrial consumption, the reduction estimates are based solely on changing fuel consumption patterns, where coal, lignite and fuel oil are all declining in importance.

The weighted heavy metal emissions from households also fell, by 29 % from 1985 to 1995. This reduction is due to a move away from hard coal and lignite for residential heating.

WATER POLLUTION

Introduction

Water is a key natural element, essential for all life on Earth and important for ecological, economic and social reasons. Human health and social and economic development depend on a regular supply of clean water. Fish and other aquatic life need water of a certain quality in order to thrive. At the same time, a wide range of human activities affect water quality, putting at risk both the future availability of this fundamental resource and the environmental health of aquatic eco-systems.

Pressures on water quality come from the release of pollutants and toxic substances into the aquatic environment. This chapter focuses on the releases which result from human activity and normally occur when waste water needs to be disposed of. However, there is also a significant pressure coming from run-off from agricultural or other land. The indicators address the most important of these pressures, i.e. eutrophication, toxicity, organic pollution, and the sectors from which they come.

It should be noted that some of the indicators covered by other policy fields are also relevant here, and complement this chapter. Of particular interest are the indicator *Water consumption (RD-1),* the indicator *Index of heavy metal emissions to water (TX-4),* and the indicator on *non-treated waste water (UP-3),* as well as parts of the chapter on *Marine Environment*.

A number of the indicators covered in other policy fields also reflect human activities which can have an indirect effect on water, e.g. waste landfilled, land permanently occupied by urbanisation, emissions to air (which are later deposited on soils and water bodies), etc.

In contrast to the first edition of this publication, this chapter focuses only on water pollution, as water resources are covered in the chapter *Resource Depletion*. The previous indicator *WP-5* was seen as simply a different presentation of information included in other indicators, and has now been moved to form part of the indicator *UP-3*.

The result is a more coherent chapter, with each indicator presenting the pressure from a single sector. There are several reasons for this. Firstly, the quality and availability of data for the different sectors is very varied, with the result that any aggregated data become a nonsense. Secondly, the most relevant indicators for each sector do not necessarily lend themselves to aggregation; for example, how to put into a single indicator nitrogen emissions from households and nitrogen balances for agriculture. Thirdly, action by policy makers often takes place at sectoral level, and separating out the pressures from each sector helps identify more clearly the areas where action may be needed.

The three sectors covered are Households and similar, Industry and Agriculture.

WP-1: Nutrient emissions from households

Definition and purpose

The indicator is defined as the average annual load of nitrogen (N) and phosphorus (P) from households discharged into aquatic ecosystems, and is expressed in kilogrammes per capita per year. Waste water generated by households is rich in nitrates and, to a lesser extent, phosphates. Unless the waste water is treated to remove nitrates and phosphates, these will end up in the rivers and coastal waters into which waste water is discharged.

The load from households is estimated by means of data on population connected to treatment plants, emission factors (kg N/inhabitant, kg P/inhabitant) and the theoretical efficiency of the treatment plants. Real emissions may differ from this, as many factors affect the efficiency of treatment. Therefore the indicator shows theoretical nutrient releases into aquatic ecosystems, the main cause of eutrophication. It also indicates inadequate sanitation and/or wastewater treatment facilities, or inadequate pollution control.

Nitrogen and phosphorus emissions from households, after treatment [1)2)]

kg per capita

	1970	1980	1985	1990	1995	1996	1997	1998	1970	1980	1985	1990	1995	1996	1997	1998
	Nitrogen								Phosphorus							
B	4.35	4.18	:	:	4.11	4.10	:	3.55	1.37	1.31	:	:	0.91	0.91	:	0.79
DK	4.18	:	3.62	2.88	1.69	1.64	1.33	1.31	1.29	:	1.09	0.75	0.37	0.36	0.29	0.29
D	:	3.64	3.53	2.90	1.74	:	:	:	:	1.10	1.06	0.76	0.38	:	:	:
EL	:	4.38	4.30	:	4.02	:	3.92	:	:	1.39	1.35	:	0.88	:	0.86	:
E	:	4.30	4.24	4.13	3.96	:	:	:	:	1.35	1.32	0.98	0.87	:	:	:
F	:	:	:	3.75	:	:	:	:	:	:	:	0.82	:	:	:	:
IRL	:	4.28	:	4.20	4.04	:	:	:	:	1.35	:	1.13	0.88	:	:	:
I	4.33	:	:	:	3.22	:	:	:	1.36	:	:	:	0.71	:	:	:
L	4.34	3.81	3.78	:	3.49	:	:	:	1.35	1.15	1.14	:	0.75	:	:	:
NL	4.13	3.73	3.50	3.36	2.15	2.08	:	:	1.28	1.13	1.05	0.87	0.46	0.45	:	:
A	4.34	4.06	3.74	3.61	2.83	:	:	:	1.36	1.26	1.14	0.95	0.62	:	:	:
P	:	4.38	4.38	4.28	3.98	3.91	3.77	3.65	:	1.39	1.38	1.16	0.88	0.86	0.83	0.80
FIN	4.13	2.42	1.95	1.80	1.75	:	:	:	1.29	0.74	0.60	0.48	0.38	:	:	:
S	3.92	2.07	1.41	1.32	1.28	:		1.28	1.20	0.64	0.44	0.36	0.28	:	:	0.28
UK	:	3.71	3.71	3.38	3.22	3.21	:	:	:	1.12	1.12	0.89	0.69	0.69	:	:
IS	:	:	:	4.38	4.38	4.38	4.38	4.38	:	:	:	1.20	0.98	0.98	0.98	0.98
NO	3.68	3.46	3.21	2.66	2.41	2.41	:	:	1.16	1.09	1.01	0.71	0.52	0.52	:	:
CH	4.07	2.66	2.38	1.96	1.69	:	1.68	:	1.27	0.82	0.73	0.52	0.37	:	0.37	:

Source: Eurostat, adapted by TAU

1) F: 1990 data refer to 1992.
2) E: 1990 data refer to 1991.

Methodology and data problems

The engineering data used in household emission estimations reflect the potential efficiency in pollution removal. The efficiency values used in the indicator estimation, expressed as a percentage of the pollutant removed, are in the case of nitrogen, 0% for primary treatment, 20% for secondary treatment, and 80% for tertiary treatment. The efficiencies used in the phosphorus emission estimation are 5%, 25% and 80% for primary, secondary and tertiary treatment, respectively. As these efficiency rates are averages, Member States with more efficient treatment have lower emissions than those estimated. This can make the comparison between Member States difficult, but the indicator provides clear information on the trend for each Member State.

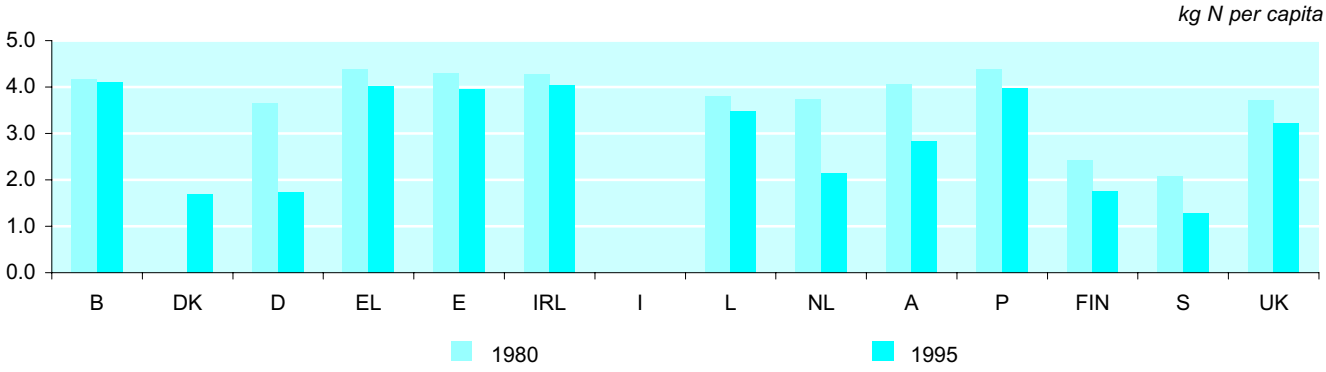
WP-1: Nutrient emissions from households

Relevant Sectors: **Households**

Targets

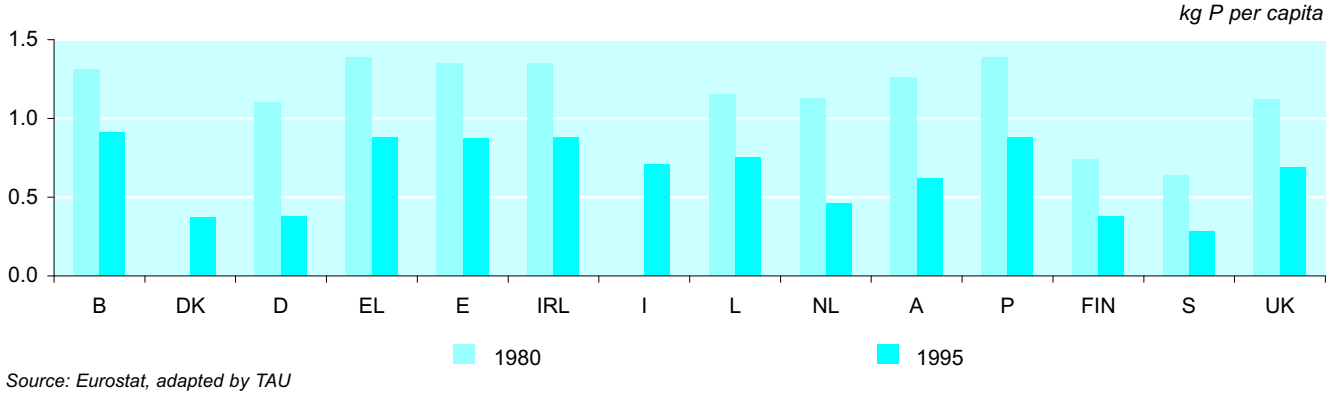
The Directive on Urban Waste Water Treatment (91/271/EEC)[1] requires Member States to treat waste water from agglomerations of more than 2 000 population equivalents to at least secondary level of treatment. However, the treatment has to be more stringent (secondary plus tertiary treatment) for discharges in areas identified as sensitive by the Member States. The time limit for implementation of the Directive is 31.12.1998, 31.12.2000 or 31.12.2005, depending on the size of the agglomeration and the sensitivity of the receiving water body.

N emissions from households, after treatment



Source: Eurostat, adapted by TAU

P emissions from households, after treatment



Source: Eurostat, adapted by TAU

Relevance: Green	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep: Green

Comments

In the 1970s per capita emissions of phosphorus and nitrogen from households were fairly similar in all EU countries. By the 1990s, improvements seen in all countries, are a consequence of the rising proportion of population connected to treatment plants and improvements in the efficiency of such plants. However, the rate of improvement is not uniform between countries; for example, S, FIN, DK and D, all signatories to the OSPAR and HELCOM conventions which aims to reduce pollution in the North Sea and the Baltic, have reduced their nitrogen emissions by around 60% over the period for which data is available, while in several countries the improvement does not exceed 10%. The result is that by the mid to late 1990s average emissions from the countries with least investment in water treatment technologies are around three times higher than from the Nordic countries and Germany.

The marked reduction in P emissions during the last 15 years is due to the reduced phosphate content of detergents.

[1] OJ L135, 30/05/1991 p. 0040 - 0052

WP-2: Nutrient emissions from industry

Definition and purpose

The indicator is defined as the average annual load of nitrogen (N) and phosphorus (P) discharged from industrial activities into aquatic ecosystems, and is expressed in kilogramme per capita. Loads are reported separately for nitrogen and phosphorus.

Nutrient emissions into aquatic ecosystems can lead to eutrophication, increased production of algae and/or other aquatic plants, thus affecting the quality of the water and disturbing the balance of organisms present within it. Such changes are usually undesirable and interfere with water uses.

Discharges of nitrogen and phosphorus from industry take place either directly from the industry itself or through the public sewer system. Water discharged to the public system will undergo the same treatment as household waste water, whereas water discharged directly from industries may be untreated or may have undergone different types and degrees of treatment, depending on the type of industry and the legislation covering discharges from industry in force in the individual countries.

Emissions from industries are based on direct emissions reported by national authorities in the Member States. Only countries for which data were found are included. No estimates were made.

Direct N emissions from industries

kg N per capita

	1985	1990	1991	1992	1993	1994	1995	1996	1997
B	:	:	1.17	:	:	0.68	0.61	:	:
DK	1.00	0.79	0.75	0.80	0.49	0.52	0.47	0.33	0.34
D	:	:	0.55	:	:	:	:	:	:
F	:	1.37	1.3	:	:	:	:	:	0.24
NL	:	:	:	:	:	0.80	0.83	0.70	:
FIN	0.62	0.65	:	0.58	0.51	0.47	:	:	:
S	:	0.89	:	:	:	:	0.35	:	:

Direct P emissions from industries

kg P per capita

	1985	1990	1991	1992	1993	1994	1995	1996	1997
B	:	:	0.31	:	:	0.13	0.13	:	:
DK	0.69	0.20	0.12	0.08	0.05	0.06	0.04	0.02	:
D	:	:	0.03	:	:	:	:	:	:
F	:	:	:	:	:	:	:	:	0.02
NL	0.97	0.74	:	:	0.20	0.35	0.39	0.38	:
FIN	:	0.14	:	0.07	0.08	0.07	0.08	:	:
S	0.13	:	0.08	:	:	:	0.04	:	:

Source: various national reports, compiled by DHI

Methodology and data problems

In many countries, a large part of total industrial emissions are treated in municipal waste water treatment plants in the same way as emissions from households. Some information is available on the industrial load of municipal waste water treatment plants. However, it is quite complicated to determine or estimate the degree whereby nutrients originating from industrial discharges are removed in these plants. This requires knowledge of the load as well as of the composition of the specific nitrogen and phosphorus compounds within the industrial waste water. In cases where nitrogen and phosphorus are bound to an organic fraction, knowledge of the specific degradation in the treatment plants is required.

As a consequence of the above limitations, it has been necessary to apply a more limited operational definition of the indicator, i.e. limited to *direct* emissions of nutrients from industries into aquatic ecosystems.

WP-2: Nutrient emissions from industry

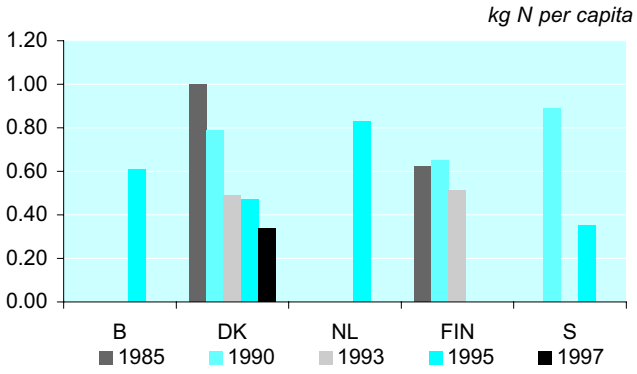
Relevant Sectors: **Industry**

Targets

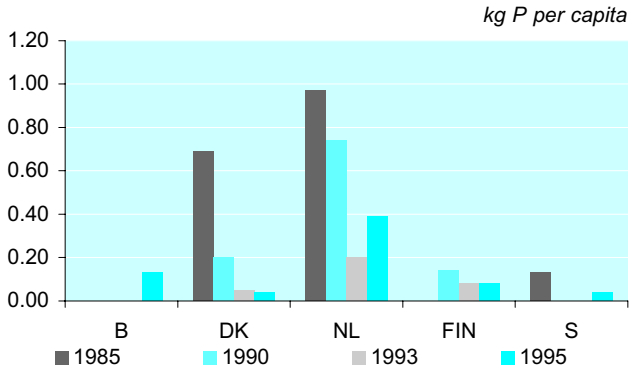
The Directive on Urban Waste Water Treatment (91/271/EEC)[2] sets out to protect the environment from the adverse effects of discharges of urban waste water and of waste water from specific industrial sectors, such as the agro-food industry.

The Directive obliges Member States to provide prior regulation or specific authorisation for all discharges of industrial waste water from the particular sectors mentioned in the Directive, as well as for all discharges of industrial waste water into urban waste water systems.

Direct emissions of nitrogen from industry into aquatic ecosystems



Direct emissions of phosphorus from industry into aquatic ecosystems



Source: DHI

Relevance: Yellow	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep: Yellow

Comments

The data presented only includes a fraction of the total emissions of nutrients from industries. But it is not possible to estimate what fraction the data do represent.

The figures suggest a general downward trend in the direct emissions of nutrients over the years, at least for those countries where data is available. Unfortunately most of the data available is for smaller Northern countries, so there is no indication of the pressure of nutrient loading coming from the industries in the larger countries, nor from the Southern countries.

[2] OJ L135, 30/05/1991 p. 0040 - 0052

WP-3: Pesticides used per hectare of utilised agriculture area

Definition and purpose

The excessive use of agricultural pesticides may result in run-off and leaching of persistent and toxic organic chemicals, including some of the products formed as pesticides break down in the environment, to (surface and ground) water. This represents an important pressure affecting the quality of water resources.

The indicator is defined as the total quantity of pesticides by type (herbicides, fungicides, insecticides and other pesticides) used per year on agricultural land *(see also TX-1)*.

The categories of Insecticides include nematicides, acaricides, and molluscicides, Fungicides includes bactericides and seed treatments and Herbicides includes defoliants and desiccants. The 'Other pesticides' category covers a wide range of products such as growth regulators, soil disinfectants and rodenticides, and varies from one country to another.

The quantities given in the table below refer to active ingredients. The active ingredients in a commercial pesticide are those which have the desired effect on the fungi, plants or insects, etc.

Sales of pesticides for agricultural use (1998) [1) 2)]

kg of active ingredients/ha of agricultural area

	Fungicides	Herbicides	Insecticides	Other pesticides	Total
EU -15	1.67	1.41	0.45	0.34	3.88
B	2.74	6.80	1.37	0.97	11.88
DK	0.30	1.03	0.02	0.07	1.43
D	0.87	1.43	0.52	0.40	3.21
EL	:	:	:	:	:
E	0.63	0.49	0.53	0.18	1.84
F	3.00	1.87	0.24	0.40	5.52
IRL	0.47	0.62	0.03	0.07	2.36
I	2.23	0.86	0.76	0.37	4.22
L	3.56	2.91	0.18	0.19	6.84
NL	5.24	2.98	1.61	1.12	10.97
A	0.92	1.09	0.06	0.21	2.27
P	3.63	0.66	0.37	0.31	4.98
FIN	0.10	0.39	0.02	0.04	0.54
S	0.11	0.46	0.01	0.01	0.60
UK	1.04	3.78	0.25	0.48	5.56

Source: Eurostat

1) Agricultural area: arable crops + permanent crops.
2) Pesticide data for B, F and P include non-agricultural pesticides.

Methodology and data problems

There are significant differences in the underlying national definitions and the range of products used in the various countries, with the result that possibilities for comparison are limited.

For a correct interpretation of the indicator, it must be borne in mind that the quantity used does not necessarily reflect the risk presented by using pesticides. The wide range of chemicals covered by the word 'pesticides' varies considerably in terms of persistence, toxicity, solubility in water, application rates, etc. Ideally, a description of the risks associated with the application of pesticides would have to take into account the differences in the intrinsic properties of the different active ingredients, and a variety of other factors such as climate, soil, and standard of spraying equipment. Data availability and the lack of a consensus on a calculation methodology do not yet allow the calculation of a scientifically sound 'pesticide risk index' *(see also TX-1)*.

WP-3: Pesticides used per hectare of utilised agriculture area

Relevant Sectors: **Agriculture**

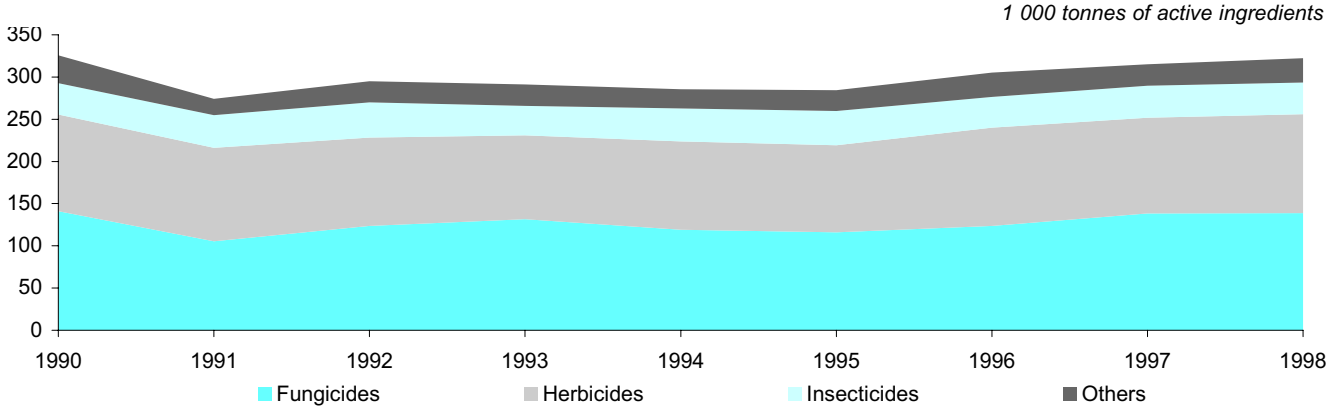
Targets

There are several EC Directives which establish limit values for pesticides although they are not directly related to this indicator. The Water Framework Directive includes biocides and plant protection products in the indicative list of main pollutants and includes a list of measures from other directives such as: Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption, which establishes limits for individual pesticides (0.10 µg/l) and for total pesticides (0.50µg/l) and the Integrated Pollution Prevention Control (IPPC) Directive (96/61/EC) which establishes a threshold value for selected pesticides.

The Harmonisation Directive 91/414/EEC on the authorisation, placing on the market and use of pesticides in the EU establishes the requirements which plant protection products must meet before they may be placed on the market and used in Member States.

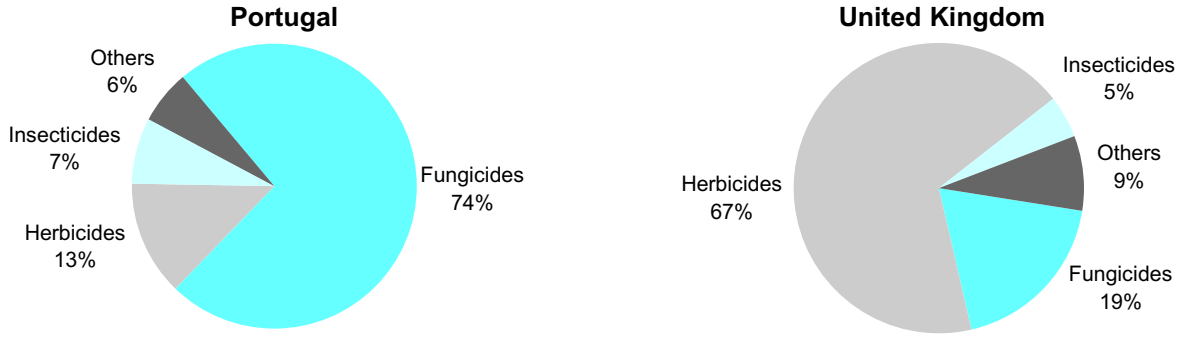
Total sales of pesticides in EU-15

1 000 tonnes of active ingredients



Source: Eurostat

Sales of pesticides by type (1998)



Source: Eurostat

Relevance: Green	Accuracy: Green	Time rep.: Green	Spatial rep.: Green

Comments

Although there was a decrease in the sales of all types of pesticides in most EU countries during the early 1990s, sales have slightly increased since 1995. One important reason behind this is the introduction in the early 90s of low dose pesticides which replaced products used in much higher doses. The quantities and types of active ingredients sold in northern and southern European countries differ due to climate conditions and different crops. Fungi appear more easily in hot conditions, resulting in the higher use of fungicides in southern EU countries. Herbicides are used in greater quantities in northern countries where weeds more readily grow.

It should also be borne in mind that use of pesticides and therefore variations in sales figures depend on weather conditions and in particular rainfall, which influence the need for fungicides, herbicides, and plant disease treatments.

WP-4: Nitrogen quantity used per hectare of utilised agriculture area

Definition and purpose

This indicator refers to the quantity of nitrogen in chemical or organic fertilisers (livestock manure, slurry) applied per unit of cultivated agricultural land and permanent pasture, measured in kg N/ha.

Biological fixation and atmospheric deposition of nitrogen are also included, as they are also important, though smaller, sources of nitrogen inputs. Biological fixation is the conversion of nitrogen in air to ammonia by bacteria primarily in symbiosis with leguminous plants while atmospheric deposition is the deposition of nitrogen on land from dust and rain.

The purpose of this indicator is to measure the intensity of manure and fertiliser use on agricultural soils and thus the potential environmental pressure on water resources from agricultural activities.

Agricultural runoff and leaching is the major diffuse source of nitrates in ground and surface water. In addition, some land-use practices, such as drainage of peat soils, can increase nitrogen leaching.

Nitrogen compounds are fairly rapidly oxidised to nitrate. Over-application may lead to nitrogen saturation in the soil, causing losses of nitrates that leach into groundwater and later to surface waters. Nitrogen can also be lost to the atmosphere by denitrification.

Above a certain level, nitrates in water can endanger human health (especially of babies and pregnant women) by contaminating the water supply, and adversely affect the stability of ecosystems and aquatic life (eutrophication of water bodies, soil acidification, etc.).

Nitrogen inputs from agriculture (1993-1997) [1)]

kg per hectare of agricultural area

	Livestock manure			Mineral fertilizer			Biological fixation			Atmospheric deposition			TOTAL INPUTS		
	1993	1995	1997	1993	1995	1997	1993	1995	1997	1993	1995	1997	1993	1995	1997
EU-15	57	56	56	73	74	75	3	3	3	14	14	15	148	147	149
B	224	226	220	112	109	114	3	3	3	33	33	33	372	370	370
DK	117	113	114	120	111	106	9	6	8	17	18	18	263	248	246
D	67	65	65	95	103	104	2	3	3	28	28	29	192	199	201
EL	49	49	49	96	88	88	2	2	2	7	7	7	155	146	146
E	23	23	23	38	36	41	2	3	3	6	6	6	68	68	73
F	47	47	46	79	85	89	6	5	5	16	16	16	147	152	157
IRL	112	110	123	94	98	91	1	1	1	10	10	10	217	219	225
I	46	46	45	63	63	62	2	2	2	11	11	12	122	121	120
L	112	114	114	142	142	142	2	2	1	27	27	27	282	284	284
NL	296	285	265	184	195	184	1	1	1	35	35	36	517	517	486
A	:	45	48	:	37	33	:	2	3	:	19	20	:	103	104
P	39	39	39	33	32	31	3	3	2	3	4	3	78	77	75
FIN	:	38	39	:	84	81	:	3	3	:	4	5	:	128	127
S	:	39	39	:	63	66	:	3	4	:	4	5	:	110	114
UK	67	66	67	77	81	77	3	3	3	15	15	15	163	165	163

Source: Eurostat

1) Area refers to agricultural area including: arable land, permanent crops and permanent meadows and pastures.

Methodology and data problems

The effects of excess nitrogen use in agriculture will vary from one area to another, as some soils are more susceptible to leaching, some areas have heavy rainfall and therefore higher run-off, etc. The data presented here cannot take these effects into account. This indicator relates only to the potential environmental pressure from nitrates used in agriculture. It does not allow for absorption of nitrogen by crops, volatilisation of ammonia from manure, emissions of N or N oxides, or binding of N in the soil. It also assumes that fertilisers and manure are distributed evenly over the whole agricultural area.

For large countries, data on inputs at national level cannot reflect the intensity of agriculture in some regions of the country. Therefore maps have been drawn up to present a fuller picture.

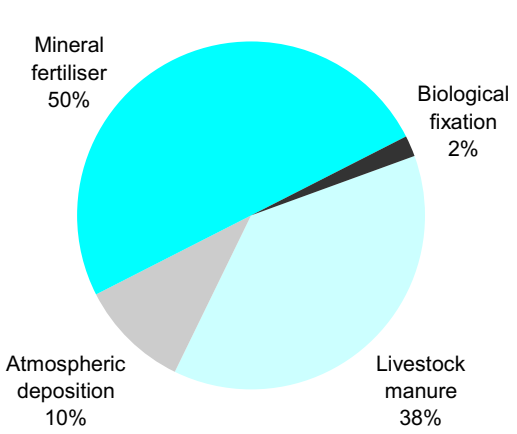
WP-4: Nitrogen quantity used per hectare of utilised agriculture area

Relevant Sectors: **Agriculture**

Targets

The objective of the Nitrates Directive[3] is to reduce water pollution caused by nitrates from agricultural sources. Member States must establish action programmes for all areas designated as vulnerable zones. These measures include limiting the use of fertilisers and restricting the application of manure to a maximum 170 kg N per ha per year. The Directive on Drinking Water[4] indicates a recommended maximum nitrate level of 25 mg/l and a limit value of 50 mg/l. The Action Programme for the Rhine calls for a 50% reduction in nitrate discharges.

Nitrogen inputs by source - EU-15 (1997)



Source: Eurostat

Relevance: Yellow	Accuracy: Yellow	Time rep.: Green	Spatial rep.: Green

Comments

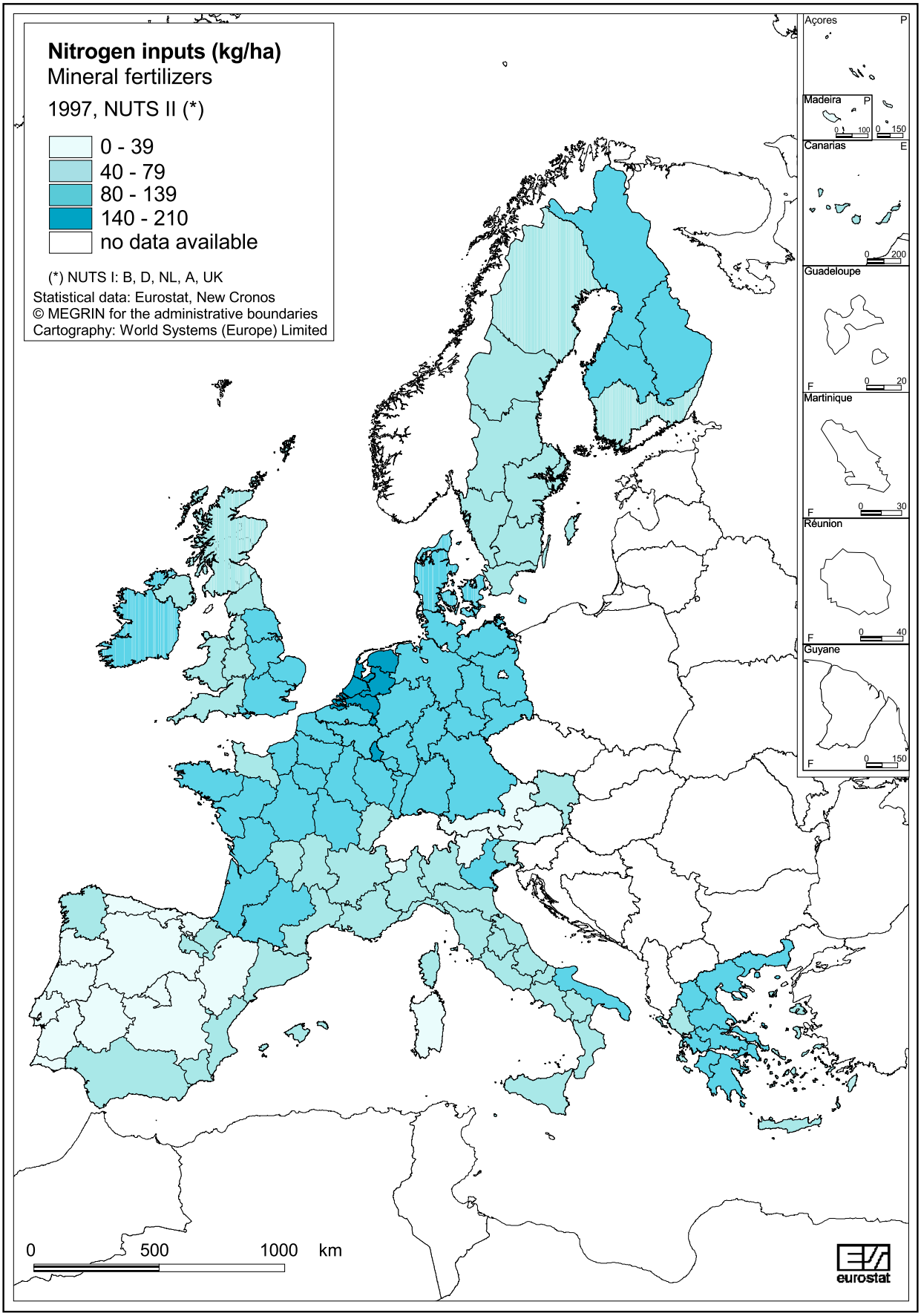
For the purposes of the Nitrate Directive, the Netherlands, Luxembourg, Germany, Denmark and Austria have declared their whole territory to be vulnerable zones. *See also RD-4.*

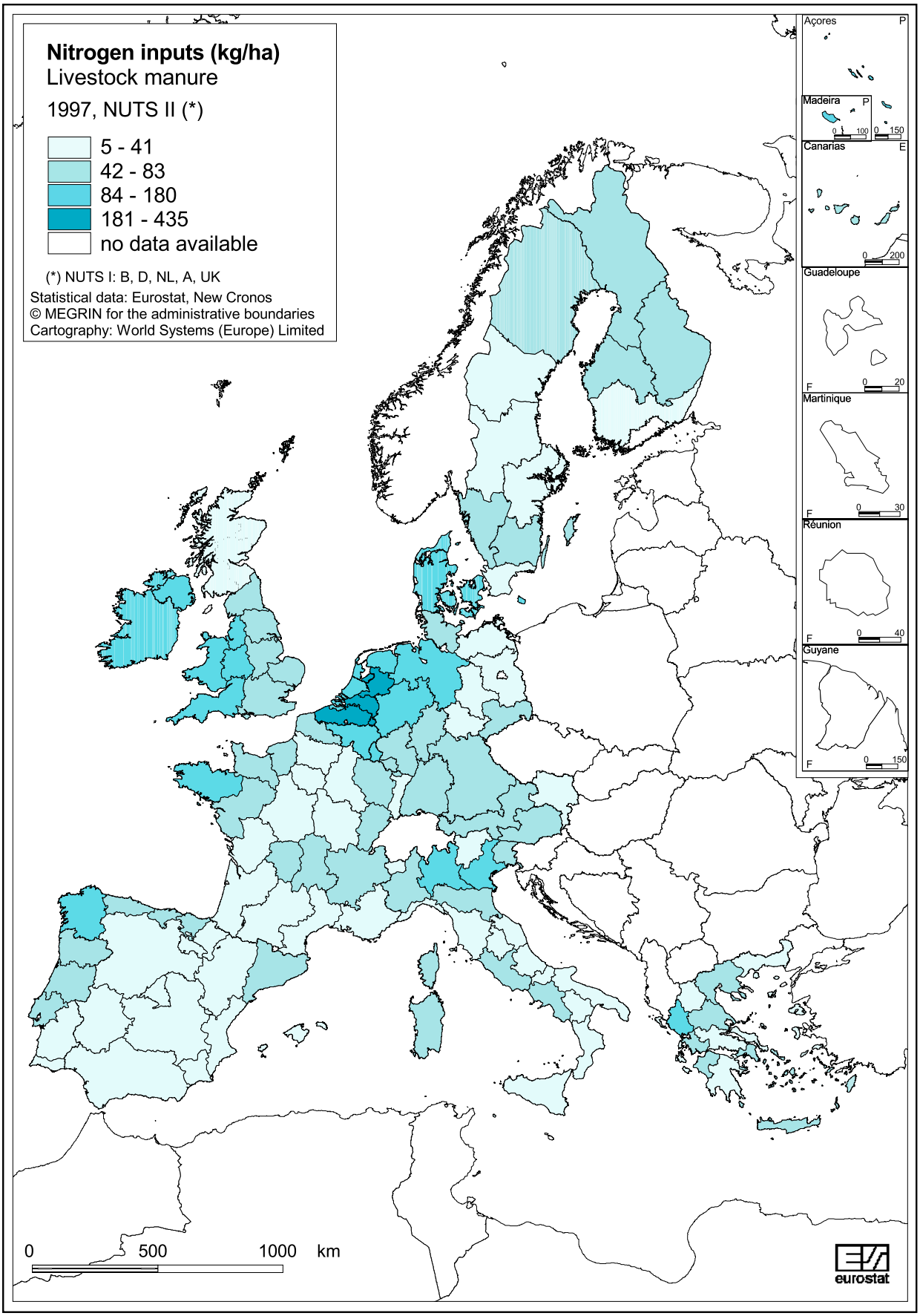
Use of mineral and organic nitrogen fertilisers (expressed as kg/ha. agricultural area) decreased between 1993 and 1995 but increased again slightly in 1997. In general, those countries with higher input levels reduced the amounts applied during the period 1993-1997 while the countries that show lower inputs increased their use.

NL, B and L have the highest total nitrogen inputs per hectare of agriculture area. Although manure inputs are higher than mineral fertiliser inputs in B, DK, IRL and NL, reflecting the high livestock density in these countries, levels are falling in B, NL and DK. This is also true for the regional distribution, where the Dutch Zuid and Oost Nederlands regions and the Flanders region in Belgium have the highest inputs for organic fertilisers *(see maps over)*. Mineral fertilisers are also used at comparatively high rates in NL, B and L. Inputs of nitrogen are lowest in E, P and A, reflecting less intensive agriculture systems in these countries as a whole, although these national figures conceal large differences between regions within the country, especially for Spain. This is also the reason why national figures for the larger countries are in general lower than for small countries. The maps (over) attempt to give a more regional picture of the distribution of nitrogen inputs, allowing a better comparison of the inputs throughout the EU.

[3] Council Directive 91/676/EEC of 12 December 1991, Official Journal L 375, 31/12/1991 p. 0001 - 0008

[4] Council Directive 80/778/EEC of 15 July 1980, Official Journal L 229, 30/08/1980 p. 0011 - 0029


Nitrogen inputs (kg/ha)
Mineral fertilizers
1997, NUTS II (*)
0 - 39
40 - 79
80 - 139
140 - 210
no data available
(*) NUTS I: B, D, NL, A, UK
Statistical data: Eurostat, New Cronos
© MEGRIN for the administrative boundaries
Cartography: World Systems (Europe) Limited
Açores
P
Madeira
P
0 100
0 150
Canarias
E
0 200
Guadeloupe
F
0 20
Martinique
F
0 30
Réunion
F
0 40
Guyane
F
0 150
0 500 1000 km
eurostat


Nitrogen inputs (kg/ha)
Livestock manure
1997, NUTS II (*)
5 - 41
42 - 83
84 - 180
181 - 435
no data available
(*) NUTS I: B, D, NL, A, UK
Statistical data: Eurostat, New Cronos
© MEGRIN for the administrative boundaries
Cartography: World Systems (Europe) Limited
Açores
Madeira
Canarias
Guadeloupe
Martinique
Réunion
Guyane
0 500 1000 km
eurostat

WP-5: Emissions of organic matter from households

Definition and purpose

Organic matter discharged from various types of human activities is a major source of pollution, as the microbiological breakdown of organic matter uses up oxygen in the recipient water bodies. Deoxygenation of fresh water and marine water in deltas and other coastal zones can result in the disappearance of fish and aquatic invertebrates. The breakdown of organic matter may also release nitrates and phosphates, which can increase eutrophication. High levels of organic pollution can restrict water use and development unless expensive pre-treatment is put in place. Organic pollution of freshwater is likely to increase the concentration of pathogens in the water and to lead to deterioration of the living environment of aquatic communities.

The indicator is defined as the quantity of organic matter discharged by households into water, measured in terms of Biochemical Oxygen Demand (BOD_5)[5] because decomposition of organic matter requires oxygen. This indicator reflects the pressure on water bodies which receive discharges of waste water, as well as the results of efforts to reduce this type of pollution.

Emissions from households are estimated by means of data on population connected to treatment plants, an emission factor (kg BOD/inhabitant) and the theoretical efficiency of treatment plants.

BOD emissions from households, after treatment

kg BOD per capita

	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998
B	21.19	20.88	17.64	:	:	:	:	:	16.33	16.13	15.97	:	13.70
DK	16.04	13.87	:	6.90	4.67	4.07	3.36	2.69	2.31	2.08	1.98	1.66	1.65
D	:	:	8.15	6.89	6.03	5.71	:	:	:	4.32	:	:	:
EL	:	:	21.81	20.12	:	:	19.86	16.58	:	15.53	:	15.13	:
E	:	20.08	19.63	18.09	:	15.97	15.39	:	:	14.11	:	:	:
F	:	:	:	:	:	:	10.75	:	:	:	:	:	:
IRL	:	:	19.84	:	16.48	:	:	:	:	14.03	:	:	:
I	20.26	:	:	:	:	:	:	:	:	9.99	:	:	:
L	19.46	:	8.75	8.14	:	:	:	:	7.76	7.67	:	:	:
NL	15.52	14.17	9.27	6.58	4.53	4.49	4.42	3.80	3.42	2.63	2.58	:	:
A	20.18	:	15.97	10.53	8.95	8.12	8.12	7.44	:	7.40	:	:	:
P	:	:	21.75	21.67	19.16	:	:	:	:	15.01	14.96	13.74	13.11
FIN	16.71	8.84	5.83	3.60	2.58	2.56	2.56	2.56	2.54	2.54	:	:	:
S	12.40	6.09	5.42	2.73	2.54	2.52	2.29	:	:	2.68	:	:	2.68
UK	:	:	7.36	7.17	7.13	:	:	:	:	6.39	6.21	:	:
IS	:	:	:	:	21.77	21.77	21.77	21.77	21.64	21.64	21.64	21.64	21.35
NO	17.67	16.45	15.84	14.32	7.63	7.34	7.04	6.75	6.89	6.39	6.39	:	:
CH	15.38	11.31	7.41	5.21	3.79	3.56	3.56	:	:	2.85	:	2.66	:

Source: Eurostat, adapted by TAU

Methodology and data problems

There is a lack of data on the efficiency of waste water treatment plants in most Member States, therefore estimations have been made based on engineering data. These data reflect the potential efficiency of domestic wastewater treatment, which does not necessarily match the actual efficiency. The values used in indicator estimation, expressed as a percentage of the removed BOD, are 30% for primary treatment, 85% for secondary, and 95% for tertiary treatment. As these efficiencies are average data, Member States with efficiency rates higher than the averages have lower actual emissions than those estimated. This can make comparison between Member States difficult, but the indicator provides clear information on the trend in each Member State.

[5] BOD 5 refers to the dissolved oxygen required by organisms for the aerobic decomposition of organic matter present in water measured for a period of five days

WP-5: Emissions of organic matter from households

Relevant Sectors: **Households**

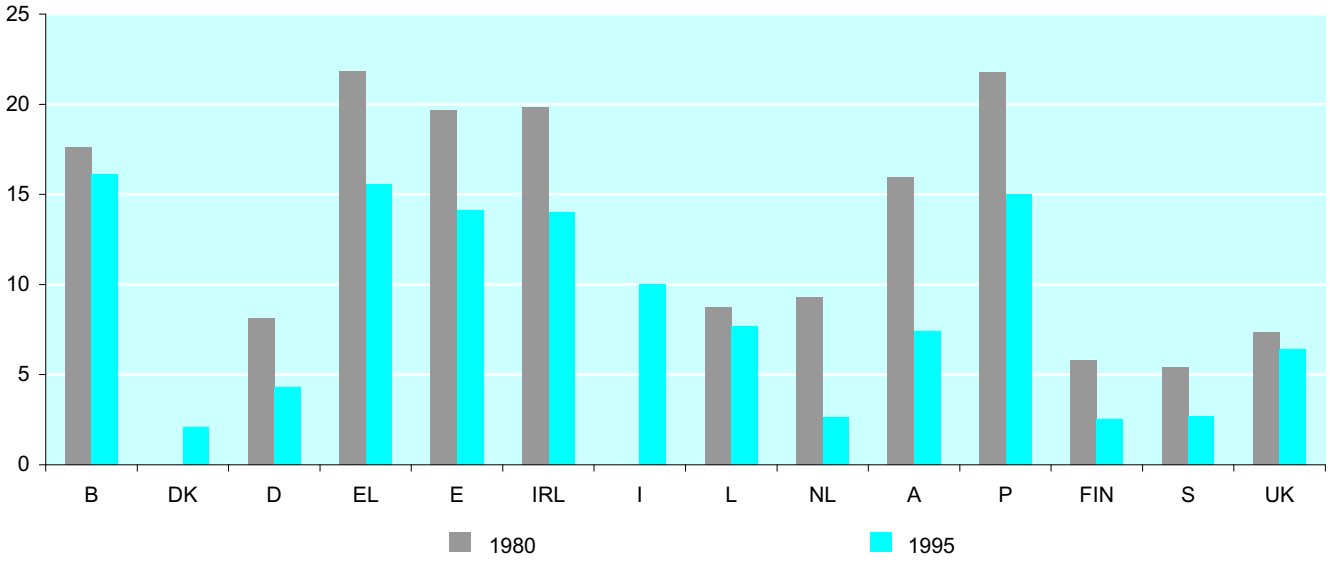
Targets

The Directives on Water Quality (Directive 76/160/EEC[6], 78/659/EEC[7] and 80/778/EEC[8]) establish guide values and limits values for BOD and dissolved oxygen depending on the intended use of the water.

The Directive on Urban Waste Water Treatment (91/271/EEC[9]) requires Member States to treat waste water from agglomerations of more than 2 000 population equivalents to at least secondary level of treatment. However, the treatment has to be more stringent (secondary plus tertiary treatment) for discharges in areas identified as sensitive by Member States and in the relevant catchment areas. The time limit for implementation of the Directive is 31.12.1998, 31.12.2000 or 31.12.2005, depending on the size of the agglomeration and the sensitivity of the receiving body.

Emissions of BOD from households, after treatment

kg BOD per capita



Source: Eurostat, adapted by TAU

Relevance: Green	Accuracy: Yellow	Time rep.: Yellow	Spatial rep.: Green

Comments

In the last 20 years, biological treatment of domestic and industrial waste water has intensified and organic pressure on different recipients has consequently declined in many parts of Europe. The greatest improvements are seen in the Nordic countries, Germany and the Netherlands, with Belgium, Ireland and the Southern countries lagging behind. In fact the data presented represent emissions from the normal populations of these countries, and therefore do not take into account the added load coming from the large tourist influx to the Mediterranean countries.

The variation in discharges from households is related to the percentage of population connected to waste water treatment plants and the efficiency of the treatment applied. Compliance with the Directive on Urban Waste Water Treatment should bring about a downward trend in this indicator, especially in those countries with higher treatment deficit.

6 Council Directive 76/160/EEC concerning the quality of bathing water : OJ L031, 05/02/1976, p. 0001 - 0007

7 Council Directive 78/659/EEC of 18 July 1978 on the quality of fresh waters needing protection or improvement in order to support fish life : OJ L222, 14/08/1978 P. 0001 - 0078

8 Council Directive 80/778/EEC of 15 July 1980 (Directive on Drinking Water): OJ L229, 30/08/1980 p. 0011 - 0029 as amended by Directive (98/83/EC)

9 OJ L135, 30/05/1991 p. 0040 - 0052

WP-6: Emissions of organic matter from industry

Definition and purpose

The indicator is defined as the quantity of organic matter discharged by industrial activities into water and is measured in terms of Biochemical Oxygen Demand (grammes of BOD_5[10] per capita per year).

It is assumed that the term 'discharged' in this context refers to emissions into aquatic ecosystems of soluble organic matter as well as that suspended in water.

Certain types of industry are more susceptible to discharging organic matter than others, depending on the activity of the industry. Emissions are estimated by means of data on employment in different types of industries, an emission factor (kg BOD/employee) which varies from one type of industry to another and an assumed fraction of industrial discharges to public sewer system as well as the theoretical efficiency of waste water treatment plants (WWTP).

BOD emissions from industries, after treatment (approximately 1993)

grammes BOD per capita per year

Type of industry	Food & beverages	Textile, wearing & leather	Wood & wood products	Pulp & paper, printing & publishing	Chemicals	Non-metallic mineral products, N.E.C.	Machinery	Other manuf. industries	Total
EU-15	1 020	20	<10	770	620	<10	10	<10	2 450
B	880	20	<10	70	1 200	<10	10	<10	2 180
DK	2 590	10	<10	200	200	<10	10	<10	3 020
D	810	10	<10	70	980	<10	10	<10	1 890
EL	<10	<10	<10	:	<10	:	<10	<10	10
E	870	30	<10	630	330	<10	<10	<10	1 860
F	1 580	20	<10	860	610	<10	10	<10	3 090
IRL	330	20	<10	90	680	<10	10	<10	1 120
I	1 130	50	<10	540	450	<10	10	<10	2 190
L	<10	<10	<10	50	:	:	<10	<10	60
NL	1 110	10	<10	100	980	<10	<10	<10	2 200
A	30	10	10	:	<10	<10	<10	<10	50
P	1 140	20	10	1 850	340	<10	10	<10	3 380
FIN	1 570	10	20	11 280	650	<10	10	<10	13 540
S	20	<10	10	6 050	450	<10	10	<10	6 540
UK	1 090	30	0	820	600	<10	10	<10	2 540

Source: DHI, based on data from Eurostat and World Bank

Methodology and data problems

Few statistical data on industrial discharges is available in the Member States, therefore the estimations have been made by applying emission coefficients developed by the NIPR Group of the World Bank.

In the IPPS study (Industrial Pollution Projecting System) by the NIPR Group it was revealed that within specified industrial sectors, BOD emission/labour ratios are approximately constant across countries at all income levels of economic development[11].

These estimations include 70 types of industries which, because of the nature of their production, are susceptible to discharging organic matter. However, several other important types of industries are missing e.g. fish industries. Also, for several countries employment data is missing for some of the industries. Therefore, the data presented should be interpreted with caution.

The theoretical efficiency rates of WWTP are expressed as a percentage of the removed BOD and the values applied are 30% for primary treatment, 85% for secondary and 95% for tertiary treatment. As these efficiency rates are average data, Member States with efficiencies higher than the averages have lower actual emissions than those estimated.

[10] BOD 5 refers to the dissolved oxygen required by organisms for the aerobic decomposition of organic matter present in water measured for a period of five days

[11] '*Industrial pollution in economic development: Kuznets revisited*', H. Hettige, M. Mani, and D. Wheeler, 1997, Development Research Group, World Bank, http:/www.worldbank.org/nipr/work_paper/kuznet)

WP-6: Emissions of organic matter from industry

Relevant Sectors: **Industry**

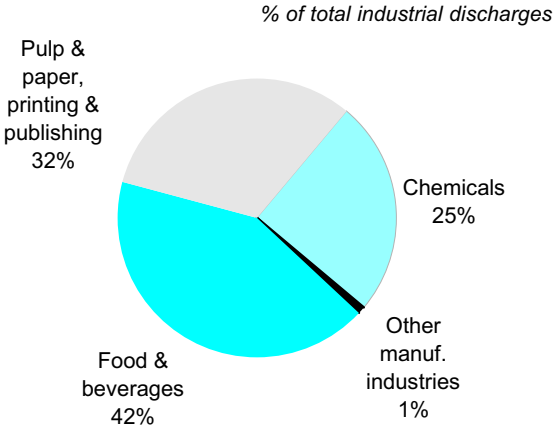
Targets

The Directives on Water Quality (Directive 76/160/EEC[12], 78/659/EEC[13] and 80/778/EEC[14]) establish guide values and limits values for BOD and dissolved oxygen depending on the water use.

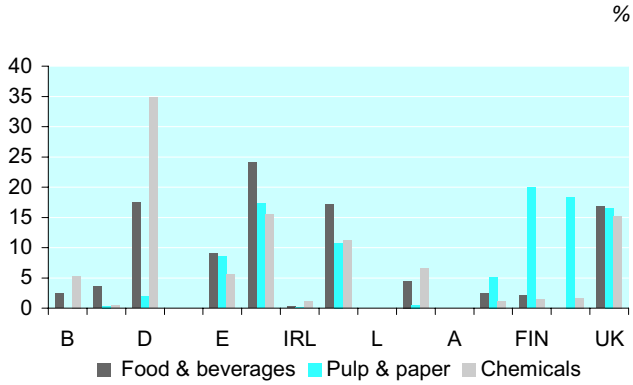
The objective of the Directive on Urban Waste Water Treatment (91/271/EEC[15]) is to protect the environment from the adverse effects of discharges of urban waste water and of waste water from industrial sectors of agro-food industry.

The Directive obliges Member States to provide prior regulation or specific authorisation for all discharges of industrial waste water from the particular sectors mentioned in the Directive, as well as for all discharges of industrial waste water into urban waste water systems.

Emissions of BOD from industries (1993) EU-15



Emissions of BOD from most relevant industries (1993)



Source: DHI, based on data from Eurostat and World Bank

Relevance: Yellow	Accuracy: Yellow	Time rep.: Red	Spatial rep.: Yellow

Comments

Data on industrial discharges shows that the major part can be ascribed to three types of industries. However, the data presented accounts only for 0.9 million tonnes BOD, which is less than 50% of the expected total industrial emissions.

Other important sources of organic pollution are agriculture, fish farming and rainwater run-off. The contributions of these sources have yet to be estimated to create an overall picture of the indicator and the extent of pollution.

[12] Council Directive 76/160/EEC on the quality of bathing water : OJ L031, 05/02/1976 p. 0001 - 0007

[13] Council Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life : OJ L222, 14/08/1978 P. 0001 - 0078

[14] Council Directive 80/778/EEC (Directive on Drinking Water): OJ 229, 30/08/1980 p. 0011 - 0029 as amended by Directive (98/83/EC)

[15] OJ L135, 30/05/1991 p. 0040 - 0052

MARINE ENVIRONMENT AND COASTAL ZONES

Introduction

The *Marine Environment & Coastal Zones* are areas of great importance as habitats for unique species of wildlife, both on land and in the seas. They are often also areas of outstanding natural beauty. In the past, the seas were often used as dumping grounds for all sorts of unwanted matter, such as untreated waste water, industrial discharges, and waste. At the same time, it has been exploited for its resources, not least of which is fish. Land in coastal areas is in high demand for industry, so as to be near ports to allow import and export of goods, for housing, for recreation, and for agriculture, as often the most fertile soils are found there. Thus, seas and coastal zones are both under increasing pressure from growing urbanisation and by all economic sectors, in particular tourism, transport, industry, energy, agriculture and fishing.

The Commission Communication COM 2000/547 of 27/09/2000 announced a European Strategy for Integrated Coastal Zone Management. This calls for a common vision for coastal zones, based on, among others, the integrity of the ecosystem, and sustainable management of the living and non-living resources of both the marine and terrestrial components of the coastal zone, with management of these zones based on a holistic approach. It is proposed that Member States establish adequate, continuous systems for monitoring and diffusing information about their coastal zone. These systems should collect and provide information in appropriate and compatible formats to decision makers at national, regional and local levels to facilitate integrated management.

The EU's Natura 2000 programme sets out to protect important natural areas, based on the Birds Directive and the Habitats Directive, and therefore is very relevant to coastal zones.

In 1995, the Ministerial Conference of the North Sea countries agreed to stop emissions, discharges and all losses of harmful substances into the marine areas by the year 2020. In 1998, both the Oslo and Paris Commissions for the protection of the North Sea (OSPAR) and the Helsinki Commission for the Baltic Sea (HELCOM) committed themselves to the same objective.

In order to enhance the exchange of information between countries on marine environment issues, the EU ministers for the environment agreed, during the first Environment Council in 1999, to create a legal framework for co-operation in the field of accidental marine pollution.

The indicators presented in this section reflect the most important pressures on the marine environment and on coastal zones identified by the scientific advisory group, covering issues such as *Eutrophication, Fishing pressure, Development along shore, Discharges of heavy metals, Oil pollution at coast and sea and Tourism intensity.* The latter is new in this edition and replaces the previous ME-6 *(Discharges of halogenated organic compounds)* for which little or no data was found.

In most cases the methodology or presentation of the other indicators has been improved compared to the previous version of this publication. Where possible an attempt to show the contribution of the different economic sectors to the pressure has been added.

To this list has been added another indicator, *Wetland loss in coastal zones,* previously found in the chapter on *Loss of Biodiversity,* which has disappeared from this edition. It has been numbered ME-3b, emphasising also the link to development.

ME-1: Eutrophication

Definition and purpose

Eutrophication is the natural or anthropogenic enrichment of a water body with nutrients, causing major changes in the ecosystems of the receiving water. Most regional EU seas have seen an increase in eutrophication problems such as algae blooms, including toxic blooms which jeopardise marine and human health.

Anthropogenic eutrophication of seas, particularly estuaries, is caused by nitrogen (N) and phosphorus (P) compounds, either discharged directly through pipes (point sources of sewage, industrial waste water *(see chapter on Water pollution)* and fish farming), run-off from land (diffuse sources originating from agriculture, *(see WP-4)*) or via deposition of (oxidised) nitrogen compounds from combustion of fuel and other matter.

Currently, the indicator is defined as the amount of nutrients, expressed in tonnes N and P per year, discharged into coastal zones, either directly or by rivers. Riverine inputs are carried by a river to the coast, and include inputs coming from the whole catchment area, although the pressure is ascribed to the most downstream country (e.g. the Rhine is ascribed to NL). Riverine inputs originate from both natural and man-made sources. Direct inputs originate from point sources, i.e. waste water effluents discharged directly into coastal waters.

Riverine and direct inputs of nitrogen and phosphorus to coastal zones [1) 2)]

1 000 tonnes

	1990	1991	1992	1993	1994	1995	1990	1991	1992	1993	1994	1995
	Total N						Total P					
Riverine inputs												
EU-15	1 311	1 107	1 273	1 269	1 586	1 719	77.5	63.8	63.4	74.4	89.6	91.3
B	49	54	59	48	51	57	4.8	5.9	5.0	3.7	2.9	6.2
DK	97	79	92	98	119	94	3.6	2.3	2.0	2.0	3.0	2.2
D	201	152	226	233	346	293	11.6	11.0	11.0	15.0	12.0	11.5
EL	:	:	:	:	:	:	:	:	:	:	:	:
E	:	:	:	:	:	:	:	:	:	:	:	:
F	67	67	67	67	67	67	4.7	4.7	4.7	4.7	4.7	4.7
IRL	147	162	117	155	169	141	4.3	3.8	3.9	5.3	8.0	4.8
I	:	:	:	:	:	:	:	:	:	:	:	:
NL	340	320	390	360	485	570	22.0	19.0	19.0	21.0	28.0	33.0
P	11	11	10	10	8	2	1.2	1.2	0.8	3.6	12.0	0.9
FIN	62	:	:	:	:	60	3.3	:	:	:	:	3.4
S	136	32	34	29	40	151	5.2	0.9	0.7	0.6	0.9	5.3
UK	201	231	278	269	300	283	16.9	15.0	16.4	18.4	18.1	19.3
Direct inputs												
EU-15	180.5	137.4	149.8	130.5	117.0	141.8	34.9	32.5	29.2	22.5	25.0	25.0
B	0.2	0.2	0.3	0.2	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	:	<0.1
DK	14.9	13.5	12.7	9.7	9.3	8.5	3.1	2.5	2.1	1.6	1.5	1.1
D	6.3	7.3	4.3	4.3	5.0	9.2	0.7	0.6	0.5	0.5	0.5	0.6
EL	:	:	:	:	:	:	:	:	:	:	:	:
E	:	:	:	:	:	:	:	:	:	:	:	:
F	:	:	:	:	:	:	:	:	:	:	:	:
IRL	10.2	10.2	10.2	10.2	10.2	10.2	2.5	2.5	2.5	2.5	2.5	2.5
I	:	:	:	:	:	:	:	:	:	:	:	:
NL	5.0	5.7	6.1	6.1	6.1	6.9	1.2	1.0	1.1	1.1	1.1	1.1
P	6.9	6.9	7.4	7.4	7.4	7.6	1.9	1.9	2.2	2.2	2.2	2.2
FIN	9.8	:	:	:	:	2.9	0.6	:	:	:	:	0.4
S	21.7	3.6	3.6	3.9	3.8	19.8	1.2	0.1	0.1	0.1	0.1	0.7
UK	105.5	90.0	105.2	88.7	75.2	76.7	23.8	23.9	20.8	14.5	17.1	16.3

Source: data submitted by countries to OSPAR and HELCOM, adapted by DHI

1) D: includes former East Germany from 1990 onwards and only inputs to HELCOM areas in 1985, 1990 and 1995.
2) S: 1991-1994 includes only inputs to OSPAR areas.

Methodology and data problems

OSPAR and HELCOM data seem to be the most reliable aggregated data sets available. However the data refers only to the Atlantic, the Baltic and North seas, and for several countries data is missing. For the Mediterranean Sea it has not been possible to find harmonised aggregated data.

ME-1: Eutrophication

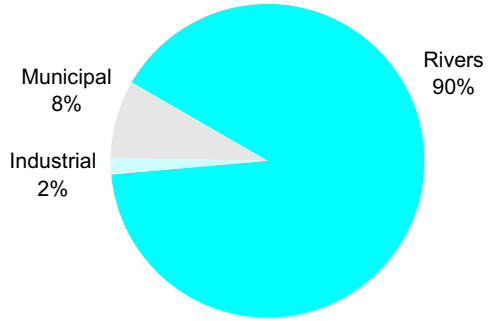
Relevant Sectors: Energy, Industry, Households, Agriculture

Targets

The targets set by the Urban Waste Water Treatment Directive (91/271/EEC)[1] *(see WP-1)* and the Nitrates Directive (91/676/EEC)[2] *(see WP-4)* should lead to improvements in this indicator.

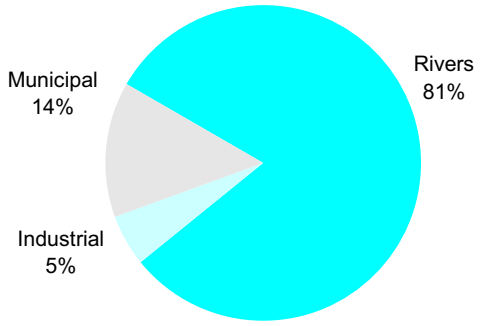
In 1998, both the OSPAR and the HELCOM Commissions committed themselves to stop emissions, discharges and all losses of harmful substances into the marine areas by the year 2020. HELCOM have set an intermediary target of halving the 1985 level of input of nutrients by 2005.

Total inputs of N into the HELCOM areas (1995)



Total inputs of P into the HELCOM areas (1995)

%



Source: HELCOM (1998), adapted by DHI

Relevance: Yellow	Accuracy: Yellow	Time rep.: Green	Spatial rep.: Green

Comments

Total inputs of nutrients are dominated by riverine contributions and in the HELCOM areas, these account for 90% of total nitrogen and more than 80% of total phosphorus. Large variations are seen in the riverine inputs reported by countries. Factors influencing these inputs are 1) the size of the catchment areas of the rivers with mouth in the reporting country e.g. the riverine inputs reported by Germany will include, among others, inputs from the whole of the Elbe catchment area; 2) rainfall e.g. in a wet year or a wet country, the nutrients washed out of soils are expected to be higher than in a dry year or a country with a drier climate; 3) the type of waste water treatment in these countries; and 4) the type of land use in the upstream countries, e.g. a large area devoted to intensive agriculture will result in more nutrient inputs. Riverine inputs from Sweden and Finland, where forests dominate, are only around 25 kg/N/ha/year.

Although no harmonised aggregated data was found for the Mediterranean Sea, the United Nations has made a study of priority pollution 'hot spots' in the Mediterranean, which identifies a total of 42 hot spots of direct discharges of N and P for Greece, Spain, France and Italy, representing a total of 33 500 tonnes N and 17 500 tonnes P.

Direct inputs of nutrients at hot spots identified in the Mediterranean Sea

1 000 tonnes tot-N and 1 000 tonnes tot-P

	EL	E	F	I	Total
N° of hot spots	9	14	5	14	42
Total N	0.7	0.7	7.2	24.8	33.5
Total P	0.2	0.2	0.6	16.5	17.5

Source: UNEP (1997) adapted by DHI

[1] OJ L 135, 30/05/1991 p. 0040 - 0052
[2] OJ L 375, 31/12/1991 p. 0001 - 0008

ME-2: Fishing pressure

Definition and purpose

The state of fish stocks in waters commonly fished by the EU and EFTA fishing fleets is of increasing concern, as shown in the table on following page. Information on catches provides some indication of one of the main pressures on fishing resources, particularly for species which are already considered over-exploited or at serious risk of depletion. Ideally this should be complemented by figures on fishing mortality and spawning stock biomass, but these are not readily available.

The data presented are for annual catches of species at risk, for all commercial, industrial, recreational and subsistence purposes, by all EU countries, expressed in tonnes live weight equivalent of the landings, that is excluding all quantities caught but not landed, for example, discarded fish or fish consumed on board. Aquaculture is not included.

Total catch of selected marine fish and shellfish species by main sea areas

1 000 tonnes live weight equivalent of the landings

	North-east Atlantic					East-central Atlantic					Mediterranean Sea				
	1990	1995	1996	1997	1998	1990	1995	1996	1997	1998	1990	1995	1996	1997	1998
	EU-15														
Total fishery	4 627	5 713	5 108	5 290	5 185	493	450	534	543	603	610	702	673	644	562
Among which:															
Marine fish	4 078	5 066	4 537	4 712	4 549	431	392	467	496	552	447	529	499	476	408
Shellfish	454	516	437	507	525	62.4	58.3	66.4	46.3	50.6	156	171	171	164	149
Tuna-like fish	50.6	67.8	66.1	70.8	71.6	205	182	166	137	137	30.9	41.2	42.5	41.3	35.0
Mackerel-like fish	427	455	311	324	395	10.6	6.91	22.0	14.4	10.8	15.8	19.2	22.0	18.4	14.0
Anglerfishes	3.77	3.52	3.53	5.16	6.30	-	-	-	-	-	0.54	1.61	1.17	1.14	0.98
Cod	320	286	317	291	260	-	-	-	-	-	-	-	-	-	-
European hake	53.3	54.4	37.9	39.8	35.5	4.97	6.61	6.59	3.68	4.24	30.5	48.4	40.1	26.5	20.1
Saithe (Pollock)	92.7	58.1	59.4	56.8	52.3	-	-	-	-	-	-	-	-	-	-
Common sole	41.1	44.1	34.4	27.2	31.2	2.86	0.49	0.34	0.96	0.96	8.22	7.86	5.15	4.12	3.40
Swordfish	6.92	4.16	3.50	2.66	2.54	0.02	0.27	0.06	0.40	0.20	8.39	9.08	7.71	8.12	9.20
	EFTA														
Cod						-	-	-	-	-	-	-	-	-	-
IS	333	203	204	209	243	-	-	-	-	-	-	-	-	-	-
NO	124	365	359	402	322	-	-	-	-	-	-	-	-	-	-
Saithe						-	-	-	-	-	-	-	-	-	-
IS	95.0	47.5	39.3	36.5	30.5	-	-	-	-	-	-	-	-	-	-
NO	112	219	222	184	194	-	-	-	-	-	-	-	-	-	-

Source: Eurostat

Methodology and data problems

The sea areas for which data are available are not quite the same as the areas used in the table on stocks. Therefore a direct comparison between the two tables is not straightforward. Non-landed by-catches or discards, which in some cases are important pressures on species not normally used for human food, are not included.

This must be seen as a fairly rough indicator, as the ability of fish stocks to recover differs greatly from one species to another. The removal of a number of fish from a threatened population of a very fecund fish (e.g. herring) is less serious than the removal of the same number of fish with a very low fecundity (e.g. sharks, rays etc).

ME-2: Fishing pressure

Relevant Sectors: **Fishery**

Targets

Council declaration of 30 May 1980 on the common fisheries policy (OJ C 158 27.06.1980) calls for rational and non-discriminatory Community measures for the conservation and reconstitution of stocks to ensure their sustainable exploitation. The primary goal of the EU Fisheries Policy is to set specific mid-to long term targets which identify sustainable levels for fish stocks or fish harvesting (see COM 2000(803)).

The Council agrees fish catch quotas annually. For 2001 the total allowable catch for certain species have been cut drastically. For the northern hake a cut of 50% was agreed, while for cod and whiting caught off the West of Scotland, cuts of 50% and 35% were agreed. Catches for several other species were cut by 10%.

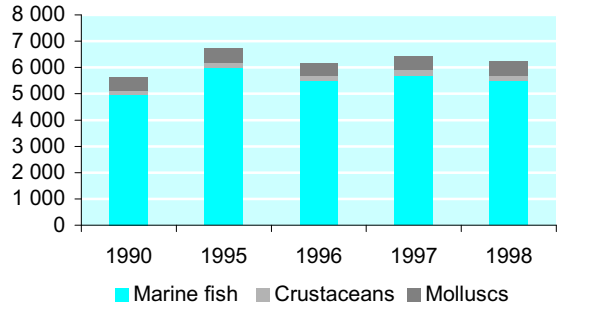
State of the main fish stocks by species and sea areas [1)]

	Baltic Sea	Skagerrak Kattegat	North Sea	West Scotland	Irish Sea	West Ireland	Celtic Sea · Western Channel	Eastern Channel	Bay of Biscay	Iberian Peninsula	Mediter-ranean Sea
Herring		FE	DR				FE	OF			
Mackerel		DR	DR	OF	OF	OF	OF	OF	OF	OF	
Sardine										DR	
Salmon	DR										
Bluefin tuna							OF	OF	OF	OF	OF
Swordfish							OF	OF	OF	OF	OF
Cod	OF	DR	DR	DR	DR		OF	DR			
Haddock		OF	OF	OF	FE			OF			
Whiting				OF	FE		FE	FE			
Saithe		OF	OF	DR							
Hake		OF	OF	OF	OF	OF	OF	OF	OF	DR	
Plaice		OF	DR		FE		DR	FE			
Sole					OF		DR	OF	OF		
Anglerfish				OF	OF	OF	OF	OF	OF	OF	
Megrim				FE	FE	FE	FE	FE	FE	FE	
Nephrops		OF	FE	FE	FE		FE		OF	FE	

Source: European Commission
1) FE = fully exploited; OF = overfished; DR = risk of depletion.

Marine fish and shellfish catch in EU-15

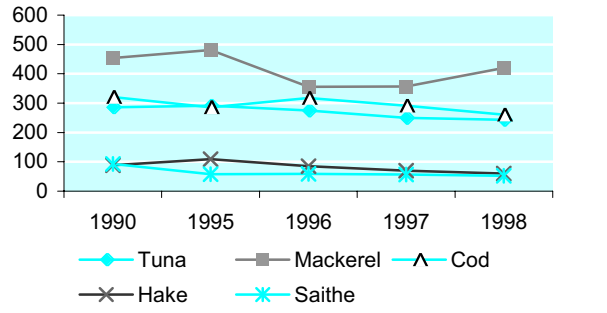
Mio tonnes live weight equivalent of the landings



Source: Eurostat

Fish catch by species in EU-15

Mio tonnes live weight equivalent of the landings



Source: Eurostat

Relevance: Green	Accuracy: Green	Time rep.: Green	Spatial rep.: Green

Comments

Total catches in 1998 were higher than 1990, though lower than in the period 1994-1997. Cod and saithe catches by EU countries and Iceland are decreasing, but this is offset by Norway, which has more than doubled its catches of cod since 1990, and now catches more cod and saithe than all EU countries combined. Catches of tuna-like fish have fallen considerably, especially in the East-central Atlantic, where they were classified as over-fished. Recent information indicates that for bottom-dwelling species the status of stocks has deteriorated further, but for pelagic species such as mackerel and herring the situation has improved or stabilised.

ME-3: Development along shore

Definition and purpose

The purpose of this indicator is to track increases in structural development in coastal zones. The indicator is defined as percentage increase in structural hard surface in the coastal zone. The indicator as presented below was calculated by interpretation of satellite images from 1975 and for approximately 1990[1] by the LACOAST project of the European Commission's Joint Research Centre (Ispra, Italy).

The indicator incorporates continuous and discontinuous urban fabric, industrial or commercial development, road and rail networks and associated land, port areas and airports, as defined in the CORINE Land Cover (CLC) project of the European Environment Agency.

Increase in built up land in the coastal zone (1975-1990)

hectares

	Built-up land in the coastal zone (1975)	Built-up land in the coastal zone (1990)	Increase in coastal built-up land (1975-1990)	% of built-up land in the coastal zone (1990)	% of total change
B	8 960	11 713	2 753	17.4	23.5
DK	177 168	186 502	9 334	3.3	5.0
D	81 696	88 005	6 309	2.2	7.2
EL	:	:	:	:	:
E	143 018	165 566	22 548	5.9	13.6
F	260 623	294 945	34 322	5.5	11.6
IRL	56 319	61 520	5 201	1.3	8.5
I	259 599	328 919	69 320	6.9	21.1
L	.	.	.	.	.
NL	58 250	59 913	1 663	4.0	2.8
A	.	.	.	.	.
P	:	:	:	:	:
FIN	:	:	:	:	:
S	:	:	:	:	:
UK	:	:	:	:	:

Source: LACOAST project (JRC)

Methodology and data problems

The LACOAST project provides data corresponding to land use changes in a 10 kilometre wide strip along the coast, using the classifications of the CLC project of the EEA. The definition of coastal zone, as a 10 kilometre wide strip, may be adequate for gauging some environmental impacts, but perhaps inadequate for others. There is an inconsistency in the data relative to the area covered by Greece between 1975-90, therefore it has not been included as it is not comparable to the rest of the countries. LACOAST can only provide data for eight countries at present. Data for Portugal are not yet available.

Roads and rail networks are only considered in CLC when the area is bigger than 25 hectares and the minimum width is 100 metres. These cases are rare in Europe. Hence, transport infrastructure has not been included in the indicator.

Because land cover changes are in general relatively slow, the second Corine Land Cover survey is expected to be repeated in 2001-2002, using the same methodology as the first Corine Land Cover. This will provide a better basis for analysis of change in land cover.

[1] The year in which the individual countries carried out their Land Cover surveys varied between 1989 and 1996

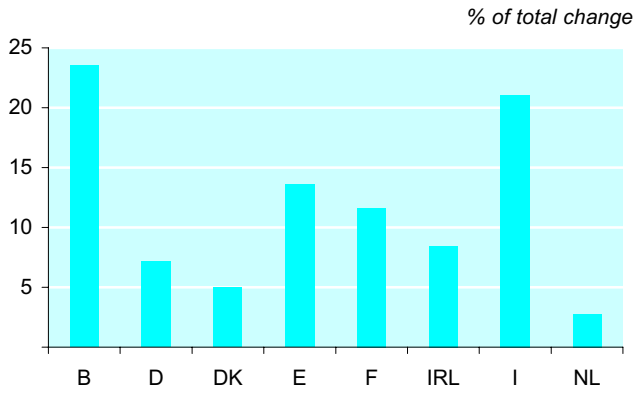
ME-3: Development along shore

Relevant Sectors: Households, Services, Industry

Targets

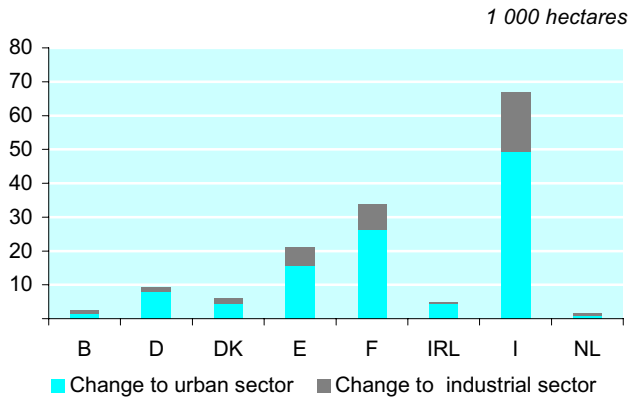
There are no fixed targets for this indicator. However, many countries are becoming aware of the rapid disappearance in natural areas along the coast, and the 1990s have seen a move towards reusing the so-called brown field sites to regenerate inner city areas, rather than allowing further urban sprawl in coastal and other areas.

Increase in built-up land in coastal zones (1975-90)



Source: LACOAST project (JRC)

Development along shore by sector (1975-90)



Source: LACOAST project (JRC)

Relevancy: Green	Accuracy: Green	Time Rep.: Yellow	Spatial Rep.: Green

Comments

Coastal zones have long been important centres of economic activity. Close to one third of the European population is concentrated within a narrow stretch of coastal land of approximately 50 kilometres (Dobris Assessment, EEA 1996). The pressure of this population and the activities associated with it are important in many coastal areas. This can be seen in particular in intensive urban developments, where impacts can multiply seasonally (especially in Mediterranean areas) to support a concentrated tourist population during only a few months per year.

The presence of industrial development in coastal zones is significant, with values reaching 42% in B or 40% in NL. In fact the small Belgian coast is by far the most built-up in the EU, viewed at country level. Of course larger countries will have equivalent sized 'hot spots' of equally intensive land use, so caution is needed when comparing countries. Belgian and Dutch ports act as major crossroads for goods entering the EU. Therefore the major growth in trade between the EU countries and the rest of the world has had an impact on the growth of industrial land in the Belgian coastal zone. This is of course normal, as industry often chooses to be close to ports to facilitate import of raw materials and export of finished products. And populations choose to live close to where the jobs are, leading to increased urbanisation also.

In the Mediterranean countries some of this increased urbanisation will be due to the important increase in the number of tourists in the last thirty years, and the infrastructure needed to cope with these. However industry in these areas is also responsible for a significant part of the growth in built-up land.

ME-3b: Wetland loss in coastal zones

Definition and purpose

Wetland loss is a very appropriate indicator of pressure on both biodiversity and water resources. Historically, wetland habitats have been under pressure through drainage for agriculture and other land use purposes. However, their important role in both biodiversity conservation and water resource management has now been recognised.

The International Ramsar Convention for Wetlands Protection (1971) defines wetlands as: 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water the depth of which at low tide does not exceed six metres.'

This indicator is defined as the loss of wetland area in the coastal zone, expressed as the percentage lost with reference to an appropriate baseline year. The only available data for two distinct points in time are sets of data from the LACOAST project of the European Commission's Joint Research Centre (JRC) in Ispra, Italy. The LACOAST project consists of an analysis of land use changes within coastal zones based on satellite images, *(see ME-3)*.

Change in wetland area in coastal zones (1975-1990)

hectares

	Wetland area 1975	Wetland area 1990	Gain 1975-1990	Loss 1975-1990	Net change 1975-1990	Wetland loss to				Wetlands change to natural land	% of wetlands gross loss as to 1975
						urban sector	transport sector	industry	agro sector		
B	170	195	42	17	25	-	-	-	-	17	10.0
DK	299 852	299 469	129	512	- 383	13		15	255	229	0.2
D	410 532	421 633	16 149	5 048	11 101	13	73	368	727	3 867	1.2
EL	:	:	:	:	:	:	:	:	:	:	:
E	83 273	80 486	841	3 628	-2 787	5	30	697	1 735	1 161	4.4
F	377 793	376 269	90	1 614	-1 524	64	197	691	346	316	0.4
IRL	541 860	528 818	2 191	15 233	-13 042	17		145	1 127	13 944	2.8
I	128 164	126 014	655	2 805	-2 150	61	36	1 005	1 184	555	2.2
L	.	.	.	.	.	.	.	.	.	.	.
NL	45 119	51 861	7 815	1 073	6 742	.	70	409	124	470	2.4
A	.	.	.	.	.	.	.	.	.	.	.
P	:	:	:	:	:	:	:	:	:	:	:
FIN	:	:	:	:	:	:	:	:	:	:	:
S	:	:	:	:	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:

Source: LACOAST project (JRC)

Methodology and data problems

The use of different data sources for the images corresponding to 1975 and 1990 has implied certain methodological differences in data processing, which could effect the comparability of data. Problems with calculations of wetland losses are due to the lack of standardisation in monitoring the extent of wetlands and the difficulties in defining wetland boundaries (current and historic), especially since some wetlands shrink or disappear totally in very dry periods. In addition, the use of satellite images can itself present problems such as concerns over resolution and accurate measurements of small wetlands (Corine Land Cover, the basis of the 1990 data, does not include units of less than 25 hectares).

ME-3b: Wetland loss in coastal zones

Relevant Sectors: Agriculture, Industry, Transport, Households, Services, Tourism

Targets

Both the Natura 2000 programme and the proposals for a more holistic integrated coastal zone management (ICZM) strategy are relevant for this indicator. Quantifiable targets do not yet exist, but it is hoped that Member States will identify their own targets within their national coastal zone management strategies.

Sectoral breakdown of wetland loss in coastal zones (1975-1990)

Source: LACOAST project (JRC)

Relevance: Yellow	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Green

Comments

The concentration of a wide variety of species in existing wetlands makes these habitats priorities for protection, especially given the evidence of the progressive loss and degradation of many of them. Coastal wetlands are important for many species of birds, including migratory species. The table suggests that while some countries are making efforts to regain lost wetland, this is generally off-set by the loss of wetlands elsewhere along the coast. However, the data should be interpreted with caution, given the general problem associated with the estimation of wetland areas.

For example, it is not at all clear why conversion to natural land appears to be one of the most important causes of coastal wetland loss. There are many possible reasons, but no information to explain which are correct, though all may make some contribution. It may simply be that these areas are in transit and are intended for development. Or rising tourist populations may lead to drainage of wetlands to provide more natural recreational areas. The land may have been drained for agriculture purposes, but abandoned after some years. Finally, there could be real cases of wetland loss caused, not by the occupation of original wetland areas, but by a drop in original water levels. This drop could, in some cases, be attributed to natural causes (droughts, etc.) and in others to excessive exploitation for human uses (agriculture, industry or consumption). In any case, wetland loss caused by direct occupation for human activities, appears to be significant (in most cases 50% of total wetland losses). Especially significant is occupation for agricultural activities.

It is expected that the data situation will eventually improve if countries adopt the recommendations to monitor integrated coastal zone management, and to make the information widely available.

ME-4: Discharges of heavy metals

Definition and purpose

Many heavy metals are needed in trace amounts for normal functions of animals and plants, but they are toxic in larger doses. Heavy metals are persistent and most can accumulate in organisms so that even small amounts in seawater or sediment may accumulate to significant exposure at the top of the food chain. It is also important that heavy metals may appear in soluble form, bound in suspended matter or in chemical complexes each having different features, capacity for bio-accumulation and toxicity and thereby different influences on the marine environment.

An analysis of the different international data sources revealed that harmonised time series are available for a small number of toxic metals only. The presented indicator is defined as the amount of mercury, cadmium, copper, lead and zinc emitted directly or by riverine inputs to coastal zones and the marine environment. Total deposition of heavy metals from air has also been considered, separately.

The indicator was developed using data resulting from monitoring by countries and reported to OSPAR, HELCOM, GESAMP and EMEP. The data were weighted to take account of their toxicity, using factors developed from OSPAR reference values for ecotoxicity on sediments and water, and expressed as Arsenic Ecotoxicity Equivalents (1g As = 1g As-EEQ). The individual factors were 39.2 for mercury, 3.3 for cadmium, 0.2 for zinc and 0.4 for copper and lead. The weighted data for all metals were then aggregated to give an indication of the ecotoxic load caused by discharges of heavy metals.

Riverine and direct inputs of heavy metals to coastal zones [1) 2) 3)]

tonnes As-EEQ

	Riverine inputs						Direct inputs					
	1990	1991	1992	1993	1994	1995	1990	1991	1992	1993	1994	1995
B	229	147	127	66	62	130	:	:	:	:	< 1	< 1
DK	18	:	:	:	:	4	7	:	:	:	:	15
D	966	950	1 195	1 178	829	670	10	8	11	6	4	6
EL	:	:	:	:	:	:	:	:	:	:	:	:
E	57	57	16	86	29	3	:	:	:	:	:	:
F	504	:	90	:	:	:	:	:	:	:	:	:
IRL	186	525	232	236	302	351	27	27	27	27	27	27
I	:	:	:	:	:	:	:	:	:	:	:	:
L	.	.	.	.	.	.	.	.	.	.	.	.
NL	842	612	632	772	1 490	2 135	19	23	10	10	10	8
A	.	.	.	.	.	.	.	.	.	.	.	.
P	306	103	20	58	117	24	:	:	:	2	2	2
FIN	148	:	:	:	:	148	33	:	:	:	26	62
S	441	:	395	:	:	352	18	:	:	:	:	58
UK	889	815	920	926	861	681	755	672	541	438	419	379

Source: OSPAR and HELCOM, adapted by DHI

1) B: zinc (1994) and zinc, copper and lead (1995)
2) DK 1990 and FIN 1994: industry discharges only.
3) P: mercury and cadmium only

Total wet and dry deposition of heavy metals

tonnes As-EEQ

	1985	1989	1991	1992	1993	1994	1995	1996
Baltic Sea	2 216	2 405	337	326	376	594	534	553
North Sea	:	3 829	:	1 392	:	:	:	:
North West Mediterranean	:	12 190	:	:	:	:	:	:

Source: HELCOM (1985), OSPAR (1992), GESAMP (1989) and EMEP (1998), adapted by DHI

ME-4: Discharges of heavy metals

Relevant Sectors: Energy, Transport, Households, Industry

Methodology and data problems

The major problems of the indicator are the limited data availability and the limited number of metals covered by the national monitoring programmes. There is little reliable data on direct and riverine inputs before 1990. Furthermore, no aggregated data have been found for direct and riverine inputs to the Mediterranean Sea.

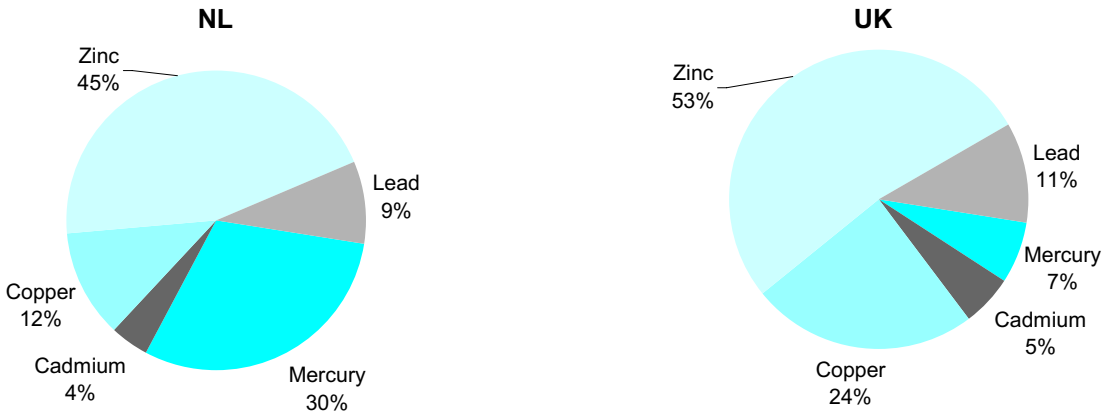
The riverine inputs result from the pressure in the whole catchment area whereby the pressure from upstream countries is ascribed to the most downstream country (e.g. the Rhine is ascribed to the Netherlands). Moreover a significant share of riverine inputs come from natural sources which cannot be managed by policy. However it is not possible to differentiate natural from anthropogenic inputs.

Targets

In 1998, both the OSPAR and the HELCOM Commissions committed themselves to phasing-out emissions, discharges and all losses of harmful substances, including heavy metals, into the marine areas by the year 2020. An intermediary target aims to halve discharges, from the baseline year 1985 by 2005.

Direct discharges of heavy metals to coastal zones - selected Member States (1995)

% of As-EEQ



Source: OSPAR and HELCOM, adapted by DHI

Relevance: Yellow	Accuracy: Yellow	Time rep.: Yellow	Spatial rep.: Yellow

Comments

A variety of both natural and anthropogenic processes cause important fluctuations in the quantity of heavy metals entering coastal waters each year. Natural processes include river flows and direct deposition through variations in the frequency of rain and snow and these will influence the indicator to a large extent.

Although most sectors are implicated, it is difficult to present a breakdown of the influence of the different sectors. Riverine inputs include natural background leakage and inputs from industry, agriculture and households. Sources of direct inputs to coastal waters include effluents either from waste water treatment plants or directly without treatment, originating in the industry and households sectors. Atmospheric deposition comes mainly from the transport and energy sector in EU and non-EU countries *(see TX-5)*.

There has been a major reduction in atmospheric deposition of heavy metals, so that in most cases riverine and direct inputs represent more than 80% of the combined inputs of the heavy metals considered. In IRL and the UK, the level of both riverine and direct inputs is high, due to higher natural background loading. More data on direct inputs for the UK is included than for other countries, as most of them suffer from a lack of data.

Direct inputs expressed in ecotoxicity terms are generally falling. Large variations in the contribution of the individual heavy metals to the ecotoxicity weighting are also observed, as shown above in the cases of direct inputs from the UK and NL.

ME-5: Oil pollution at coast and at sea

Definition and purpose

Oil pollution in sea areas plays havoc with marine ecosystems, endangers marine and birdlife and pollutes beaches and coastlines. Furthermore, oil pollution can have a considerable impact on human activities that depend on clean seawater and clean shores, notably tourism, fishing and aquaculture. Although major oil spills are the most visible, small spills occurring more regularly can have a more insidious long term effect.

This indicator can be defined as the total accidental, licensed and illegal disposal of mineral oil into the coastal and marine environment. The sources of oil pollution are multiple and highly variable and include many different sectors, such as discharges from ships and discharges from offshore activities, coastal industries, municipal waste water treatment plants, overflows from storm water, as well as atmospheric deposition. Discharges from ships in operation include accidental spills as well as legal and illegal discharges.

Oil spills larger than 7 tonnes per spill [1)]

tonnes

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
B	-	71	-	-	4 100	-	-	-	-	-
DK	-	0	-	-	-	-	:	-	-	28
D	-	143	-	-	61	-	29	-	-	-
EL	-	1 100	-	1 515	300	608	-	29	900	-
E	-	18	10	71 429	-	282	-	-	-	-
F	-	-	-	-	2 000	-	-	-	7 329	-
IRL	-	-	-	-	-	-	-	-	-	-
I	-	-	151 900	10	14	25	-	-	-	-
NL	-	100	150	348	-	-	10	-	-	-
P	25 500	100	-	-	-	12 000	-	-	-	143
FIN	-	-	-	-	-	-	-	-	-	-
S	-	900	50	-	17	-	70	-	-	-
UK	835	1 355	25	28	89 522	-	-	71 429	343	-

Source: ITOPF, adapted by DHI

1) The mass of oil spilt is approximate, as some of the records do not contain the exact amount of oil spilt.

Total discharges of oil from refineries and offshore installations [1) 2) 3)]

tonnes

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
EU-15	22 335	28 490	3 961	3 148	2 796	2 457	2 058	1 855	1 610	1 417	1 202
B	44	39	33	26	22	15	8	8	8	9	10
DK	352	603	700	558	56	93	116	186	203	217	241
D	29	30	29	446	308	187	46	53	55	61	64
EL	89	73	62	49	39	36	26	27	27	28	25
E	91	95	92	91	228	245	238	239	228	202	200
F	203	193	168	145	174	195	225	198	181	168	153
IRL	45	36	34	33	29	25	18	19	15	11	10
I	540	463	389	314	276	244	201	169	135	103	79
NL	2 570	1 709	1 413	951	735	561	457	457	393	341	299
P	180	181	200	180	146	142	112	131	120	105	104
FIN	34	28	21	18	16	14	11	11	9	7	5
S	26	24	26	26	20	16	12	12	11	12	12
UK	18 133	24 963	18 808	17 186	17 487	13 521	10 080	10 131	10 444	10 212	9 920

Source: DHI, based on data from EUROSTAT 1999, OSPAR 1997 and CONCAVE 1999

1) Discharges from refineries (1988-1989, 1991-1992, 1994-1996) are based on emission coefficients developed by DHI.
2) Former East Germany included from 1990 onwards.
3) Discharges from offshore platforms are based on emission coefficients developed by DHI.

ME-5: Oil pollution at coast and at sea

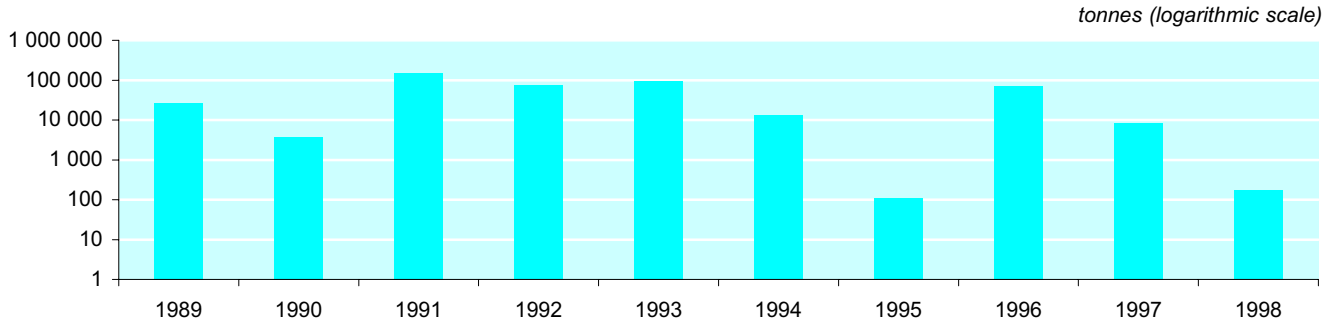
Relevant Sectors: Industry, Energy, Transport

Targets

With the International Convention for the Prevention of Pollution from Ships, 1973 and the related Protocol of 1978 (MARPOL 73/78) the International Maritime Organisation established internationally agreed pollution prevention rules affecting the design and operation of oil tankers. The EU has adopted the MARPOL Convention and has set deadlines for the phasing out of the use of single hulled oil tankers operating under the flag of a Member State or in traffic to and from EU ports. All new oil tankers delivered on or after 6 July 1996 are required to be of double hull construction, to prevent oil pollution in the event of collision or stranding. Single hull oil tankers delivered before that date are required to comply with the double hull or equivalent design standards not later than 25 years and in some cases 30 years after their date of delivery. A new Regulation with the aim of accelerating the phasing out of the single hulled tankers which do not conform has recently been proposed by the Commission.

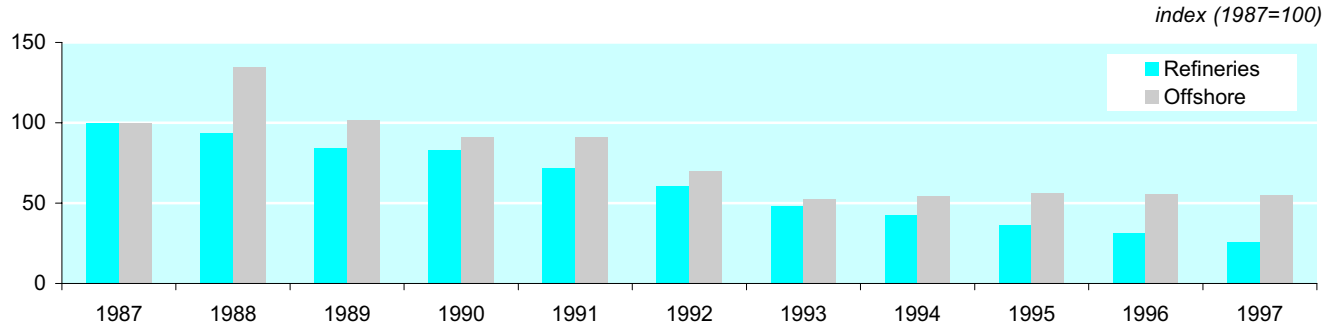
In addition, OSPAR and HELCOM have set a target of gradually phasing-out and halving discharges of hazardous substances, including mineral oil, from the baseline year 1985 to 2005.

Oil spills above 7 tonnes per spill - EU-15



Source: ITOPF

Discharge of oil from refineries and offshore installations - EU-15



Source: DHI

Relevance: Yellow	Accuracy: Yellow	Time Rep.: Green	Spatial Rep.: Green

Comments

As spills from shipping dominate total discharges, these are shown separately, so as not to mask the trend in the regular oil pollution which occurs as a result of normal economic activity. Clearly this regular pollution is much easier to predict and to regulate than the major accidental spills which dominate the table on oil spills. Of the sources concerned, only discharges from offshore installations and coastal refineries are measured or estimated on a regular basis, as shown in the second table. These have been falling since the eighties, indicating improved methods and technologies being used to unload oil from platforms or refineries to tankers, and vice versa, and improved treatment of industrial waste water before discharge. It should be observed that total oil production at sea and treated crude oil at refineries have increased considerably in the same period.

Comparisons between tanker age and accident statistics show increasing accident rates for older ships. Therefore full compliance with the MARPOL Convention should see a reduction in the number of accidents as well as in the seriousness of the spills.

ME-6 (new): Tourism intensity

Definition and purpose

Although tourism is a widespread social and economic activity in Europe, it can induce a wide variety of stress, damage and pollution in the host area. The coastal zones attract hundreds of millions of tourists each year, predominantly in the summer period, but increasingly also at other times of the year.

The indicator is defined as the number of nights spent by tourists in the coastal zone each year. As the only available data is for NUTS 2 regions, the NUTS 2 regions located along the coasts are taken as a proxy for coastal zones.

Tourists staying in the following types of accommodation are included: hotels & similar establishments (HSE) and other collective accommodation establishments (OCAE) which includes tourist campsites (TC), holiday dwellings (HD)[1], other collective accommodation not included elsewhere (OCA n.i.e.)[1].

Nights spent by residents and non-residents in the coastal zone by types of accommodation 1)

Mio nights spent

	HSE					Total OCAE				
	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
B	4.61	4.87	5.28	5.60	5.75	8.26	8.14	7.35	7.05	6.83
DK	8.05	8.67	8.68	8.80	8.77	14.05	17.01	17.35	16.37	16.44
D	25.55	25.68	26.34	26.85	28.38	36.87	36.69	35.09	35.13	36.09
EL	33.10	31.89	36.71	38.81	:	:	1.27	1.01	1.05	:
E	141.60	139.80	146.96	157.05	203.55	:	:	:	:	:
F	54.93	:	58.64	:	67.30	75.16	:	:	:	:
IRL	18.05	18.63	18.80	20.38	21.27	6.07	5.79	7.28	5.64	5.81
I	153.81	156.77	155.59	156.57	162.41	67.21	69.31	70.08	69.85	73.50
NL	11.22	11.22	:	:	:	18.36	18.36	:	:	:
P	27.94	28.06	29.35	32.40	32.73	8.31	:	7.96	:	8.59
FIN	9.50	9.83	10.41	10.77	10.96	1.89	1.79	2.04	2.01	2.09
S	13.62	13.73	13.90	:	15.25	:	:	:	:	11.89
UK	104.24	115.73	128.74	:	123.38	:		:	:	:

	TC					HD					OCA n.i.e				
	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999	1995	1996	1997	1998	1999
B	2.94	3.13	2.42	2.22	2.00	3.48	3.18	3.07	2.99	2.95	1.83	1.84	1.86	1.84	1.88
DK	12.39	11.68	12.12	11.06	11.36	:	4.25	4.16	4.21	4.02	1.06	1.09	1.07	1.10	1.07
D	9.13	8.35	8.40	7.70	:	:	13.27	13.96	14.48	14.98	15.01	15.08	12.73	12.95	12.69
EL	1.15	1.27	1.01	1.05	:	:	:	:	:	:	:	:	:	:	:
E	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
F	75.16	:	71.86	:	76.91	:	:	:	:	:	:	:	:	:	:
IRL	3.24	3.33	:	1.53	1.57	:	:	:	1.64	1.86	6.99	:	:	2.47	2.39
I	47.92	49.36	50.01	49.59	:	10.86	11.23	:	:	:	:	:	9.34	9.21	:
NL	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
P	:	:	6.97	:	:	:	:	:	:	:	:	:	:	:	:
FIN	1.52	1.39	1.56	1.53	1.66	0.26	0.28	0.34	:	:	:	0.12	0.13	0.13	0.10
S	:	:	7.72	:	8.19	:	3.32	3.01	:	2.94	:	0.72	:	:	0.75
UK	44.84	52.41	36.62	:	39.22	30.57	:	:	:	:	14.72	19.21	19.10	:	19.35

Source: Eurostat

1) D: HD: Bremen and Hamburg excluded; E: non-residents:TC: excluding Canarias and Ceuti & Melilla; F: overseas departments excluded; NL: 1994 data used for 1995; P: non-residents: TC: excluding Açores & Madeira; FIN: HD: Väli Suomi excluded, OCA n.i.e.: Åland excluded; S: Småland med öarna and Västsverige excluded; UK: 1994-97: NUTS 95 regions (break in series), HD and OVA: 1995 is 1994 data.

Methodology and data problems

Tourists staying in private accommodation are not included. In some countries this represents an important part of the total e.g. 63% in France. The national figures mask the fact that in some countries the tourists are concentrated in a small part of the country, particularly the southern coasts. The map (see over) illustrates this. Tourism is also very seasonal reaching their peak, in terms of numbers and pressure on the environment, in the summer months. The annual figures cannot properly reflect this.

[1] HSE: establishments arranged in rooms, and providing common services. Includes holiday villages providing hotel services;
HD: collective facilities under common management, such as clusters of houses or bungalows arranged as dwelling-type accommodation and providing no or limited hotel services;
OCA n.i.e.: youth hostels, tourist dormitories, group accommodation, holiday homes for the elderly, holiday accommodation for employees and workers' hotels, halls of residence for students and school dormitories, and other similar facilities.

ME-6 (new): Tourism intensity

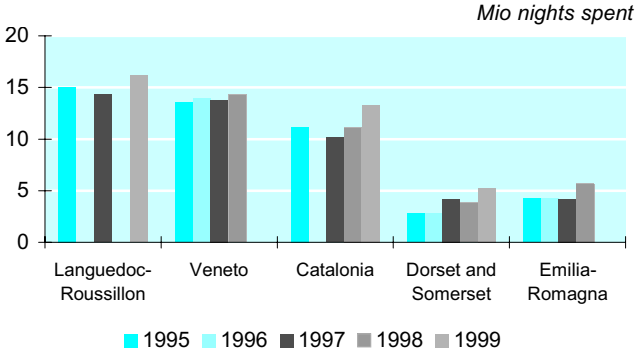
Relevant Sectors: **Tourism**

Targets

Several relevant targets are found in the 5EAP, including better organisation of mass tourism, integrated coastal zone management plans, buffer zones around sensitive areas, changing visitor behaviour, etc.

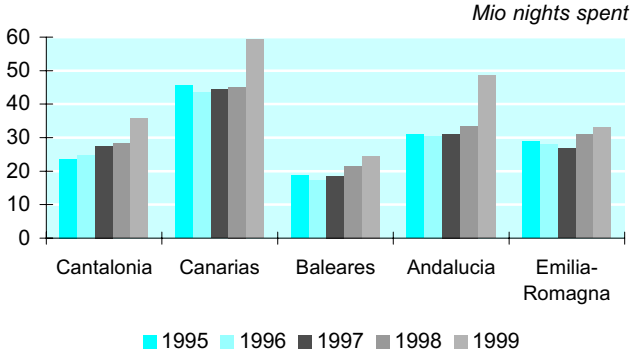
Communication COM 2000/547 on a European Strategy for Integrated Coastal Zone Management calls for a holistic approach to coastal zone management which reconciles the needs of all stakeholders in the zone, including tourists.

Nights spent in campsites in selected top regions



Source: Eurostat

Nights spent in hotels in selected top regions



Source: Eurostat

Share of coastal population and area in total population and area (mid 90s) [1)]

%

	EU	B	DK	D	EL	E	F	IRL	I	NL	P	FIN	S	UK
Share of coastal population	58	40	100	13	93	69	62	100	81	62	100	87	100	61
Share of coastal area	73	29	100	20	86	43	63	100	84	53	100	119	100	85

Source: Eurostat
1) EU: excluding French overseas departments (also excluded from F).

Relevance: Green	Accuracy: Yellow	Time rep.: Yellow	Spatial rep.: Yellow

Comments

The NUTS 2 breakdown does not allow a very accurate estimation of tourist populations along the coast, as NUTS 2 regions are very big and with the result that in some cases (DK, IRL, P and S) the NUTS 2 coastal regions cover the whole country. Therefore the figures should be interpreted with caution.

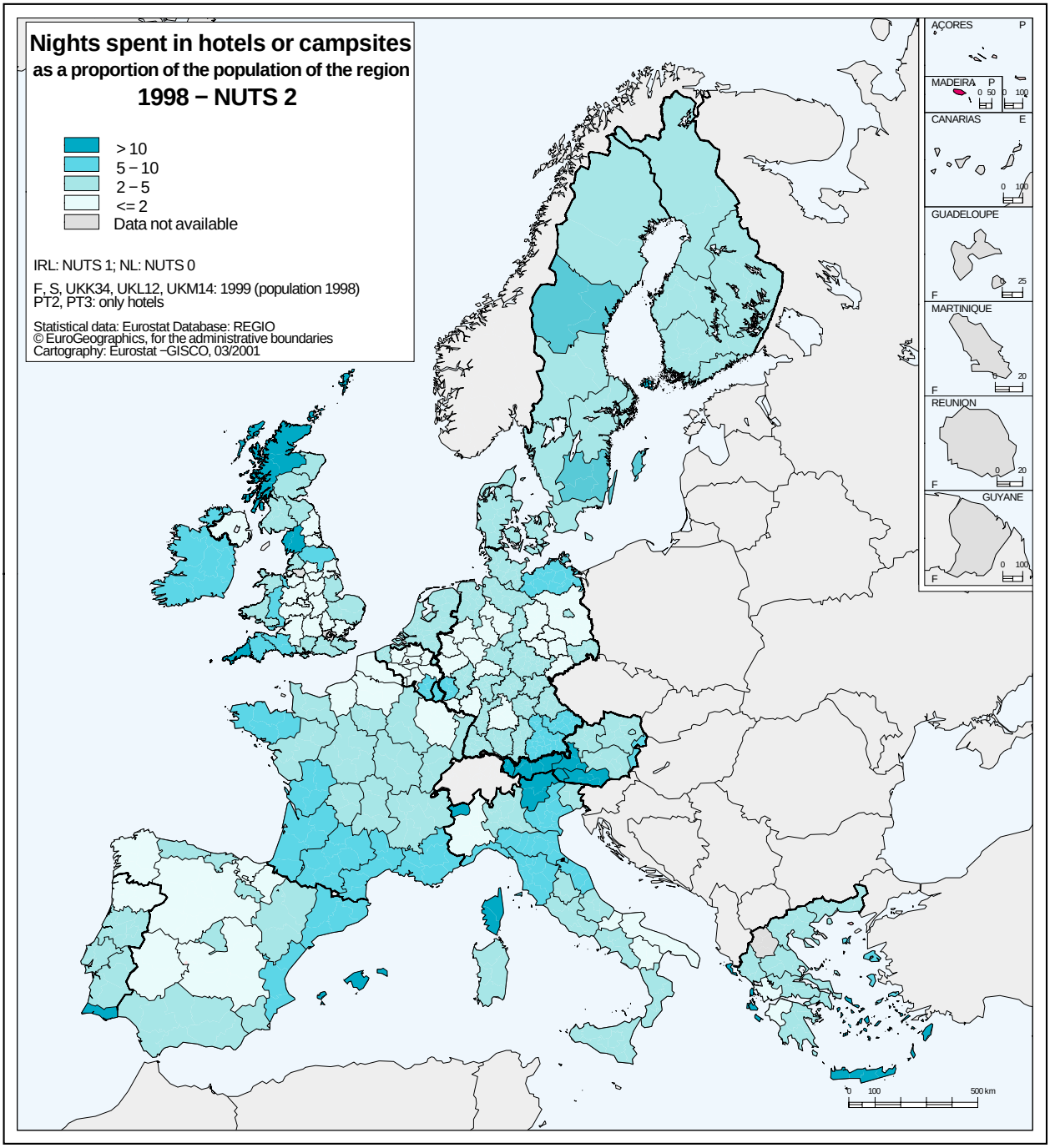
The overall annual growth rate for tourism in Europe is 3.7% per year ('Environment in the EU at the turn of the century', EEA, 1999) with an expected increase in international arrivals by about 50% between 1996-2010 ('Global tourism forecasts to the year 2000 and beyond', Vol.5: Europe, WTO, Madrid, Spain). It is acknowledged that the Mediterranean region is the world's leading leisure tourism destination and accounts for 30% of international tourism arrivals, predominantly visitors from other European countries.

The map on the next page presents number of nights spent in hotels and campsites as a percentage of the resident population. This gives an indication of the extra burden on the local environment coming from the tourism industry. As tourist areas are generally warm, dry regions, water resources are usually under most stress. However, in many cases it is precisely because of the tourists that the areas have invested in modernising their waste handling systems and waste water treatment plants. Moreover, tourists increasingly want more than sun and sand, and many tourist regions are now realising the value of their natural areas as a tourist attraction and are taking steps to maintain these areas.

Four regions in Spain have the highest number of tourist-nights spent in hotels in the whole EU: Balearic islands (58.5 mio), Canary islands (38 mio), Catalonia (33.5 mio) and Andalucia (32 mio). The Languedoc-Roussillon region of France is the most popular destination for campers (16 mio), followed by Veneto (14.2 mio) (I), Catalonia (13.5 mio) (E) and Provence-Alpes-Côte d'Azur (12.5 mio) (F).

ME-6 (new): Tourism intensity

Nights spent in hotels or campsites as a proportion of the population of the region (1998)



Source: Eurostat

CLIMATE CHANGE

Introduction

The Earth's atmosphere keeps the planet warm. Without the warming cover of natural greenhouse gases, mainly carbon dioxide (CO_2) and water vapour, life as we know it would not exist on Earth. Human activities and particularly burning of fossil fuels increase the concentration of greenhouse gases such as CO_2, methane and others in the atmosphere, resulting in more heat being trapped and global temperatures rising. The increased energy in the weather system is predicted to lead to increased storms and rainfall in some areas, while others suffer drought. How fast and where this change will happen is still controversial, but there is consensus in the scientific community that the consequences may be serious.

In 1992 the United Nations Conference on Environment and Development, in Rio de Janeiro, adopted the Framework Convention on Climate Change as the basis for global political action. As a result of this convention, new commitments to reduce emissions of greenhouse gases beyond the year 2000 were agreed in Kyoto in December 1997. The Kyoto Protocol, signed by 84 parties and ratified or accessed by 32 parties, stipulates that Annex 1 Parties (mainly industrialised countries) shall individually or jointly reduce their aggregate emissions of a 'basket' of six greenhouse gases to 5% below 1990 levels by the period 2008-2012.

In contrast to this political target the Inter-governmental Panel on Climate Change (IPCC) indicates the need for a n immediate 50-70% reduction in global CO_2 emissions in order to stabilise global CO_2 concentrations at the 1990 level by 2100.

The EU and its Member States have committed themselves to an 8% reduction over the period concerned (compared with 7% for the USA and 6% for Japan and Canada (UNFCCC, 1997)). In June 1998, a system of 'burden sharing' was agreed by EU Member States. Under this agreement several countries were allowed to increase emissions, provided these are offset by reductions in other countries. The table (over) illustrates the targets for individual Member States, the emissions for 1990 and 1998 and the agreed target emission levels for the period 2008-2012. It also shows the reductions now needed to meet the targets for each country, based on the 1998 emissions.

The 'Kyoto basket' of six greenhouse gases form the basis of the indicators presented here. The first three indicators cover CO_2, CH_4 and N_2O, as in the previous publication. In 1998 these gases accounted for 99% of the environmental pressure leading to climate change. The fourth indicator is new and covers the Kyoto industrial gases hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphurhexafluoride (SF_6).

The three major greenhouse gases, carbon dioxide, methane and nitrous oxide can be weighted by their Global Warming Potentials (GWP, assuming a 100-year time horizon: $CO_2 = 1$, $CH_4 = 21$, $N_2O = 310$. This means that over a period of 100 years one tonne of CH_4 will have a warming effect equivalent to 21 tonnes of CO_2). Based on these GWPs, indices of emissions of greenhouse gases have been calculated, to show how far the European Union as a whole and the individual Member States have been successful in reducing greenhouse gas emissions.

CC Introduction

Total emissions[1] of CO_2, CH_4 and N_2O in 1990 and 1998 and the EU 'Burden Sharing' agreement [2]

	Emissions 1990 (Mio. tonnes CO_2-eq.)	Emissions 1998 (Mio. tonnes CO_2-eq.)	Change 1990 to 1998	Burden sharing from 1990 to 2008-2012	Target emissions 2008-2012 (Mio. tonnes CO_2-eq.)	Reduction needed in 1998 emissions to reach target (%)
EU-15	4 149	4 046	-2.5%	-8.0%	3 817	5.6
B	136	145	6.3%	-7.5%	126	13.0
DK	70	76	8.7%	-21.0%	55	27.3
D	1 201	1 012	-15.8%	-21.0%	949	6.2
EL	104	120	15.0%	25.0%	130	
E	302	360	19.4%	15.0%	347	3.7
F	539	544	1.0%	0.0%	539	0.9
IRL	53	64	19.1%	13.0%	60	5.1
I	515	538	4.6%	-6.5%	481	10.6
L	14	6	-58.4%	-28.0%	10	
NL	209	226	8.1%	-6.0%	196	13.1
A	75	79	4.1%	-13.0%	66	16.4
P	63	74	17.8%	27.0%	80	
FIN	72	76	5.8%	0.0%	72	5.4
S	70	70	0.7%	4.0%	73	
UK	727	658	-9.5%	-12.5%	636	3.3

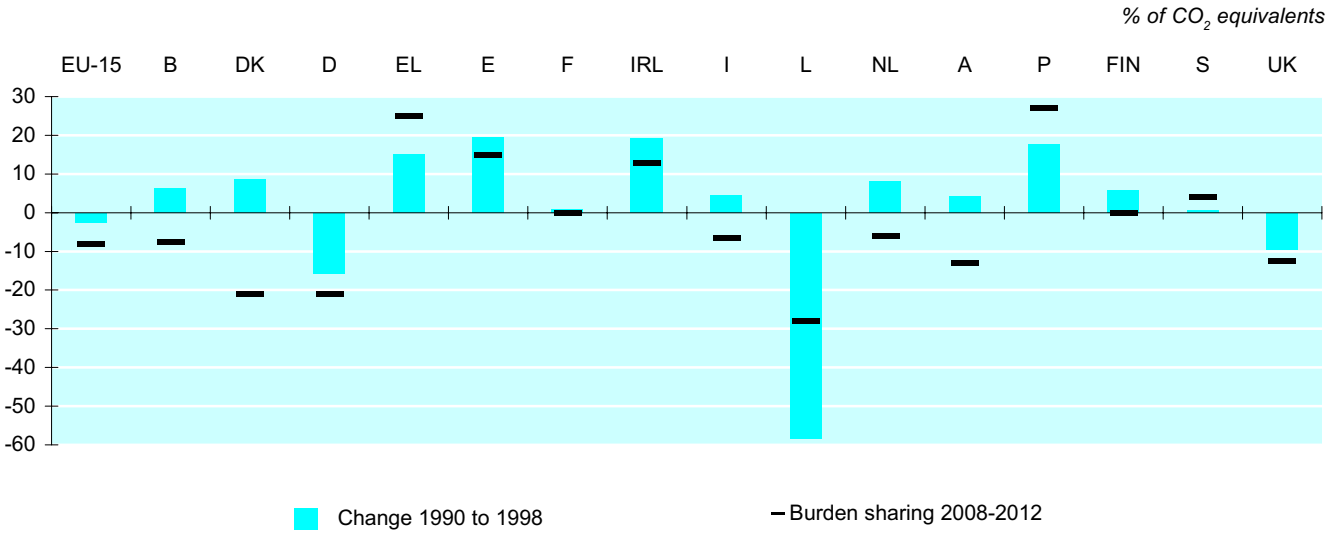
Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

1) CO_2 emissions do not include emissions and removals from Land-Use Change and Forestry (LUCF).

2 Reduction needed to reach target (%) = the reduction in emissions needed between 1998 and 2008-2012 if Member States are to reach their agreed targets, expressed as a percentage of 1998 emissions.

The targets set for 2008-2012 by the burden sharing agreement vary for each Member State. Belgium, Denmark, Germany, Italy, Luxembourg, the Netherlands, Austria and the United Kingdom have agreed to reduce their emissions, while France and Finland aim to not exceed their 1990 emission level. Greece, Spain, Ireland, Portugal and Sweden are allowed to increase emissions. The actual trends are shown in the column 'Change' and can be compared with the targets. As six of the countries which agreed to stabilise or reduce emissions have actually increased emissions since 1990, the last column sets out the reductions, compared to 1998 emissions, needed to reach the 2008-2012 targets.

Percentage change in total emissions of CO_2, CH_4 and N_2O in the EU, 1990 to 1998, and their 'Burden Sharing' agreement



Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

CC: Index of emissions of greenhouse gases

Aggregation of emissions of greenhouse gases

Greenhouse gases lend themselves fairly easily to aggregation into a single index to give an overview of whether targets are being reached. This aggregation is based on the global warming potential (GWP) of each of the gases. GWP refers to the amount of heat trapped by the different gases, which varies from one gas to another, and also depends on several factors including the amount of time the gas in question is likely to remain in the atmosphere. Therefore global warming potentials vary depending on the time scale used. For the purposes of aggregation below, the 100 year GWP is used, as recommended by the IPCC. Because GWPs use CO_2 as the reference gas, the aggregated emissions are said to be in CO_2 equivalents.

CO_2, CH_4 and N_2O account for 99% of total weighted emissions. Because of the unreliability of the data on the industrial gases, the indices below are based on only CO_2, CH_4 and N_2O emissions.

Index of emissions of CO_2, CH_4 and N_2O by EU Member States, weighted by GWP [1)]

1990=100

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Target for 2008-2012
EU-15	100.0	100.1	97.6	95.3	95.7	96.7	98.6	97.1	97.5	-8.0%
B	100.0	105.5	105.5	104.3	107.8	109.0	112.1	105.7	106.3	-7.5%
DK	100.0	115.2	106.6	109.4	114.0	109.5	128.4	114.2	108.7	-21.0%
D	100.0	95.7	91.1	89.4	87.9	87.6	88.9	85.9	84.2	-21.0%
EL	100.0	98.6	101.0	101.4	102.8	104.4	106.3	110.2	115.0	25.0%
E	100.0	102.3	105.3	100.5	105.8	109.4	107.6	115.8	119.4	15.0%
F	100.0	104.6	102.1	97.3	96.6	97.8	99.8	98.6	101.0	0.0%
IRL	100.0	101.3	102.4	102.0	105.5	107.1	110.1	114.7	119.1	13.0%
I	100.0	100.0	99.2	97.6	97.0	102.2	101.5	102.1	104.6	-6.5%
L	100.0	97.2	94.7	92.2	89.7	54.9	55.4	48.2	41.6	-28.0%
NL	100.0	103.0	102.0	102.7	103.2	107.3	110.8	109.7	108.1	-6.0%
A	100.0	105.0	96.9	96.4	98.8	101.1	103.8	104.6	104.1	-13.0%
P	100.0	103.0	109.2	107.0	108.5	113.7	111.0	114.0	117.8	27.0%
FIN	100.0	98.3	84.8	85.8	97.4	100.4	108.3	101.9	105.8	0.0%
S	100.0	93.0	94.2	94.2	97.0	96.3	111.1	100.0	100.7	4.0%
UK	100.0	100.1	96.9	93.4	93.4	91.8	94.5	90.9	90.5	-12.5%

Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

1) 100 year horizon.

In the eight years since 1990 the EU has managed to achieve a 2.5% reduction in greenhouse gas emissions (largely due to one-off effects, such as the reunification of Germany and the restructuring of the electricity industry in the UK), meaning that more than twice this reduction (5.1%) has to be achieved in the next ten to fourteen years. Two of the countries which were allowed to increase emissions have already exceeded the allowed increase, so that they too will now have to reduce emissions. Five of the countries which agreed to reduce emissions by 2008-2012 have increased emissions since 1990, leaving considerable reductions to be achieved if they are to meet their targets.

CC-1: Emissions of carbon dioxide (CO_2)

Definition and purpose

The purpose of this indicator is to monitor the total net anthropogenic emissions of carbon dioxide (CO_2), the most important greenhouse gas. Anthropogenic CO_2 emissions result from the use of energy, from industrial processes, the use of products, agriculture, land-use change, forestry and waste.

The national CO_2 emissions shown in the tables below are complied according to the IPCC Guidelines for National Greenhouse Gas Inventories. In accordance with these guidelines, emissions from use of fuels for international aviation or maritime purposes and from biomass burning are not included in the national totals. And due to large uncertainties in some of the data, the table below does not include emissions from land-use change and forestry.

The emissions shown are gross, i.e. do not take into account CO_2 absorbed from the atmosphere by forestry or other activities.

The main source of emissions is burning of fossil fuels, whether in power stations, industry, households or for transport purposes. Therefore this indicator should be seen together with *AP-6.*

CO_2 emissions [1) 2)]

tonnes per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change 90-98
EU-15	9.1	9.2	8.9	8.7	8.7	8.8	9.0	8.8	8.9	-3%
B	11.5	12.2	12.1	11.9	12.3	12.4	12.8	11.9	12.0	4%
DK	10.3	12.3	11.3	11.6	12.2	11.6	14.0	12.2	11.4	10%
D	12.8	12.2	11.6	11.3	11.1	11.1	11.3	10.9	10.8	-16%
EL	8.4	8.3	8.4	8.4	8.5	8.6	8.8	9.1	9.5	13%
E	5.8	6.0	6.2	5.9	6.2	6.5	6.1	6.7	6.9	19%
F	6.9	7.3	7.0	6.6	6.5	6.6	6.8	6.7	7.0	3%
IRL	9.0	9.2	9.3	9.1	9.5	9.6	9.9	10.4	10.8	20%
I	7.6	7.5	7.5	7.4	7.3	7.7	7.6	7.6	8.0	5%
L	35.1	33.8	32.5	31.2	29.9	17.4	17.2	14.5	12.2	:
NL	10.8	11.1	10.9	11.0	11.0	11.5	11.9	11.8	11.6	7%
A	8.1	8.5	7.6	7.5	7.7	7.9	8.2	8.3	8.2	2%
P	4.3	4.6	5.0	4.8	4.9	5.2	5.0	5.2	5.4	24%
FIN	11.8	11.5	10.4	10.5	11.7	11.9	13.0	12.6	12.4	5%
S	6.5	6.4	6.5	6.5	6.7	6.6	7.2	6.4	6.4	-1%
UK	10.2	10.2	9.9	9.6	9.6	9.4	9.7	9.2	9.2	-9%
IS	8.5	8.1	8.5	8.8	8.5	8.6	8.9	9.1	9.1	7%
NO	8.3	7.9	8.0	8.4	8.8	8.8	9.4	9.4	9.4	13%
CH	6.8	6.9	6.6	6.4	6.2	6.3	:	:	:	-7%

Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

1) 1998 data for IS and NO estimated by EEA.
2) Change 90-98 refers to change from 1990 to 1998 (CH 1990 to 1995).

Methodology and data problems

The IPCC 'Guidelines for National Greenhouse Gas Inventories' (1996) have been formally adopted by all Parties to the UNFCCC, including the EU and its Member States, as the international method to estimate emissions of greenhouse gases. However methods for estimating CO_2 removals by forestry and land use change are still being discussed. Further work by UNFCC and IPCC is needed to verify the data and minimise the levels of uncertainty.

Data for Luxembourg from 1990-1994 includes emissions resulting from the combustion of motor fuels purchased in Luxembourg by cross-border commuters or by through traffic, attracted by low fuel prices in the Grand Duchy. Since 1995 these emissions have been excluded, resulting in a break in the time series. Due to its small weight, this inconsistency does not affect the EU total significantly.

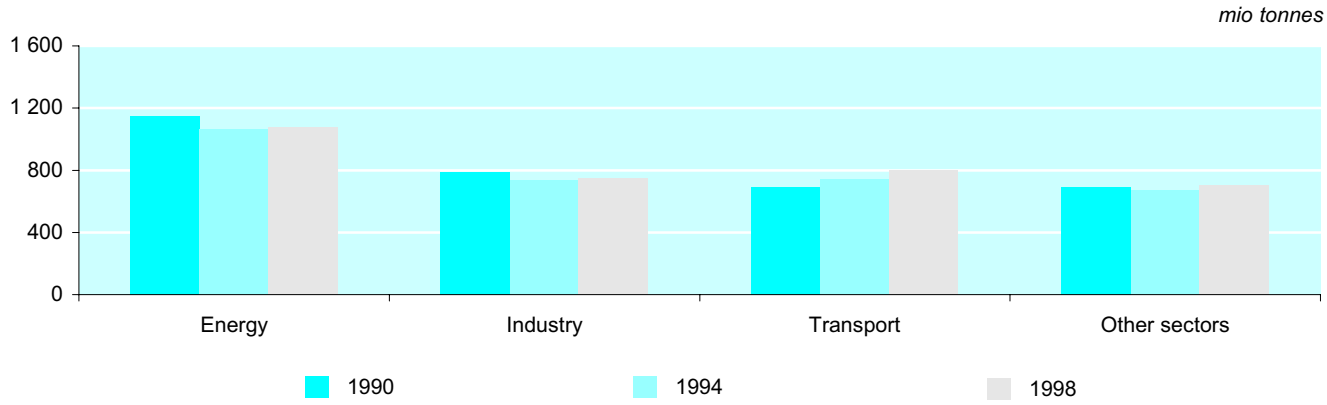
CC-1: Emissions of carbon dioxide (CO_2)

Relevant Sectors: Energy, Industry, Transport, Households

Targets

In response to the Kyoto Protocol, the EU has agreed to an overall 8% reduction, in relation to 1990 levels, in the emissions of a basket of 6 greenhouse gases by the period 2008-2012. The targets for individual Member States vary, see introduction, with some countries being allowed to increase emissions, provided these are off-set by larger reductions in other Member States.

CO_2 emissions by sector - EU-15



Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

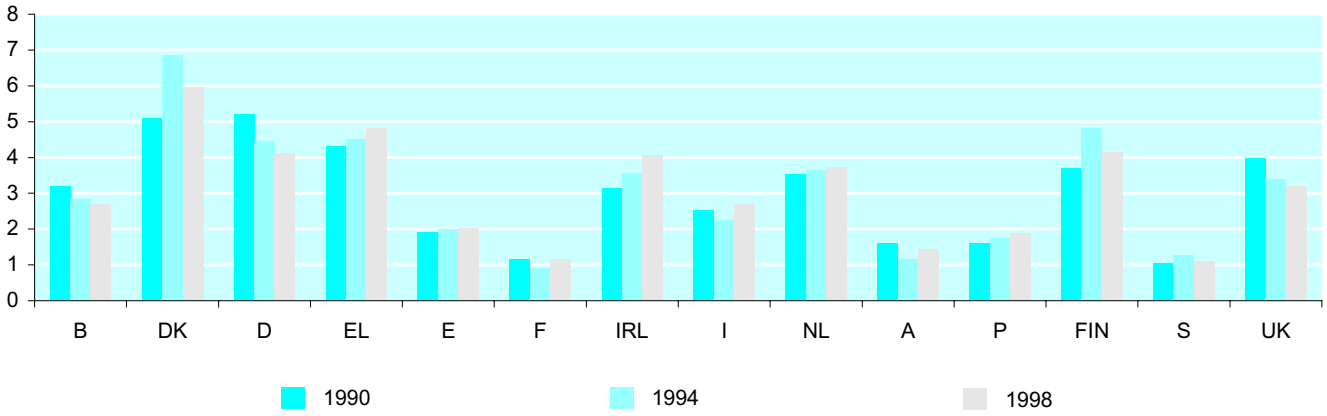
In EU-15 CO_2 emissions per capita decreased by 3% between 1990 and 1998. There is no common trend at a country level. While Germany, Luxembourg and the UK achieved significant reductions, other countries show an increase in CO_2 emissions. In Germany the reduction can be attributed to structural changes in industry after re-unification, use of different types of fuel and more energy efficient technology. In Luxembourg emissions fell as the country's dominant industry, the steel industry, closed blast furnaces and converted production to electric arc technology. In the UK the reduction is the result of major changes in the electricity industry, with a move away from use of coal towards gas for electricity generation *(see also RD-5)*. In countries with an increase in emissions, high economic growth was observed. Emissions ranged from 5 t./capita in Portugal to 12 t./capita in Belgium, Luxembourg and Finland. The EU average was 9 t./capita.

The bulk of CO_2 emissions in the EU come from four main sectors. The energy sector (exploration and transformation, production of electricity) is the most important, contributing 32% of total emissions in 1998. This is also the sector where most of the reductions have been made. The industry sector is responsible for 22% of total emissions, and shows a small improvement compared to 1990. The transportation sector shows a steady increase and now has 24% share of total emissions. If international transportation by air and sea were to be included, the CO_2 emissions from the transport sector would be 25% higher. The sector known as 'others' is mainly composed of residential and commercial heating and is responsible for 21% of total emissions.

CC-1: Emissions of carbon dioxide (CO_2) - continued

CO_2 emissions of the energy sector

tonnes per capita

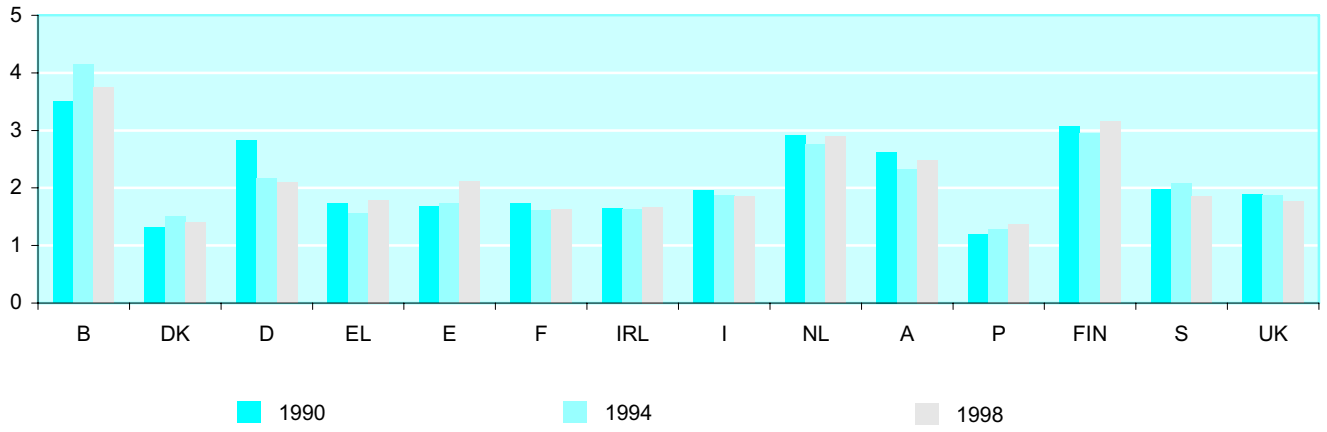


Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

Electricity generation dominates this sector, and the large variations in CO_2 emissions reflect the differences in energy sources used to generate electricity. High intensity of nuclear power, hydropower or imports (France, Sweden, Austria) resulted in low emissions from this sector. Significant reductions can be observed in Belgium, Germany and the UK, mainly as a result of fuel switching.

CO_2 emissions of the industry sector

tonnes per capita



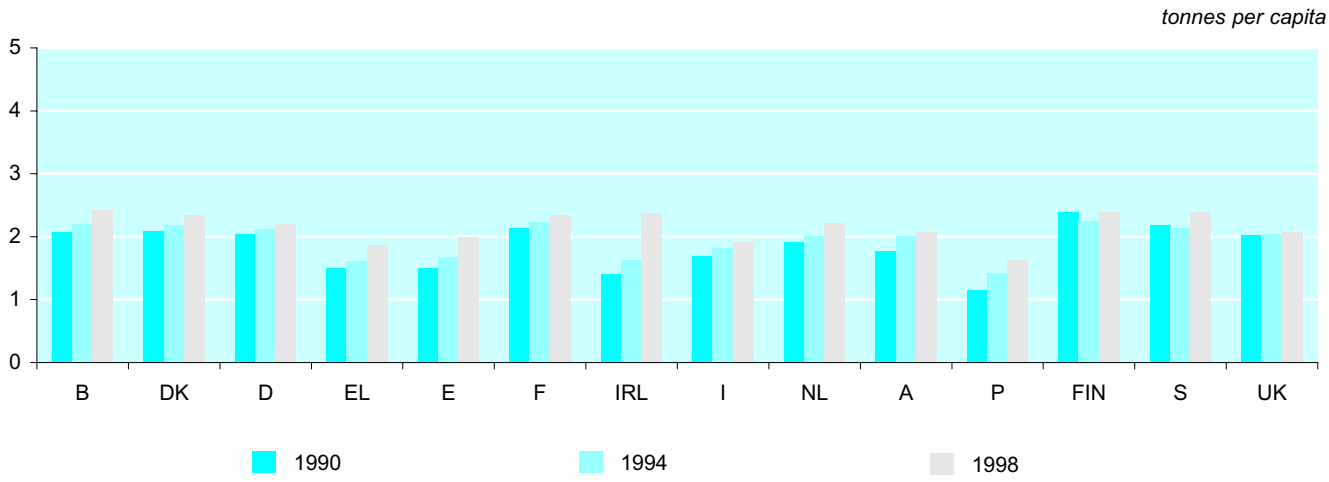
Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

Structural changes and economic growth affect CO_2 emissions from the industrial sector. Structural changes, particularly following re-unification, are the main reason for the reduction in Germany (-26%). Emissions from Spain and Portugal increased remarkably (+25% and +15%).

CC-1: Emissions of carbon dioxide (CO_2) - continued

Relevant Sectors: Energy, Industry, Transport, Households

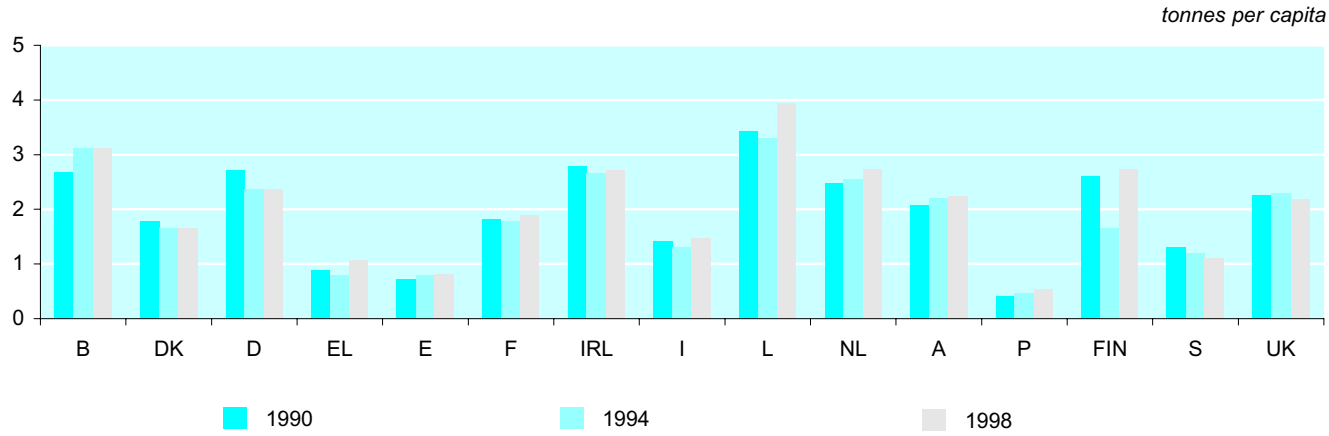
CO_2 emissions from the transport sector



Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

In contrast with other sectors the situation for the internal transport sector is quite similar among countries. All of the countries show a steady rise or stagnation at a high level, except Luxembourg, for the reasons explained under Methodology and data problems. The relative increase in CO_2 emissions is higher for countries with lower absolute emissions (Greece, Spain, Ireland, and Portugal). Ireland in particular has seen a spectacular increase of 67% in emissions, from being one of the lowest emitters from the transport sector in 1990 to the second highest in 1998, reflecting the economic boom in the country. Only in Finland and the UK did emissions remain stable; these countries also had the highest petrol prices in 1998.

CO_2 emissions from other sectors



Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

CO_2 emissions from the sector known as 'Others' are dominated by residential and commercial heating (EU-15 at 1.9 tonnes per capita). The Mediterranean countries (Greece, Spain, Italy and Portugal) are favoured in this respect and as a consequence have low emissions (0.5 to 1.5 tonnes per capita). The Scandinavian countries, with their high building standards in thermal protection, have remarkably maintained lower emissions than other countries (1.1 to 1.7 tonnes per capita). Choice of fuel also has an impact, and the high use of electricity for heating in France is reflected in the relatively low figure for France.

CC-2: Emissions of methane (CH_4)

Definition and purpose

The main sources of anthropogenic methane (CH_4) are agriculture (mainly from livestock and flooded paddy fields), waste landfill sites, coal mining and natural gas production and transportation.

The purpose of this indicator is to monitor total anthropogenic CH_4 emissions. Although total CH_4 emissions are lower than total CO_2 emissions, CH_4 has a high global warming potential (GWP) (21 times higher than CO_2, assuming a 100-year time horizon, 56 times assuming a 20-year time horizon) and CH_4 is the second biggest contributor to anthropogenic *Climate Change*. CH_4 enters into complex chemical reactions in the atmosphere, also influencing the ozone levels in the troposphere and stratosphere; ozone is also a direct greenhouse gas. Methane's indirect effect on global warming resulting from these chemi-cal reactions could be comparable in magnitude to its direct effect, although considerable uncertainty remains.

The emissions data presented below are compiled according to the 1996 IPCC 'Guidelines for National Greenhouse Gas Inventories' which have been formally adopted by the Parties of the UNFCCC as the international method for estimating emissions.

CH_4 emissions [1)2)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change 90-98
EU-15	57	55	53	51	49	49	47	47	46	-19%
B	61	61	61	61	59	58	58	57	57	-6%
DK	54	55	54	55	54	54	53	52	54	0%
D	70	63	58	53	49	48	43	43	43	-38%
EL	43	39	43	43	43	44	43	43	44	2%
E	42	43	44	45	46	47	49	51	53	24%
F	52	51	50	50	49	47	45	43	42	-18%
IRL	174	176	175	175	175	176	178	179	176	1%
I	33	34	32	32	33	33	34	34	34	2%
L	63	57	56	55	55	54	58	58	54	-15%
NL	87	87	83	80	78	76	75	71	68	-22%
A	70	68	65	64	62	61	60	58	57	-19%
P	64	65	64	63	64	64	64	64	64	-1%
FIN	72	56	49	49	48	53	53	48	40	-44%
S	33	38	37	37	35	34	30	29	29	-13%
UK	64	63	61	55	50	50	49	47	45	-30%
IS	56	54	53	52	52	51	52	52	51	-7%
NO	75	76	77	77	79	79	79	79	79	5%
CH	37	36	35	35	34	33	:	:	:	-8%

Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

1) 1998 data for IS and NO estimated by EEA.

2) Change 90-98 refers to change from 1990 to 1998 (CH 1990 to 1995).

Methodology and data problems

Further work by UNFCC and IPCC is needed to verify the data and to minimise the levels of uncertainty. The uncertainties for methane are high compared to carbon dioxide.

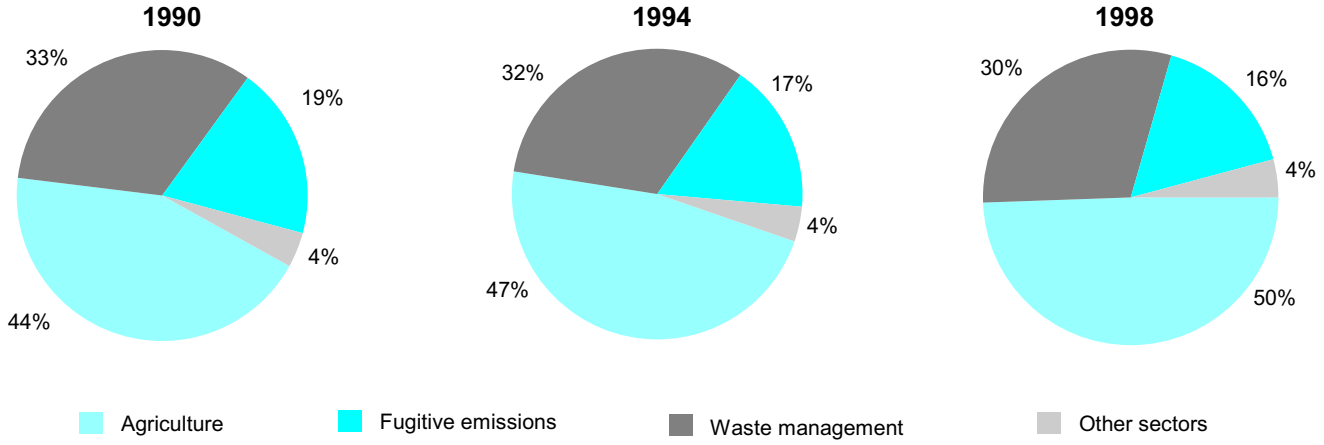
CC-2: Emissions of methane (CH_4)

Relevant Sectors: Agriculture, Households, Energy, Transport

Targets

In response to the Kyoto Protocol, the EU has agreed to an overall 8% reduction, in relation to 1990 levels, in the emissions of a basket of 6 greenhouse gases, including methane, by the period 2008-2012. The targets for individual Member States vary, see introduction, with some countries being allowed to increase emissions, provided these are off-set by larger reductions in other Member States.

CH_4 emissions by sector - EU-15



Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

Relevance: Green	Accuracy: Green	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

The table shows a significant decrease in total anthropogenic methane emissions in EU-15 between 1990 and 1998. Germany, the Netherlands, Finland and the UK have achieved the highest reductions, through reduction in livestock numbers, better waste management and fewer losses in the gas distribution network and from coal mining, due in part to the closure of mines in several countries.

The highest per capita methane emission figures are seen in Ireland, which has a high level of cattle and sheep, the main source of agricultural methane emissions, compared to its small population. Agriculture is the most important source of anthropogenic methane emissions (50%), with waste and waste water management accounting for 30% and distribution of fuels, in particular natural gas, responsible for a further 16%.

The more industrialised countries in which agriculture represents a very small part of the economy tend to have the lowest emissions. These also tend to be the countries with the most advanced management systems for waste. Anaerobic decomposition of waste in landfill sites is the major source of gas from waste. Since 1990 emissions from waste have risen in five countries, Spain (+71%), Italy (+18%), Portugal (+10%), Belgium (+5%) and Greece (+4%). Over the same period Germany and Finland have managed to reduce emissions from waste by 60%, illustrating the improvements which might be expected as countries implement the Landfill Directive[1].

Fugitive emissions from coal mining and distribution of gas have fallen by 46% in the UK and by 26% in Germany, though these two countries are still responsible for two thirds of such emissions in the EU.

[1] OJ L182 , 16/07/1999 p. 0001 - 0019

CC-3: Emissions of nitrous oxide (N_2O)

Definition and purpose

The main purpose of this indicator is to monitor anthropogenic N_2O emissions. N_2O is one of the major greenhouse gases and its radiative forcing capacity is high. The global warming potential for N_2O amounts to approximately 310, assuming a 100-year time horizon (IPCC second assessment report, 1996). Nitrous oxide emissions are produced mostly by denitrification processes in anaerobic environments with a high nitrate load, such as soils on which manure and other fertiliser has been spread and sediments in polluted water bodies. N_2O is also released in limited quantities by the use of fossil fuels.

The main sources of anthropogenic N_2O emissions are intensive agriculture and a number of industrial processes. Natural sources are poorly quantified but are probably twice as large as anthropogenic sources. They are not included in this indicator. The indicator is linked to *Ozone Depletion* as, due to its long lifetime, N_2O can reach the stratosphere and influence the ozone layer through chemical reactions.

The emissions below have been calculated according to the 1996 IPCC 'Guidelines for the National Greenhouse Gas Inventories', formally adopted by the Parties to the UNFCC as the international method for estimating emissions.

N_2O emissions [1) 2)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change 90-98
EU-15	3.5	3.4	3.3	3.1	3.2	3.2	3.3	3.3	3.0	-13%
B	3.0	3.0	2.9	3.0	3.1	3.2	3.3	3.2	3.3	9%
DK	6.8	6.7	6.3	6.4	6.2	6.1	6.0	5.7	5.8	-15%
D	2.8	2.7	2.8	2.6	2.7	2.7	2.7	2.5	2.0	-30%
EL	3.0	3.0	2.9	2.8	2.8	2.8	2.8	2.9	2.9	-4%
E	3.4	3.4	3.3	3.1	3.2	3.2	3.6	3.6	3.6	5%
F	5.1	5.1	4.8	4.6	4.7	4.7	4.8	4.8	4.3	-15%
IRL	8.4	8.2	8.1	8.2	8.4	8.5	8.6	8.4	8.8	5%
I	2.6	2.6	2.6	2.6	2.5	2.6	2.6	2.6	2.2	-16%
L	2.6	2.4	2.1	1.9	1.6	1.7	1.7	1.6	1.6	-39%
NL	4.4	4.5	4.6	4.5	4.6	4.7	4.6	4.7	4.6	4%
A	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	8%
P	2.0	2.0	2.0	2.0	2.0	2.1	2.1	2.1	2.1	6%
FIN	3.7	4.8	2.2	2.2	3.5	3.6	3.6	2.2	4.8	29%
S	3.2	1.1	1.0	1.0	1.1	1.0	3.2	2.8	2.9	-8%
UK	3.7	3.6	3.2	2.9	3.2	3.0	3.1	3.2	3.1	-17%
IS	1.6	1.6	1.2	1.1	1.1	1.1	1.5	1.5	1.5	-7%
NO	4.0	4.0	3.3	3.5	3.5	3.4	3.4	3.4	3.4	-15%
CH	1.7	1.7	1.7	1.7	1.7	1.7	:	:	:	-2%

Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

1) 1998 data for IS and NO estimated by EEA.

2) Change 90-98 refers to change from 1990 to 1998 (CH 1990 to 1995).

Methodology and data problems

Estimating N_2O emissions is not as straightforward as estimating CO_2, and the uncertainties in the resulting data are more important than for CO_2. Further work by UNFCC and IPCC is needed to verify the data and to minimise the levels of uncertainty.

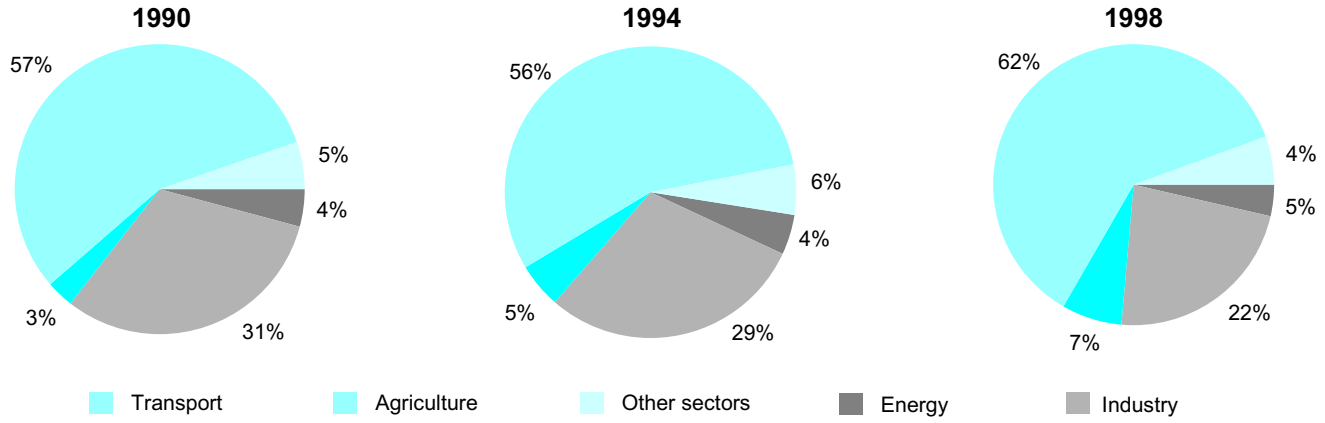
CC-3: Emissions of nitrous oxide (N_2O)

Relevant Sectors: Agriculture, Industry, Energy, Transport

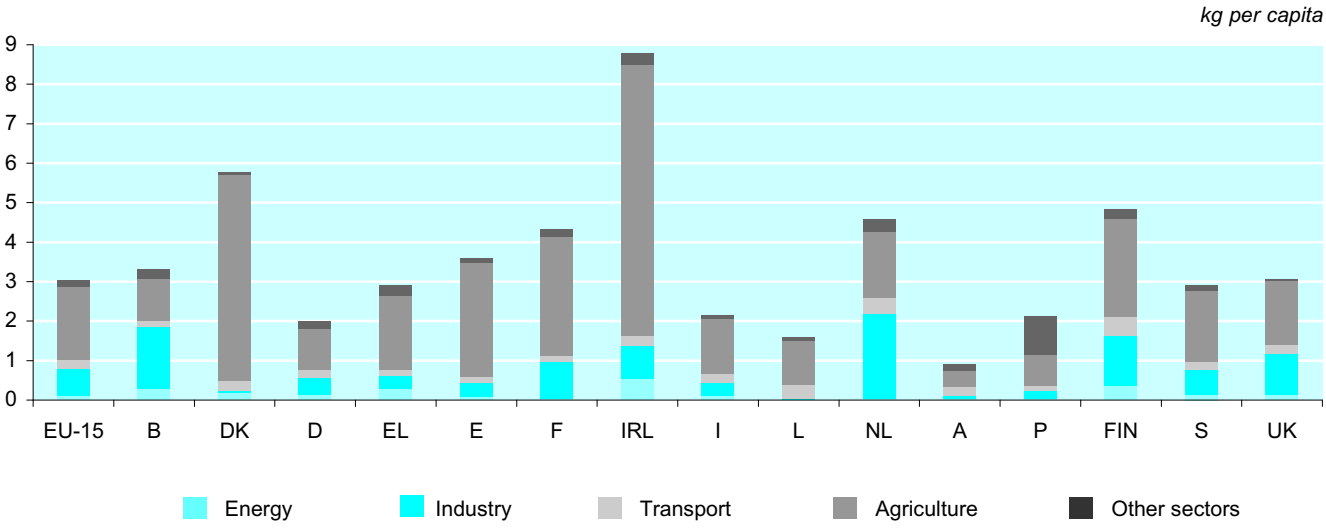
Targets

N_2O is one of the gases included in the basket of greenhouse gases covered by the Kyoto Protocol. As part of this protocol the EU has agreed to an 8% reduction in emissions of this basket of gases by 2008-2012, compared to 1990.

N_2O emissions by sector - EU-15



N_2O emissions by sector (1998)



Source for both graphs: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

Relevance: Green	Accuracy: Green	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

Agricultural soils are the main source of emissions, accounting for 62% of all emissions, which explains the high per capita emissions in Ireland and Denmark, both countries with an important agriculture sector. It is significant that the Netherlands, which has an intensive agricultural industry, has relatively low per capita emissions from that sector, reflecting the strict manure management legislation in that country. Industry contributes 22% of overall emissions, due mainly to process emissions from the chemical industry. These have tended to decrease since 1990. Emissions from transport have increased due to the increased use of catalysts which produce N_2O as a by-product of NO_x reduction.

CC-4 (new): Emissions of HFCs, PFCs and SF_6

Definition and purpose

The purpose of this indicator is to monitor the emissions of the three industrial gases covered by the Kyoto Protocol: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphurhexafluoride (SF_6).

HFCs are alkane-hydrocarbons containing fluorine but no chlorine and are used as substitutes for CFCs *(see chapter on Ozone Depletion)*. HFC143a (tetrafluoroethane) is the most widely used HFC and is used mainly in air conditioners for road vehicles, which are subject to significant leakage. It is further used as a refrigerant agent for refrigerators and as a solvent and blowing agent.

PFCs are a group comprised of seven gases or volatile solvents: perfluoromethane (CF_4), perfluoroethane (C_2F_6), perfluoropropane (C_3F_8), perfluorobutane (C_4F_{10}), perfluorocyclobutane (c-C_4F_8), perfluoropentane (C_5F_{12}) and perfluorohexane (C_6F_{14}). The main source of perfluoromethane and perfluoroethane is primary aluminium production. The other PFCs are used as solvents mainly in the electronics industry.

SF_6 is a gas that was introduced during the second half of the 20th century in the industry sector, as an inert or cover gas of unique properties. The main uses are as a cover gas in metal industry (magnesium), or for electrical insulation purposes in power transmission equipment and in several specialised electronic applications.

Due to their high global warming potential, long atmospheric lifetime, and increasing emissions, these gases are increasingly contributing to climate change.

The figures below are reported following the 1996 'IPCC Guidelines for National Greenhouse Gas Inventories'. So as to enable aggregation of the different gases they are presented in CO_2 equivalents, based on their 100 year global warming potential.

HFC, PFC and SF_6 emissions [1) 2)]

kg CO_2 equivalents per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change 91-98
EU-14	:	80	79	81	92	101	107	118	122	52%
B	:	17	23	30	36	63	73	88	86	414%
DK	19	23	28	49	60	85	113	121	127	442%
D	113	113	118	138	141	137	125	130	130	15%
EL	89	88	:	87	96	48	49	50	51	-42%
E	99	89	97	81	122	167	191	232	238	167%
F	135	109	95	82	79	87	106	118	125	15%
IRL	:	11	23	34	45	56	64	73	81	615%
I	14	14	14	14	23	32	30	37	37	160%
L	:	:	:	:	:	:	:	:	:	
NL	228	225	209	214	234	230	255	271	268	19%
A	:	56	95	134	173	212	214	216	219	293%
P	:	14	18	22	26	30	38	45	52	268%
FIN	:	28	36	44	51	59	66	74	82	191%
S	:	91	99	108	117	125	127	129	140	55%
UK	70	63	50	49	60	72	79	85	95	51%

Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

1) EU-14 excludes Luxembourg, 1992 figures exclude Greece.
2) Change 91-98 refers to change from 1991 to 1998.

Methodology and data problems

Data availability is poor. Most countries have only recently started to integrate HFCs, PFCs and SF_6 into their emission inventories. Furthermore, a detailed inventory based on individual substances is needed for aggregation. For some countries only EEA estimates are available. Although reduction targets refer to 1990 as the base year, estimates for that year have proved difficult for many countries.

Further work by UNFCC and IPCC is needed to improve the data and to minimise the levels of uncertainty.

CC-4 (new): Emissions of HFCs, PFCs and SF_6

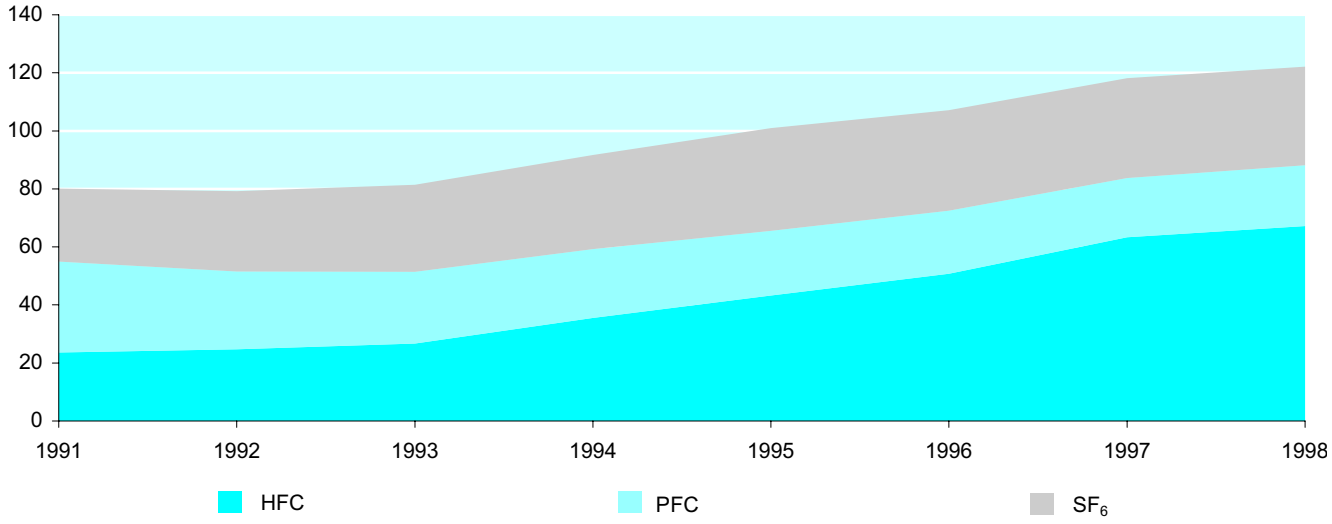
Relevant Sectors: Industry, Energy, Households

Targets

Under the Kyoto Protocol HFCs, PFCs and SF_6 were included for the first time in the basket of greenhouse gases covered by international agreements. In response to the protocol, the EU agreed to an 8 % reduction, in relation to 1990 levels, in emissions of this basket of gases by 2008-2012. The target reduction is based on global warming potential.

HFC, PFC and SF_6 emissions in EU-14 [1)]

kg CO_2 equivalents per capita



Source: Annual European Community Greenhouse Gas Inventory, submission to UNFCCC, May 2000, EEA

Relevance: Green	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Red

Comments

Because of the different global warming potential of the large number of gases covered by this indicator, reductions in emissions of individual gases may be more than offset by small increases in emissions of gases with a much higher global warming potential. In other words, the total amount in tonnes of gas emitted may fall, but emissions in terms of global warming potential may rise. The estimates show that total emissions expressed in GWP are increasing. The strongest increase can be observed in Belgium, Denmark, Ireland, Austria, and Portugal. Emissions of HFCs dominate, and are increasing, reflecting their wide use in consumer products and the difficulties of recycling the gases at the end of the life of these products. The main source of PFCs and SF_6 emissions is within the industrial sector, where recycling is generally easier. Emissions of PFCs from production processes are decreasing.

AIR POLLUTION

Introduction

Acidification, tropospheric ('ground-level') ozone and eutrophication are inter-related, transboundary environmental problems caused by emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC) and ammonia (NH_3), and their chemical conversion products. Acidification - the deposition of acidifying pollutants (SO_2, NO_x, NH_3) onto vegetation, surface waters, soils and buildings - affects biological populations and forests, leads to polluted groundwater damaging water supply systems and is harmful to buildings and monuments. Eutrophication, which is exacerbated by the deposition of nitrogen compounds (NO_x and NH_3), leads to changes in ecosystems, such as changes in plant community composition and biodiversity, and is a factor alongside acidification and tropospheric ozone in forest decline. Tropospheric ozone - a pollutant not directly emitted but formed by the reaction of precursors such as nitrogen oxides (NO_x) and VOC under the influence of sunlight - is harmful to human health, as it can damage all parts of the respiratory tract. In addition, it also affects crop and tree species, degrades materials and contributes to climate change. Human health is also at risk from high concentrations of particles, particularly those smaller than 10µm, which have been associated with heart and lung disease.

The main EU air directives cover emissions of SO_2 (AP-3) and NO_x (AP-1) from large combustion plants, the sulphur contents of fossil fuels (AP-6) and the limits on emissions from transport vehicles (AP-5). A new proposed directive (NEC) sets national emission ceilings for SO_2, NH_3, NO_x and VOC, to be achieved by 2010.

The NEC proposal, which is closely related to existing EU environmental policy and legislation (such as the Acidification strategy adopted by the Commission in March 1997 and the Auto Oil I package), is more ambitious than the multi-pollutant protocol to the United Nations Economic Commission for Europe (UNECE) Convention on Long Range Transboundary Air Pollution (CLRTAP) signed in Gothenburg in 1999, which also sets national emission ceilings for most UNECE countries including the EU Member States.

AP-1: Emissions of nitrogen oxides (NO_x)

Definition and purpose

The purpose of this indicator is to track the release of nitrogen oxides into the atmosphere. Nitrogen oxides in the atmosphere can be transported over large distances and deposited many kilometres away from the source. These emissions are partly responsible for a series of problems, including acidification, eutrophication, and increased concentration of photo-oxidants in the atmosphere, resulting in episodes of photochemical smog. Local NO_x emissions in urban areas with high traffic intensity are associated with impacts on human health and thus play a role in the Urban Environmental Problems theme.

Nitrogen oxides (NO_x) include the nitrogen oxides NO and NO_2. For the sake of comparability, NO_x emissions are given here in units of NO_2.

Anthropogenic emissions of NOx far outweigh natural sources, such as lightning and the chemical transformation of nitrous oxide in the stratosphere. Emissions of nitrogen oxides (NO and NO_2) arise primarily from the reaction of nitrogen and oxygen during the combustion of fossil fuels and biomass, but also from selected production processes.

NO_x emissions from large point sources are reported individually. When such data are not available, emissions can be estimated by multiplying activity data, such as the amount of fuel consumed by the emission factors related to the activity. Detailed methodologies (such as the EMEP/CORINAIR) already exist for the estimation of NO_x emissions from main human activities.

NO_x emissions [1)]

kg NO_2 per capita

	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change 80-98
EU-15	38	37	37	38	38	38	37	36	35	33	32	31	30	29	28	-25%
B	32	32	33	33	34	34	34	34	34	34	34	33	31	30	29	-9%
DK	57	57	56	55	54	53	52	62	53	52	53	48	55	47	44	-24%
D	43	43	43	43	41	38	34	31	29	27	25	24	23	23	22	-49%
EL	43	42	40	38	36	34	32	33	32	32	33	33	34	35	36	-15%
E	27	24	25	26	27	29	30	31	32	31	31	31	30	30	30	11%
F	35	34	34	34	34	33	33	34	33	31	30	29	29	28	28	-19%
IRL	35	33	33	33	33	34	34	34	37	33	32	32	33	32	33	-5%
I	29	29	30	32	33	34	34	35	35	33	31	31	31	29	29	1%
L	57	57	58	59	60	61	61	62	63	63	57	52	54	43	40	-30%
NL	41	40	40	39	39	39	39	38	37	35	33	32	32	30	29	-28%
A	30	29	28	28	27	26	25	25	24	22	23	21	21	21	21	-30%
P	32	31	31	31	31	31	31	33	35	35	36	37	38	38	38	19%
FIN	59	58	58	58	57	57	57	58	56	56	55	51	52	51	49	-18%
S	48	48	48	47	47	47	47	46	45	45	43	41	34	31	29	-40%
UK	46	45	46	48	49	50	49	46	45	41	39	36	35	32	30	-35%
IS	60	85	92	97	100	100	103	104	109	111	110	106	110	105	:	75%
NO	46	:	:	54	:	52	52	49	49	50	49	49	51	51	51	10%
CH	27	28	27	27	26	25	25	24	22	21	19	19	19	18	:	-32%

Source: Annual European Community CLRTAP inventory, November 2000, EEA, including EEA estimates. IS, CH: Eurostat.

1) 'Change 80-98' refers to % change in total emissions between 1980 and 1998 (IS, CH to 1997)

Methodology and data problems

Good estimates of NO_x emissions require detailed information on the characteristics of combustion conditions and processes, the operating conditions of engines or other combustion sources. Since this information is often of a rather poor quality and the influencing factors complex, the resulting estimates are less reliable than those of SO_x emissions. In addition, data does not always cover emissions from all mobile sources. Further work is needed by CLRTAP/EMEP to improve estimates.

AP-1: Emissions of nitrogen oxides (NO_x)

Relevant Sectors: Transport, Energy, Industry

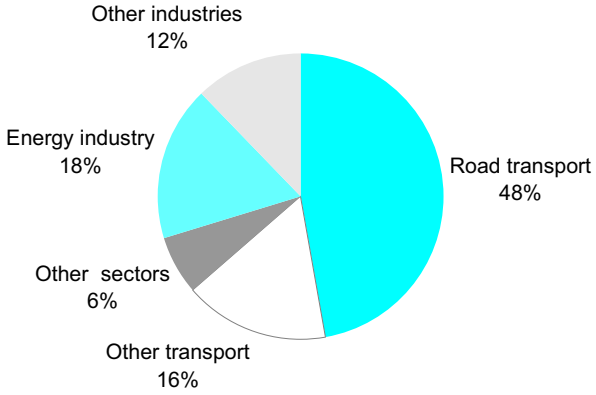
Targets

In 1988, the UNECE CLRTAP Sofia Protocol was signed, establishing targets for the stabilisation of NO_x emissions to the levels of 1987, to be reached by the year 1994. At EU level, the target set by the 5EAP is a 30 % reduction in emissions to the levels of 1980.

New targets for NO_x were set by the 1999 Gothenburg Protocol (UNECE CLRTAP), i.e. a reduction of 49% by 2010 compared to 1990. The proposed EU Directive on National Emission Ceilings[1] sets limits for emissions in 2010 which correspond to a reduction of around 57% compared to 1990.

NO_x emissions[1)] by sector - EU-15 (1998)

%



Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) The EU-15 average includes EEA estimates for Spain, Italy, the Netherlands and Portugal.

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

The main contributors to NO_x emissions in the EU-15 are (road) transport, power stations (electricity production), other mobile sources and industry. Nearly half of all anthropogenic NO_x emissions result from the combustion of fossil fuels in vehicles. Total emissions of NO_x have decreased by 25 % since 1980, due to considerable efforts to introduce and improve abatement technologies for coal-fired power plants during the eighties. The energy industry and other industries achieved a reduction of approximately 33 % and 22 % from 1990 to 1998. The main obstacle to achieving the targets is the continued increase in petrol and diesel fuel use for road transport *(see AP-5)* although reductions have already been achieved due to gradual introduction of catalysts. Because of the time lag involved before vehicles fitted with catalysts have replaced the existing stock of road vehicles, the full impact of the introduction of catalysts has not yet been felt. From 1990 to 1998 the NO_x emissions from road transport activities decreased from 6.3 Mio. tonnes to about 5.0 Mio. tonnes (- 21 %).

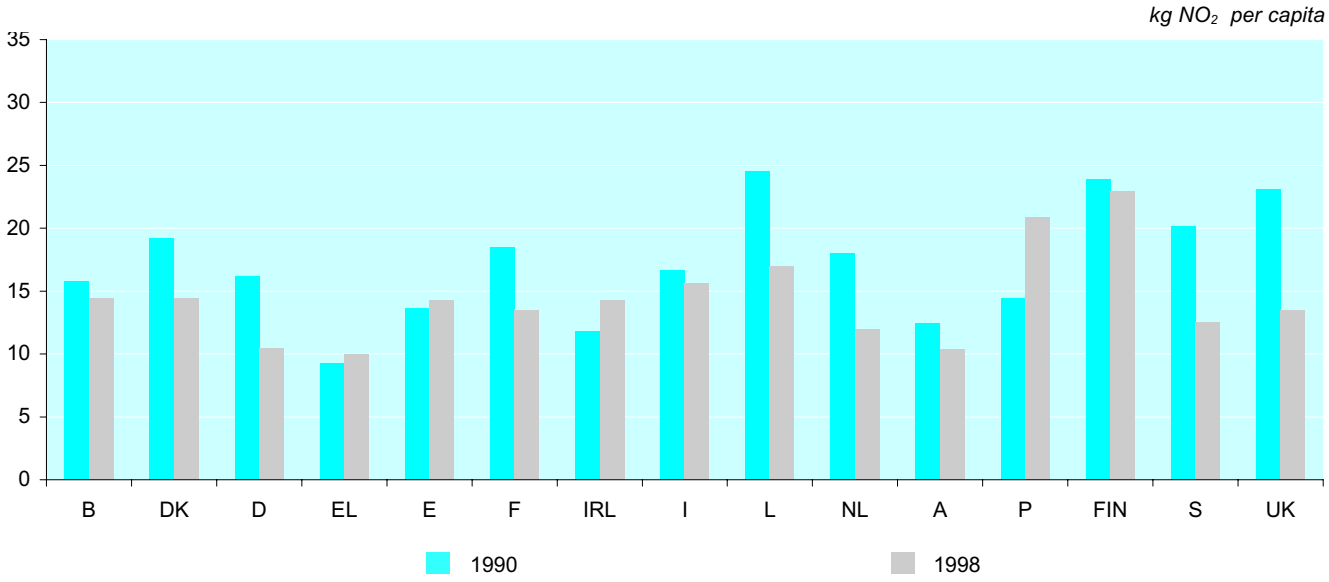
[1] OJ C375, 28/12/2000 p. 0001-0011

AP-1: Emissions of nitrogen oxides (NO_x)

Sectoral breakdown of EU-15

Transport, energy industry and other industries are the major contributors to NO_x emissions. 'Road transport' includes NO_x emissions from all kinds of internal road transport. 'Other transport' includes emissions from internal non-road transport. International transport, including transport between EU Member States, is not considered. 'Energy industry' includes NO_x emissions from fuel combustion in energy and transformation industries (electricity production, petroleum refining and manufacture of solid fuel briquettes, etc). 'Other industries' includes NO_x emissions from fuel combustion of other industries and emissions from industrial processes.

NO_x emissions[1)] from road transport

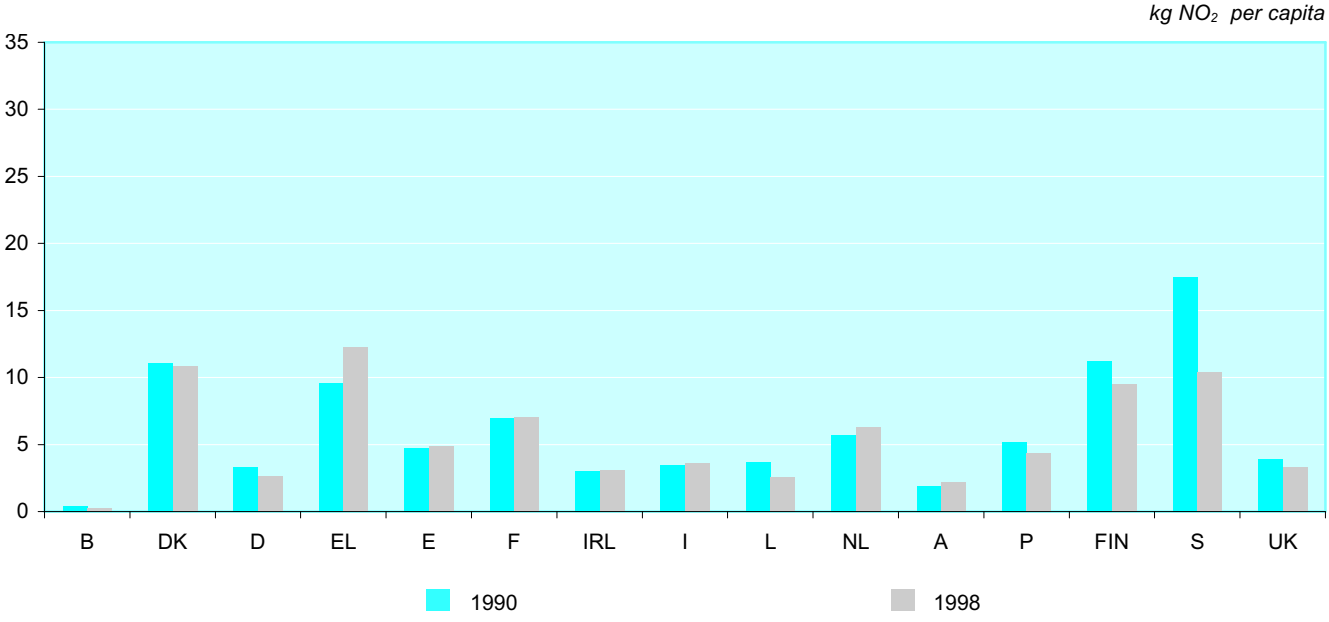


Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data for Spain, Italy and Portugal are EEA estimates.

Emissions from road transport depend on total fuel consumption, the use of advanced engine technology and the use of catalysts.

NO_x emissions[1)] from other transport



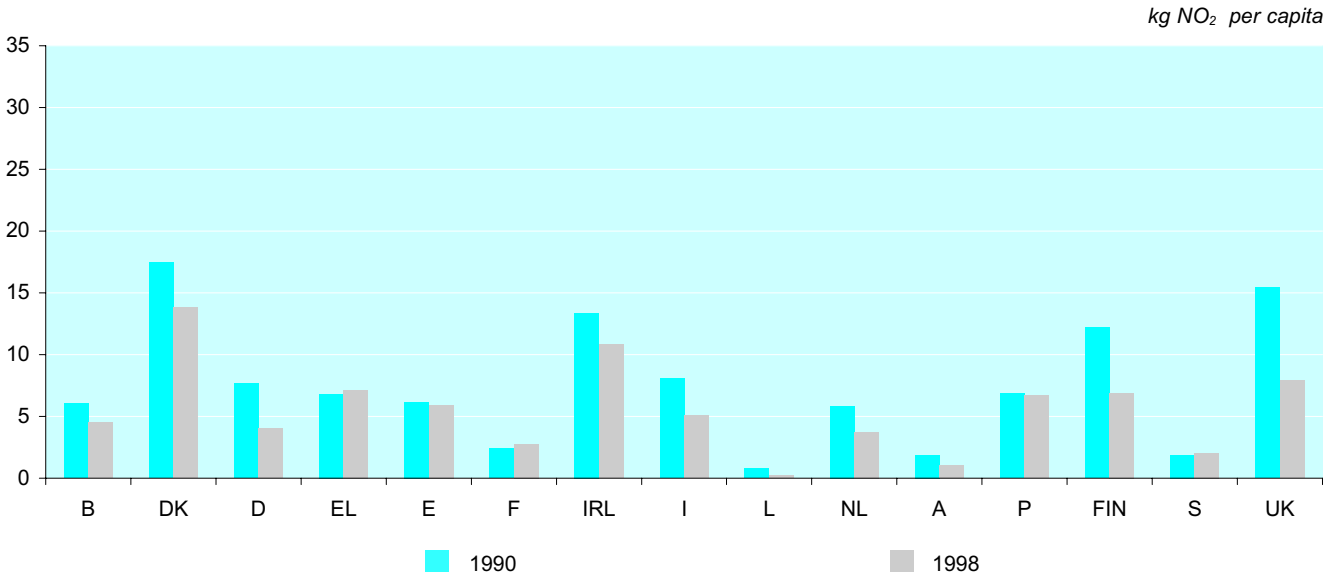
Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data for Spain, Italy and Portugal are EEA estimates.

AP-1: Emissions of nitrogen oxides (NO_x)

Relevant Sectors: Transport, Energy, Industry

NO_x emissions[1)] from the energy industry

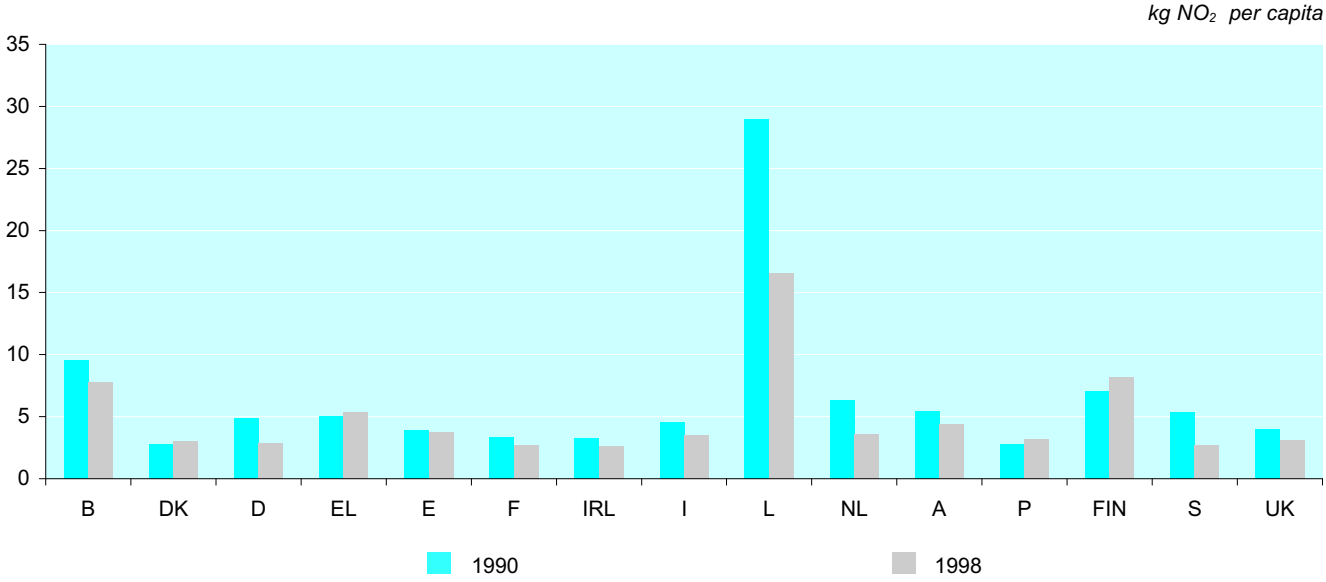


Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data for Spain, Italy and Portugal are EEA estimates.

NO_x emissions from the energy industry depend on fuel consumption for energy generation, the types of fuels that are used and the use of power plant technologies or catalytic flue gas treatment. Some Member States have low NO_x emissions due to less use of fossil fuels for electricity production or higher rates of electricity import. A decrease in emissions may be caused by the use of advanced power plant technologies or catalytic flue gas treatments, but also by the use of other types of fuel (e.g. natural gas instead of coal), which allow for the use of less-emitting technologies.

NO_x emissions[1)] from other industries



Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data for Spain, Italy and Portugal are EEA estimates.

Emissions from fuel combustion and industrial processes fell by 22 % for EU-15 from 1990 to 1998, although the trend is not uniform among Member States. The decrease in some Member States may be mainly caused by structural changes (e.g. the iron and steel industry at Luxembourg) and not by an increase in the use of advanced technology.

AP-2: Emissions of non-methane volatile organic compounds (NMVOCs)

Definition and purpose

Emissions of volatile organic compounds (VOC) are normally separated into methane and non-methane (NMVOC) due to different effects on the environment. The main purpose of this indicator is to monitor NMVOC emissions.

Together with nitrogen oxides, NMVOCs contribute to the formation of photo-oxidants and are thus responsible for photochemical smog, especially during the summer. NMVOC emissions are directly related to the use of organic solvents, and to the production, transportation, distribution, storage and use of fossil fuels for energy purposes.

Although the CLRTAP protocols aim at a reduction of the emissions of all volatile organic compounds, it is now widely recognised that NMVOCs are more important ozone-precursors than methane.

The EMEP/CORINAIR methodologies give estimations of NMVOC emissions from all anthropogenic activities. These NMVOC emissions include all hydrocarbons that are volatile under ambient air conditions, including those where hydrogen atoms are partly or fully replaced by other atoms (S, N, O, halogens, etc.). The parameters which Member States need to gather in order to be able to fully implement these methodologies include:

- amount of fuel consumed for energy purposes,
- information on the storage and handling of fuels during transportation and distribution,
- statistical data on the amount of solvents contained in a series of products (e.g. paint, dry-cleaning agents etc.).

NMVOC emissions [1)]

kg NMVOCs per capita

	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change 90-98
EU-15	44	43	43	43	43	42	42	40	39	37	36	35	33	32	31	-25%
B	67	67	61	54	48	41	34	30	30	30	29	28	26	27	26	-24%
DK	39	39	37	36	35	33	32	33	32	29	31	31	26	26	24	-24%
D	42	42	42	42	42	41	41	35	32	29	27	24	23	22	21	-49%
EL	65	63	57	51	45	39	33	33	33	34	34	35	36	37	38	15%
E	45	44	45	46	47	47	48	48	47	44	46	44	43	43	43	-10%
F	47	46	46	46	45	45	45	44	43	41	39	37	36	35	33	-25%
IRL	32	31	31	31	31	31	31	32	32	30	30	29	30	31	31	-1%
I	38	35	36	37	38	39	39	40	41	41	41	41	37	36	36	-6%
L	42	42	44	45	47	48	50	47	44	41	44	40	40	36	31	-37%
NL	38	37	37	37	36	35	34	28	29	27	25	24	23	20	19	-43%
A	47	47	49	49	50	48	45	40	36	34	32	32	31	30	29	-34%
P	32	31	31	31	32	32	32	33	35	35	37	37	38	38	38	19%
FIN	44	43	43	43	42	42	42	41	40	39	37	36	34	34	34	-20%
S	64	64	64	64	63	63	63	60	58	56	53	51	50	48	48	-23%
UK	40	41	41	42	43	44	43	41	39	38	37	35	33	31	30	-29%
IS	24	43	45	49	50	50	50	55	54	52	53	45	45	36		-28%
NO	44	:	:	61	:	65	71	70	77	80	82	84	84	82	78	10%
CH	51	50	49	48	46	45	44	40	37	34	32	30	29	28		-37%

Source: Annual European Community CLRTAP inventory, November 2000, EEA, including EEA estimates. IS and CH: Eurostat.

1) 'Change 90-98' refers to % change in total emissions between 1990 and 1998 (IS and CH 1997).

Methodology and data problems

The use of solvents and the transportation, storage and handling of fuel are the main sources of NMVOC emissions, but the reliability of estimates of these emissions is generally low. This is mainly due to poor data on the use of solvents. In this case, Member States generally use a general 'solvent balance' (i.e. production + imports - exports + stock variations) and default emission factors to obtain the 'potential' total NMVOC emissions from the usage of solvents and other related products. The unavailability of data causes several gaps in national inventories. The data from 1980 to 1989 includes several estimates and should be interpreted with care. Further work is needed by CLTRAP/EMEP to improve estimates.

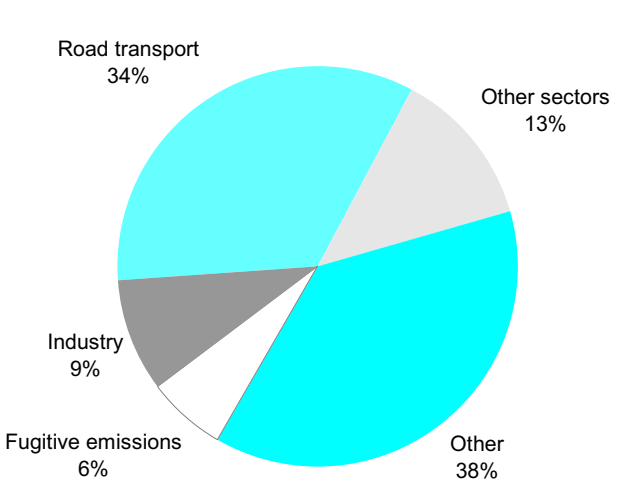
AP-2: Emissions of non-methane volatile organic compounds (NMVOCs)

Relevant Sectors: Transport, Industry

Targets

The 1999 UNECE CLRTAP Gothenburg Protocol set a target of a 57% reduction in VOC emissions between 1990 and 2010. The proposed EU Directive on National Emission Ceilings[2] sets similar targets for the 15 EU countries.

NMVOC emissions by sectors - EU-15 (1998)[1)]



Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) Data includes EEA estimates for Spain, Italy, Portugal and Finland.

Relevance: Green	Accuracy: Yellow	Time Rep.: Green	Spatial Rep.: Green

Comments

Road transport is responsible for 34 % (year 1998) of NMVOC emissions, mainly in exhaust gases from motor vehicles and in the form of fugitive emissions of gasoline, which occur during filling of petrol tanks. Other fugitive emissions occur during extraction, transportation and distribution of fossil fuel.

Emissions from the industrial sector, which made up approximately 9 % of total emissions in 1998, are mainly due to releases during the different industrial processes. The heading 'Other' makes up 38% of total NMVOC emissions and refers mainly to emissions from use of solvents and products containing solvents and volatile organic compounds which are released during use. Although these solvents are used in different sectors (i.e. industry, households, services, etc), it is not possible to attribute them to the relevant sectors.

According to the figures, total emissions of NMVOCs in the EU decreased by approximately 25 % between 1990 and 1998, though in Greece and Portugal emissions rose significantly. The largest reductions took place in Germany, Netherlands, Luxembourg and Austria. Further decreases can be expected once the Solvent Directive[3] (1999/13/EC) is fully implemented, the IPPC Directive[4] (96/61/EC) is enforced and the emissions from Road Transport are reduced according to the Ozone Directive (92/72/EEC[5] and COM(2000) 613[6]) and to Directive 98/69/EC[7].

2 OJ C375, 28/12/2000 p. 0001-0011
3 OJ L085, 29/03/1999 p. 0001-0022
4 OJ L257, 10/10/1996 p. 0026-0040
5 OJ L297, 13/10/1992 p. 0001 - 0007
6 OJ C029 E, 30/01/2001 p. 0291 - 0314
7 OJ L350, 28/12/1998 p. 0001 - 0057

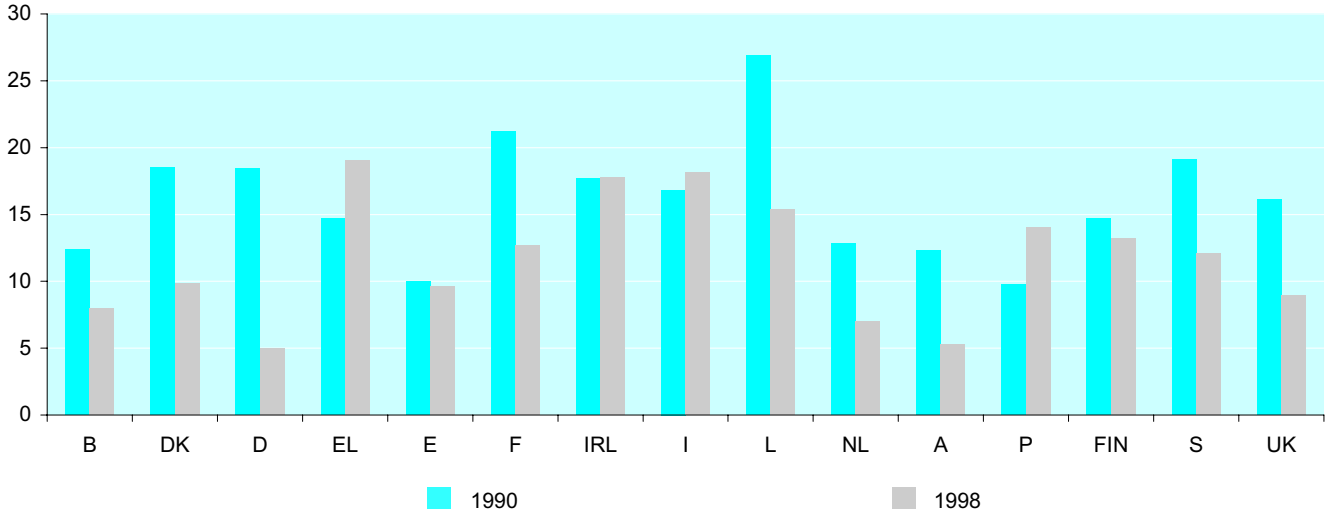
AP-2: Emissions of non-methane volatile organic compounds (NMVOCs)

Sectoral breakdown of EU-15

The road transport and industry sectors are the largest contributors to NMVOC emissions, according to the data from the EEA. 'Fugitive emissions' includes emissions from extraction and distribution of fossil fuel. 'Other' includes mainly emissions from use of solvents and products. 'Industry' includes NMVOC emissions from processes and fuel combustion.

NMVOC emissions[1)] from road transport

kg NMVOC per capita



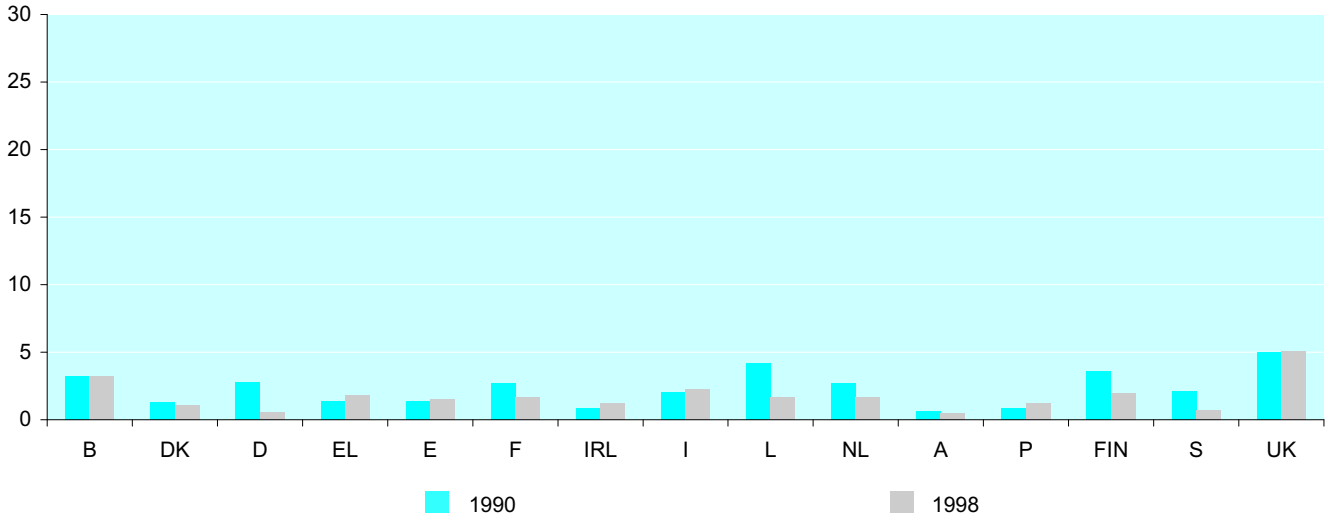
Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data include EEA estimates for Spain, Italy, Portugal and Finland.

Emissions from road transport depend on total fuel consumption, the use of advanced engine technology, catalysts and absorbers. The progressive fitting of catalytic convertors to petrol engined road vehicles has contributed to the fall in emissions from this sector seen in some countries. The increase seen in Portugal and Greece reflects the age of the vehicle fleet in these countries, as well as the increased use of road vehicles.

NMVOC fugitive emissions[1)]

kg NMVOC per capita



Source: Annual European Community CLRTAP inventory, November 2000, EEA.

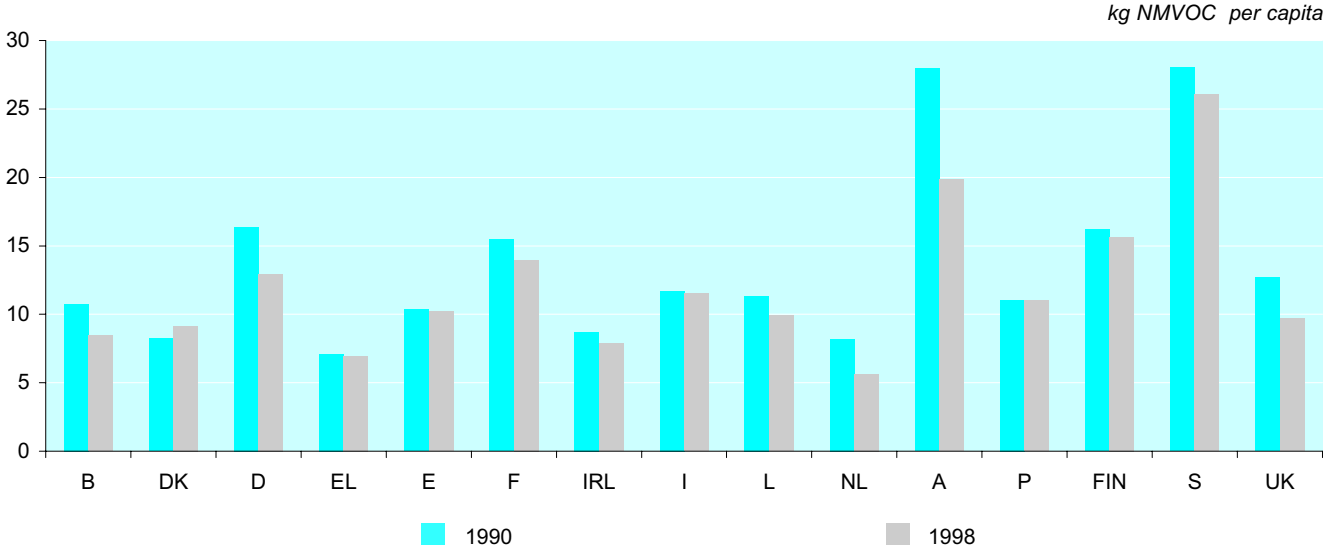
1) 1998 data include EEA estimates for Spain, Italy, Portugal and Finland.

Fugitive emissions depend on total fuel consumption and the use of emission-abatement technologies in the distribution of fossil fuel.

AP-2: Emissions of non-methane volatile organic compounds (NMVOCs)

Relevant Sectors: Transport, Industry

NMVOC emissions[1)] from 'Other'

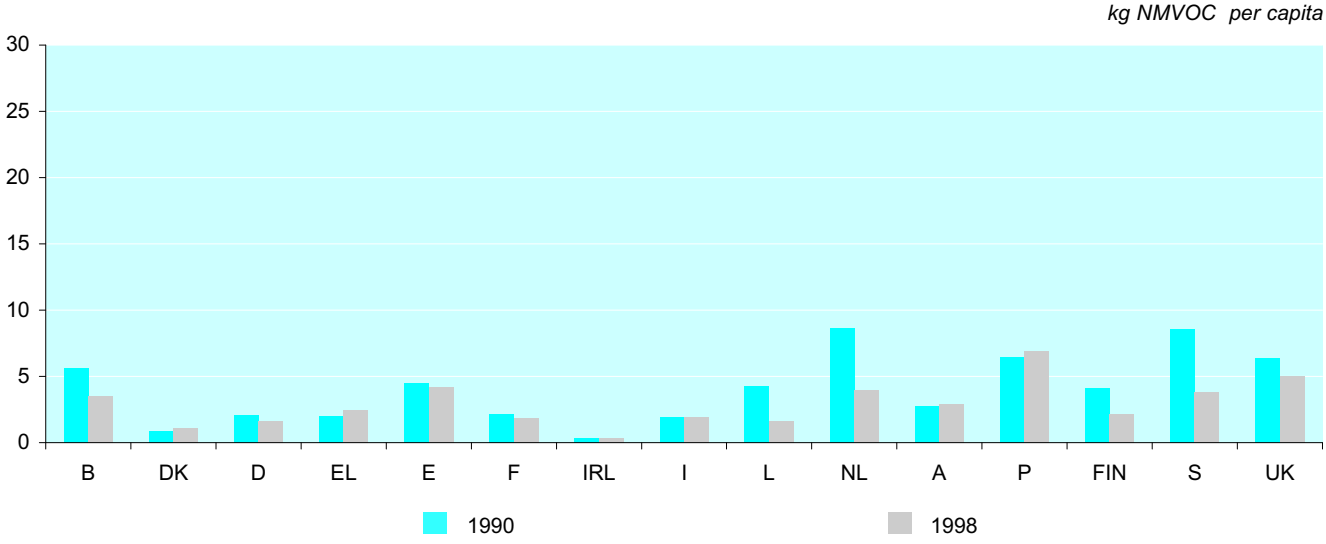


Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data include EEA estimates for Spain, Italy, Portugal and Finland.

The emissions of 'Other' depend mainly on the use of solvents and solvent-containing products. The largest reductions are seen in the countries that have implemented solvent control regulations.

NMVOC emissions[1)] from industry



Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data include EEA estimates for Spain, Italy, Portugal and Finland.

NMVOC emissions from the industry sector are mainly attributable to production processes. Reductions have been achieved by using alternative products and technologies, or by means of emission-abatement technologies.

AP-3: Emissions of sulphur dioxide (SO_2)

Definition and purpose

The purpose of this indicator is to show trends in anthropogenic sulphur dioxide (SO_2) emissions. SO_2 emissions are partly responsible for acidification, and for the occurrence of winter smog episodes. SO_2 has also been found to contribute to the degradation of visibility due to high concentrations of aerosol sulphates in the atmosphere.

Natural SO_2 emissions, for example from the eruption of volcanoes, are not taken into account in this indicator, but play an important role in some regions of Europe.

The main anthropogenic source of sulphur dioxide emissions is the combustion of coal, lignite and petroleum products. The total amount of SO_2 emissions is directly related to the amount of sulphur contained in the different types of fossil fuels and the desulphurisation techniques used. For transport, emissions are directly related to the amount of sulphur content of different fuels. For electricity production, emissions depend both on the sulphur content and on the efficiency of the desulphurisation technologies used (e.g. flue gas scrubbers, calcium additives, fluid bed combustion). Emissions are given in units of SO_2.

The sulphur content of diesel fuels has an impact on the emissions of particles from diesel engines *(see AP-4)*.

SO_2 emissions [1)]

kg SO_2 per capita

	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change 80-98
EU-15	65	54	54	53	49	48	45	40	37	33	30	28	24	21	21	-68%
B	41	41	40	39	39	38	37	33	32	29	25	24	24	22	20	-52%
DK	66	66	60	54	48	41	35	47	37	30	30	29	35	21	15	-78%
D	95	95	95	95	83	79	67	50	41	36	30	26	18	17	16	-83%
EL	57	55	54	53	52	51	50	54	54	53	51	53	52	50	51	-10%
E	76	62	59	55	46	55	53	53	52	49	48	44	38	38	38	-50%
F	24	23	23	23	23	23	22	24	21	18	17	16	16	13	14	-40%
IRL	55	52	52	52	53	53	53	51	48	45	49	45	41	45	48	-13%
I	67	34	34	36	35	33	29	27	25	23	22	23	20	18	18	-73%
L	44	44	43	42	41	40	39	38	38	38	32	21	19	13	8	-81%
NL	19	18	17	16	15	14	14	12	11	11	10	10	9	8	7	-61%
A	51	25	23	20	15	13	12	11	8	8	7	7	7	6	6	-89%
P	35	34	34	34	34	34	35	34	40	34	32	37	34	34	34	-5%
FIN	54	53	53	53	53	52	52	39	28	24	22	19	21	19	17	-68%
S	16	16	16	16	16	16	15	13	12	12	11	11	9	6	6	-63%
UK	87	66	69	68	67	65	65	62	60	54	46	40	34	28	27	-68%
IS	38	31	33	29	34	33	32	28	31	33	30	30	32	32	:	-15%
NO	34	:	:	18	:	14	12	10	9	8	8	8	8	7	7	-80%
CH	18	12	11	10	8	8	6	6	6	5	4	5	5	5	:	-75%

Source: Annual European Community CLRTAP inventory, November 2000, EEA, including EEA estimates. IS and CH: Eurostat.

1) 'Change 80-98' refers to % change in total emissions between 1980 and 1998 (IS and CH to 1997)

Methodology and data problems

When details of the sulphur content of fuels or the efficiency of desulphurisation plants are not available, default emission factors are generally used by Member States to estimate SO_2 emissions. Notwithstanding this, estimates of emissions of SO_2 are considered to be fairly reliable. Further work is needed by CLTRAP/EMEP to improve estimates.

AP-3: Emissions of sulphur dioxide (SO_2)

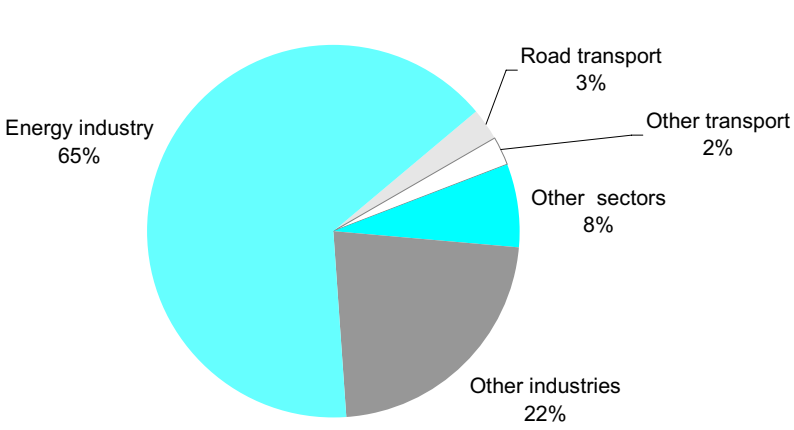
Relevant Sectors: Energy, Industry, Transport

Targets

The second sulphur protocol to the UNECE CLRTAP was signed in 1994 and formally adopted by the EU in 1998[8]. It contains a basic obligation to control and reduce sulphur emissions in order to ensure that deposition of oxidised sulphur compounds do not exceed critical levels, and sets a minimum target for the EU of a reduction of 62 % by 2000 compared to 1980 levels.

New targets set by the Gothenburg Protocol represent a fall of 75% between 1990 and 2010, and the proposed EU Directive on National Emission Ceilings[9] aims for a decrease of 77% for EU-15 over the same period.

SO_2 emissions by sector- EU-15 [1)] (1998)



Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data include EEA estimates for Spain, Italy, Portugal.

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

SO_2 emissions have fallen by two thirds since 1980, with A, D, L, DK and I seeing the largest decreases. The result is that Germany, the highest per capita emitter all through the 1980s, is now well below the EU average. One contributory factor to Germany's improved performance has been the reduction in use of lignite, a fuel with high sulphur content. Increased dependence on lignite for electricity generation is one reason why Greece is now the highest per capita emitter in the EU, followed by Ireland, a significant user of peat as a fuel to generate electricity. The major fall in emissions in Luxembourg reflects the move in the iron and steel industry to the electric arc method of steel production, which eliminates the need for coke, and thus the associated emissions of SO_2.

In general the decreases seen between 1980 and 1998 can be attributed to:

- European legislation reducing the sulphur content of fuels (fuel oils),
- the introduction of flue gas desulphurisation equipment,
- the increase in use of nuclear power,
- the move away from sulphur-rich fuels, in particular coal and lignite, towards natural gas.

8 OJ L326, 03/12/1998 p. 0034 - 0034

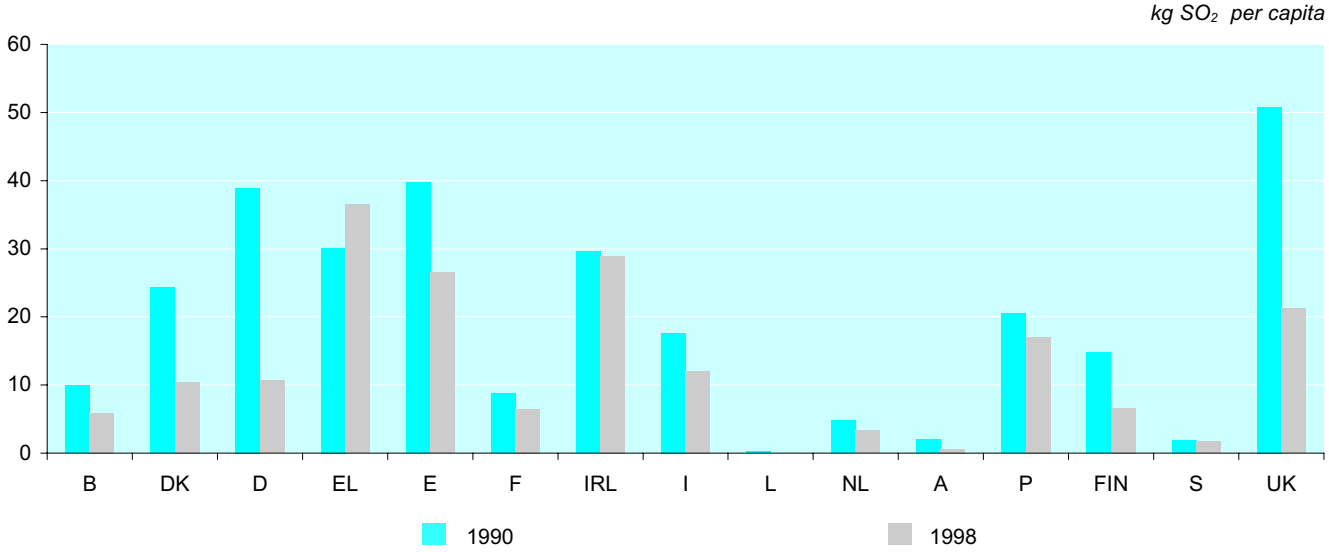
9 OJ C375, 28/12/2000 p. 0001-0011

AP-3: Emissions of sulphur dioxide (SO_2)

Sectoral breakdown of EU-15

The energy industry (mainly electricity production) and other industries are the most important sources of SO_2 emissions. The energy sector was responsible for approximately 65 % of total SO_2 emissions in 1998. This is also the sector where the largest improvements have been seen. Emissions from other industries refer mainly to emissions from industrial processes and from fuel combustion in industry. Other SO_2 emissions, not shown below, are due to residential and commercial heating, including the service sector.

SO_2 emissions[1)] from the energy industry

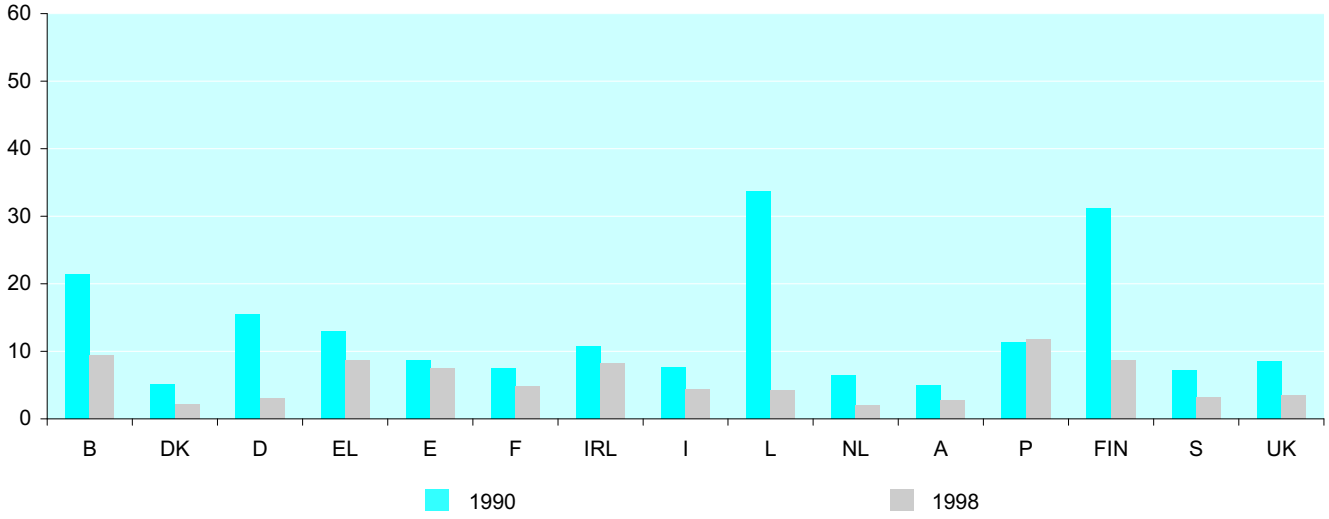


Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data include EEA estimates for Spain, Italy, Portugal.

SO_2 emissions from the energy industry initially depend on the type and sulphur content of fuel used for electricity generation. The largest reductions are seen in those countries that have switched to low sulphur fuels and/or have installed flue gas desulphurisation technology.

SO_2 emissions[1)] from other industries



Source: Annual European Community CLRTAP inventory, November 2000, EEA.

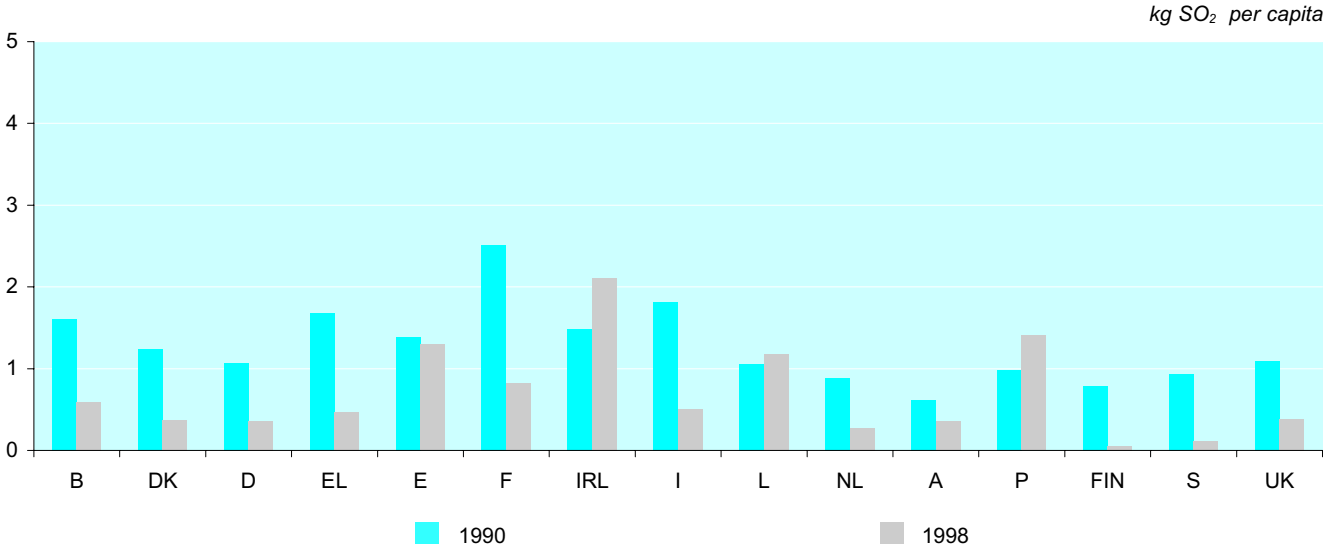
1) 1998 data include EEA estimates for Spain, Italy, Portugal.

Decrease in SO_2 emissions from other industries in some Member States are mainly caused by changes in the structure of industry in the EU, and by a move away from high sulphur fuels.

AP-3: Emissions of sulphur dioxide (SO_2)

Relevant Sectors: Energy, Industry, Transport

SO_2 emissions[1)] from road transport

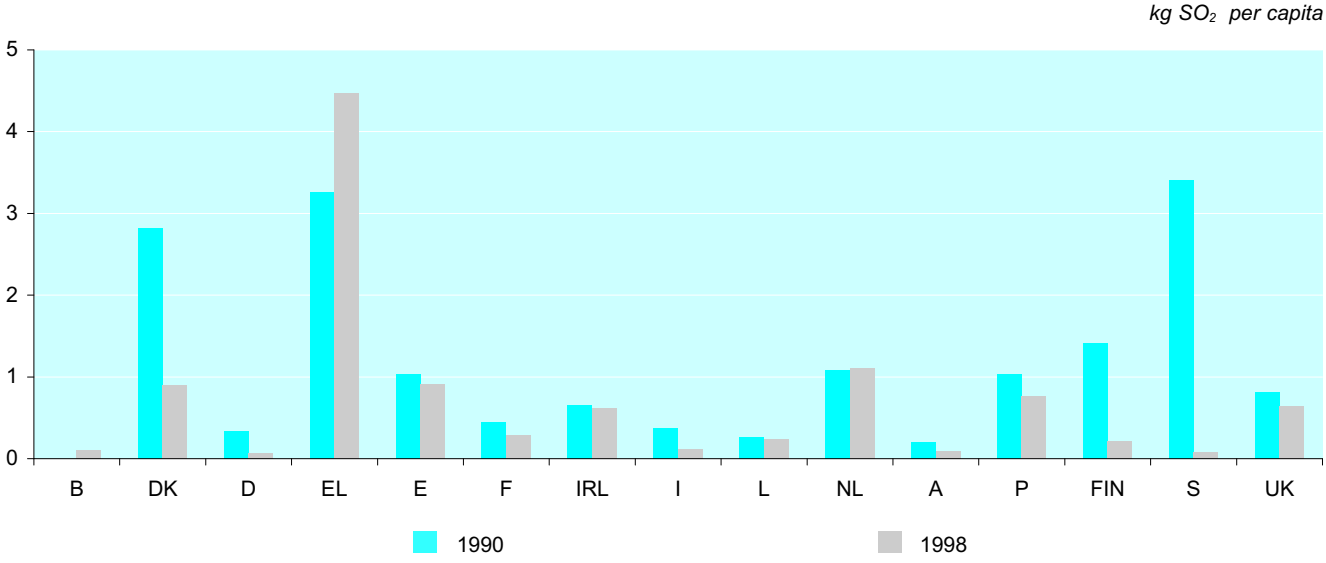


Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data include EEA estimates for Spain, Italy, Portugal.

The emissions from road transport depend on total fuel consumption and the sulphur content of the fuels used. The improvement due to the reduction in the S content of petrol has been partly off-set by the major increase in the use of diesel fuel *(see AP-5)*.

SO_2 emissions[1)] from other transport



Source: Annual European Community CLRTAP inventory, November 2000, EEA.

1) 1998 data include EEA estimates for Spain, Italy, Portugal.

'Other transport'covers internal air and rail transport and inland navigation, which includes ferries between the mainland and islands within the national territory, as well as other mobile sources and machinery. High emissions of some Member States are due to high consumption of heavy fuel oil with high sulphur concentration for inland navigation, as well as use of high sulphur diesel in other machinery. International transport, including transport between EU Member States, is not covered.

AP-4: Emissions of particles

Definition and purpose

The purpose of this indicator is to show the main activities responsible for the release of particles into the atmosphere. Suspended particles, combined with high levels of SO_2, lead to episodes of winter smog in areas of low wind speeds and temperature inversion. Under these conditions, pollutants cannot be diluted in the upper atmospheric layers, which leads to high concentrations in the lower atmosphere affecting the population. Particles smaller than 10µm in diameter are considered to have a negative effect on health. When inhaled, they penetrate deep into the lungs and are thought to contribute to the increase in death rates in members of the population suffering from heart and lung diseases. Particle emissions (including dust and soot) are also associated with degradation of visibility.

Airborne particles include solid and liquid particles of various sizes and chemical composition. The finer particles are mostly carbon (soot resulting from incomplete combustion of fuels, especially diesel and wood) and, to a lesser extent, sulphate, nitrate or ammonium aerosols. These can be transported over long distances. Coarser particles originate mainly from mechanical processes such as mining, quarrying, and other industrial processes, as well as wear and tear of tyres and brakes in road traffic.

The total amount of particle emissions from all anthropogenic activities is mainly related to the combustion of fossil fuels.

Particle emissions [1) 2)]

kg per capita

	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 80-96
EU-15	12.0	11.6	11.2	11.2	11.0	10.7	9.4	6.9	5.8	5.3	4.9	4.8	4.6	:	-59%
B	:	:	:	:	:	:	2.4	:	:	:	2.7	:	:	:	:
DK	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
D	33.3	34.2	33.6	33.4	32.3	31.1	23.0	12.0	8.0	6.0	4.0	4.0	4.0	4.0	-81%
EL	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
E	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
F	8.1	5.4	4.9	4.7	4.5	4.3	4.1	4.1	3.9	3.7	3.6	:	:	:	-52%
IRL	27.6	33.1	28.8	29.9	28.3	:	29.9	:	:	:	:	:	:	:	11%
I	7.7	7.9	7.8	8.3	8.7	8.8	8.8	:	:	:	:	:	:	:	16%
L	:	8.4	:	:	:	:	:	:	:	:	:	:	:	:	:
NL	11.2	6.1	5.7	5.5	5.4	5.1	5.0	4.0	4.0	4.0	4.0	3.0	3.0	3.0	:
A	9.9	7.7	5.5	5.5	5.1	5.1	5.0	4.9	:	:	:	:	:	:	-49%
P	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
FIN	:	16.7	16.3	15.4	15.4	15.5	15.2	14.4	12.2	11.2	10.4	9.5	10.0	10.1	:
S	:	:	:	:	:	:	4.7	:	:	:	:	:	:	:	:
UK	6.4	6.0	6.1	6.0	5.9	5.7	5.5	5.4	5.2	5.0	4.6	3.7	3.6	:	-41%
IS	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
NO	5.0	5.4	5.8	5.6	5.3	5.3	5.6	5.2	5.1	5.7	6.2	5.9	6.2	5.0	32%
CH	5.8	4.3	:	:	3.2	3.2	3.6	3.4	3.2	3.0	2.9	2.8	2.7	2.6	-49%

Source: Eurostat

1) The EU average includes Eurostat estimates. DK, E, EL and P are excluded from the average.
2) 'Change 80-96' refers to % of change in total emissions between 1980 and 1996 or the latest year for which sets of data are available.

Methodology and data problems

Until about 10 years ago, interest was mainly concentrated in total particles and their potential soiling effect. Nowadays the focus has moved to the very fine breathable particles known as PM10 and PM2.5 (particles of less than 10 or 2.5 µm in diameter, respectively) due to concern for their probable impact on human health. Differences in national definitions and methodologies, including differences in size thresholds, mean that sets of data should not be used for comparing countries, but rather to follow trends over time within individual countries. This indicator is calculated on the basis of fuel use and emission factors, which vary according to the combustion process. Specific emission factors, currently available only for a few combustion processes, are associated with a high level of uncertainty, which affects the reliability of the estimates obtained. Much work by CLRTAP/EMEP is currently underway to improve and standardise methods to calculate this indicator.

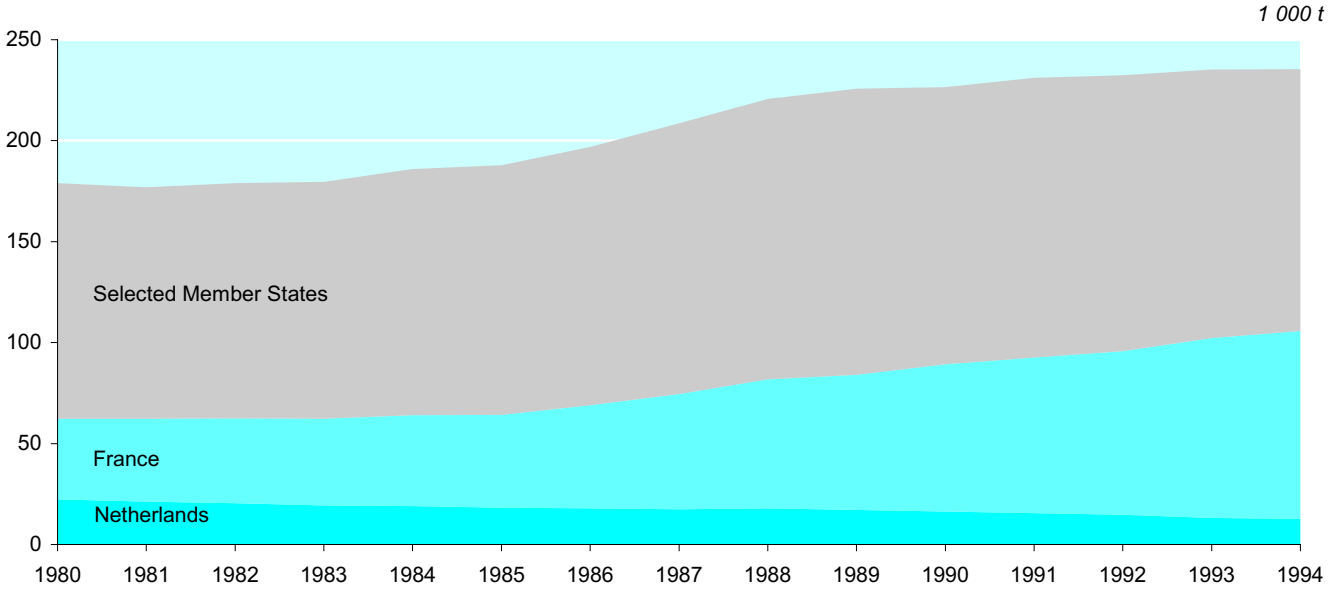
AP-4: Emissions of particles

Relevant Sectors: Transport, Energy, Industry

Targets

Based on the Air Quality Framework Directive 96/62/EC, Directive 99/30/EC[10] sets limit values for the ambient air quality of particles such as PM 10 for the year 2005. There are no emission targets for particles in the EU.

Particle emissions from road transport - selected Member States 1)



Source: Eurostat

1) Includes Eurostat estimates for Austria, Denmark, Finland, the United Kingdom and Germany.

Relevance: Green	Accuracy: Yellow	Time Rep.: Green	Spatial Rep.: Yellow

Comments

Emissions of particles have decreased significantly over the last two decades, mainly due to a decline in the use of coal for heating and power generation. The table shows that for most of those countries that have had continuous data since the 1980s, emissions have decreased significantly, in some cases by as much as two thirds. Emissions from road traffic, especially from diesel engines, however, have in general been increasing, although there are now signs of a decrease in some countries.

The major sources of particles are the energy sector, industry and transport. The type of emissions differ depending on the sector and the fuel used. From a toxicological viewpoint, particle emissions from diesel engines have to be assessed differently. As far as the sectoral pattern of emissions is concerned, sets of data are currently not comparable between Member States. Even for countries with similar populations and economic development, such as Germany, France and the UK, there are serious differences due to variations in calculation methods, coverage of processes and definitions, rather than in emissions themselves. For example in 1990, road emissions represented 6 % of the total in Germany but 26 % in the UK and 45 % in France.

The graph above illustrates particle emissions of the road transport sector, because the fine particles emitted by road vehicles are of particular concern. The overall trend for the selected Member States shows a steady increase between 1985 and 1994. The trend for individual Member States may be quite different, as is highlighted in the graph for France and the Netherlands. The Netherlands report a steady decrease of around 40 % (between 1980 to 1994) for their emissions, whereas France shows an increase of approximately 130 %. This is mainly due to a shift to diesel fuel for road transport in France, coupled with higher levels of mobility.

[10] OJ L163, 29/06/1999 p. 0041 - 0060

AP-5: Consumption of petrol and diesel oil by road vehicles

Definition and purpose

This indicator is defined as the amount of petrol and diesel oil used directly by road transport. Increased traffic, and the associated increase in petrol and diesel burnt, is a major cause of air pollution, and is the largest single factor impeding a reduction in emissions, particularly of NO_x and particles. Less polluting fuels such as liquefied petroleum gas and natural gas as alternatives for buses and passenger cars are currently being promoted, but use of these remains marginal, in spite of lower taxes to encourage uptake.

The pollution produced by road vehicles depends on technical and other factors. The technical factors include fuel type, engine size, age of the vehicle, level of maintenance of the vehicle, and presence of a catalytic converter. Other factors include driving patterns e.g. stop-start driving, and the mileage covered in different traffic conditions, e.g. in urban areas, on motorways, etc.

The per capita consumption of petrol and diesel oil is given in oil-equivalents (oe) where one kilogramme of oil equivalent has a net caloric value of 41 868 kJ.

Petrol and diesel oil consumption by road vehicles [1)]

kg oe per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Change 85-98
EU-15	467	490	507	538	558	576	581	598	607	604	608	621	630	648	45%
B	512	567	588	641	656	641	646	668	682	693	693	704	708	726	47%
DK	534	517	533	542	577	621	620	632	642	672	678	682	690	693	34%
D	520	548	572	590	600	635	646	654	667	653	664	656	666	679	36%
EL	306	323	337	353	372	382	406	411	419	422	435	455	466	488	69%
E	306	319	333	408	434	455	478	505	496	515	520	551	556	608	104%
F	532	555	571	602	621	638	628	636	663	641	642	666	674	694	39%
IRL	398	392	335	392	420	443	456	482	485	503	479	598	642	731	92%
I	419	448	453	475	497	506	517	546	554	551	560	561	568	603	46%
L	1 378	1 427	1 583	1 659	1 942	2 283	2 685	2 896	2 892	2 901	2 715	2 754	2 857	2 964	149%
NL	456	422	432	447	467	473	472	493	504	512	526	562	567	559	33%
A	528	547	551	587	605	617	673	663	664	657	666	665	664	670	35%
P	206	219	240	266	284	305	331	362	381	399	414	440	455	495	139%
FIN	592	631	673	681	721	730	706	701	686	700	687	668	701	706	26%
S	643	685	701	737	757	712	700	724	709	732	729	722	726	736	21%
UK	506	537	560	594	618	632	625	627	635	631	629	651	654	647	34%
IS	575	605	669	694	682	714	732	713	706	714	694	:	:	:	34%
NO	542	584	608	612	612	612	638	643	669	661	650	707	702	:	37%

Source: Eurostat

1) 'Change 85-98' refers to change of total consumption from 1985 to 1998 (IS 1985 to 1995, NO 1985 to 1997)

Methodology and data problems

There are no major problems concerning data on the use of petrol and diesel oil by road transport. The extremely high figures for Luxembourg, and the increase in the consumption of petroleum products from 1985 to 1992, result from its location and favourable price regime which encourages sales to citizens of neighbouring countries, and can also be attributed to cross-border traffic (mainly commuters). Therefore, the figures do not accurately reflect consumption within the country itself.

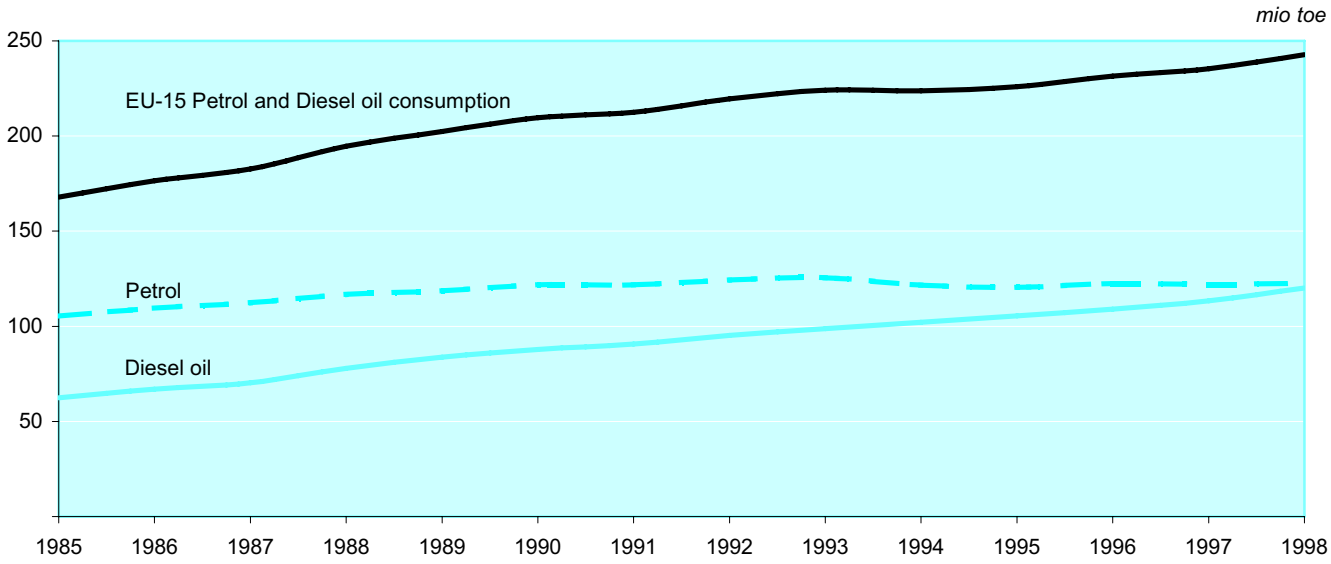
AP-5: Consumption of petrol and diesel oil by road vehicles

Relevant Sectors: **Transport, Energy**

Targets

Directive 98/70/EC[11] sets out new environmental specifications for petrol and diesel fuel for road vehicles, including a ban on sales of leaded petrol, from 1 January 2000. The same Directive also sets out tougher specifications for petrol to be met by 1 January 2005. The Directives 98/69/EC[12] (amendment of Directive 70/220/EEC[13]) and 99/96/EC[14] (amendment of Directive 88/77/EEC[15]) set limits for emissions from private cars, vans and heavy goods vehicles.

Petrol and diesel oil consumption by road vehicles - EU-15



Source: Eurostat

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

In the EU road transport was responsible for around 40% of the total consumption of petroleum products in 1998. Of this transport-related consumption, petrol accounted for about 50% and diesel oil for around 49%. (LPG accounted for approximately 1% of the total inland market consumption of petroleum products but is not included in the EU-15 averages presented in the above table and graph). The consumption trends for the Union reflect those of individual EU Member States (with an average of approximately 650 kg oe per capita in 1998, depending on the country). The increase of 45% in the consumption of motor fuels in the 15 Member States from 1985 to 1998 is dominated by the steady increase in diesel fuel consumption, responsible for 77% of the EU-15 total increase. In France and Austria consumption of petrol actually decreased, so that the full increase in consumption of motor fuels was caused by an increase in diesel consumption. For Belgium 99% of the total increase was caused by the increase in diesel consumption. On the other hand, in Denmark, Greece and Italy more than 50% of the total increase was caused by the increase in petrol consumption.

[11] OJ L350, 28/12/1998 p. 0058 - 0068
[12] OJ L350, 28/12/1998 p. 0001 - 0057
[12] OJ L076, 06/04/1970 p. 0001 - 0022
[14] OJ L044, 16/02/2000 p. 0001 - 0155
[15] OJ L036, 09/02/1988 p. 0033 - 0061

AP-6: Primary energy consumption

Definition and purpose

This indicator is defined as gross inland consumption of fossil fuels (GIC), i.e. the total amount of fossil fuels used to meet the national demand for energy. In this case, primary energy is taken to include imports of petroleum products and is calculated as follows:

Primary production + Imports ± Stocks changes - Exports - Marine bunkers

Energy drives the economies of highly industrialised countries. However, combustion of fossil fuels is closely related to Air Pollution problems. To a certain extent, direct pressures such as NO_x emissions can be reduced through better technologies. However, such improvements can only have limited effects if the trend of energy consumption continues to rise at the same pace as economic growth.

Consumption is given in kilogrammes of oil-equivalent (kg oe) per capita.

Gross inland energy consumption of fossil fuels [1)]

kg oe per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	% fossil to final
EU-15	2 863	2 885	2 925	2 905	2 932	2 937	2 980	2 930	2 883	2 872	2 926	3 026	2 980	3 043	79%
B	3 507	3 521	3 514	3 488	3 582	3 633	3 824	3 865	3 732	3 814	3 845	4 153	4 139	4 305	78%
DK	3 639	3 659	3 659	3 408	3 112	3 203	3 651	3 422	3 504	3 709	3 670	4 376	3 886	3 729	93%
D	4 104	4 125	4 140	4 084	3 981	3 926	3 824	3 680	3 641	3 590	3 583	3 701	3 606	3 605	86%
EL	1 731	1 684	1 778	1 902	2 088	2 083	2 071	2 120	2 064	2 149	2 181	2 285	2 293	2 417	94%
E	1 567	1 541	1 555	1 641	1 738	1 789	1 903	1 959	1 833	1 959	2 088	2 027	2 187	2 261	80%
F	2 402	2 327	2 329	2 253	2 313	2 337	2 446	2 365	2 282	2 147	2 232	2 389	2 280	2 413	57%
IRL	2 448	2 527	2 630	2 650	2 663	2 858	2 861	2 821	2 832	2 990	3 008	3 181	3 300	3 459	98%
I	2 180	2 224	2 354	2 395	2 504	2 531	2 547	2 577	2 515	2 469	2 626	2 608	2 634	2 706	90%
L	7 594	7 475	7 294	7 497	8 074	8 355	8 801	8 722	8 722	8 284	7 031	7 120	6 835	6 495	84%
NL	4 104	4 277	4 367	4 255	4 268	4 320	4 495	4 435	4 466	4 419	4 561	4 709	4 607	4 553	95%
A	2 399	2 428	2 518	2 413	2 446	2 591	2 748	2 500	2 456	2 489	2 541	2 659	2 717	2 762	77%
P	906	1 013	1 044	1 137	1 407	1 431	1 468	1 624	1 563	1 592	1 708	1 644	1 756	1 928	84%
FIN	3 268	3 452	3 843	3 462	3 594	3 472	3 593	3 424	3 532	3 787	3 366	3 808	3 822	3 810	59%
S	2 452	2 482	2 351	2 375	2 220	2 083	2 055	2 036	2 054	2 109	2 183	2 298	2 163	2 166	40%
UK	3 300	3 369	3 390	3 372	3 370	3 344	3 395	3 330	3 327	3 343	3 327	3 452	3 328	3 407	87%

Source: Eurostat

1) % fossil to final is the % of primary fossil energy to total primary energy consumption in the year 1998.

Methodology and data problems

No problems were encountered when preparing this indicator.

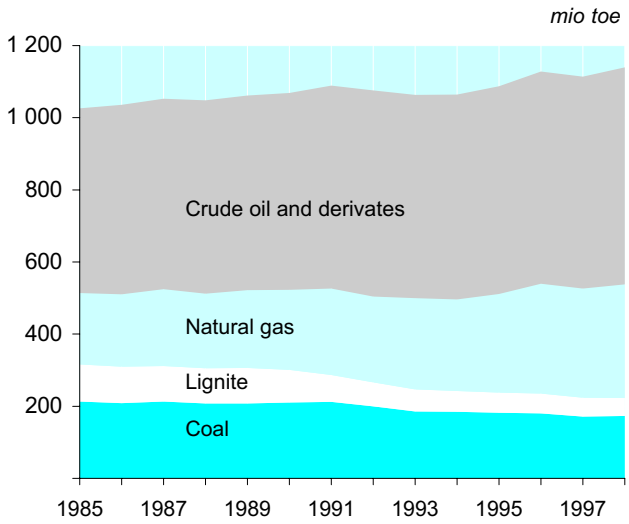
AP-6: Primary energy consumption

Relevant Sectors: Transport, Energy, Households, Industry

Targets

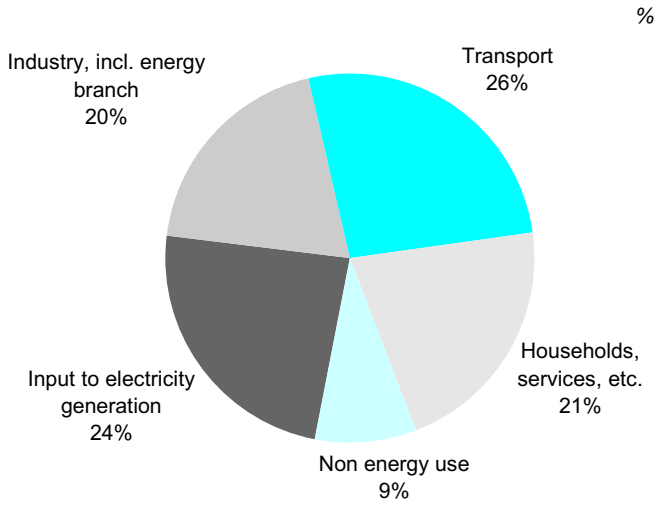
The EU targets air pollution due to energy consumption by two approaches. The first approach is the improvement of the quality of certain liquid fuels as set out in Directive 1999/32/EC[16] (which sets a limit of 1% sulphur in heavy fuel oil from 1 January 2003 and 0.1% in gas oil from 1. January 2008) and in Directive 1998/70/EC[17] on environmental specifications for petrol and diesel fuel for road vehicles *(see AP-5)*. The second approach is the support of clean technologies and efficient use of fuels namely solid fuels as defined in Council Decision 1999/24/EC[18].

Primary fossil energy consumption - EU-15



Source: Eurostat

Consumption of fossil fuels - EU-15 (1998)



Source: Eurostat

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

Energy consumption depends on climatic conditions, industrial structure and transportation needs, as well as on economic variables such as energy prices and average income levels. The consumption of fossil fuels as a fraction of total energy consumption relies on the availability of other energy sources (mainly hydropower or nuclear power). Since 1985, consumption trends have shown a small but steady yearly increase. France and Germany are exerting influence on the levels of average fossil energy consumption in the EU. In both countries there is a decrease in fossil energy supply. The reduction in France is caused by additional nuclear power installations replacing fossil energy. The reduction in Germany is mainly due to structural changes in energy demanding industries and the use of more efficient power plant technology in East Germany after re-unification.

The type of fuel used to meet demand has changed over time. The use of solid energy carriers, such as coal and lignite has been reduced. The significant reduction in consumption of lignite can be attributed to the German re-unification. The use of natural gas and petroleum products has increased. Natural gas with its low emissions is used as a substitute for other fuels in the industry and electricity generation sectors as well as in commercial and residential heating.

While 24 % of primary fossil energy input is utilised in the electricity production, 9 % of final consumption is used for non-energy consumption, serving mainly as input for the chemical industry, 20% by the industry sector as process input or for heating purposes. The household and commercial sectors consume 21 % and the transport sector is responsible for 26 % of fuel consumption.

[16] OJ L121, 11/05/1999 p. 0013 - 0018
[17] OJ L350, 28/12/1998 p. 0058 - 0068
[18] OJ L007, 13/01/1999 p. 0028 - 0030

OZONE LAYER DEPLETION

Introduction

The distribution of ozone in the stratosphere is a function of altitude, latitude and season. It is determined by photochemical and transport processes. The ozone layer is located between 10 and 50 km above the Earth's surface and contains 90 % of all stratospheric ozone. Under normal conditions, stratospheric ozone is formed by a photochemical reaction between oxygen molecules, oxygen atoms and solar radiation.

The ozone layer is essential to life on Earth as it absorbs harmful ultraviolet-B radiation from the sun. In recent years the thickness of this layer has been decreasing, leading in extreme cases to holes in the layer.

The main cause of ozone layer depletion is the increased stratospheric concentration of chlorine and bromine from industrially produced agents, such as CFCs, halons, HCFCs, carbon tetrachloride, methyl chloroform and methyl bromide. The agents are released into the environment during the production process, by the use of certain products, by leakage from cooling systems and fire extinguishers and (in the case of methyl bromide) by use in soil fumigation or in quarantine and in the pre-shipment of perishable goods.

Once in the stratosphere, each chlorine or bromine atom can destroy many thousands of ozone molecules. The amount of damage that an agent can inflict upon the ozone layer is expressed in relation to that of CFC-11 and is called the Ozone Depletion Potential (ODP), where the ODP of CFC-11 is 1.

The lifetime of some of these ozone-depleting substances (ODS) is very long and they may continue to deplete the ozone layer long after their use has been phased out. In this publication, ODP values for a 100-year period are used. Nevertheless, some shorter-lived substances, such as HCFCs may have a very high chlorine loading potential and thus their effect in the short term is much larger than that reflected by their ODP value.

The main potential consequences of ozone layer depletion are:

- increase in UV-B radiation at ground level: a one percent loss of ozone leads to a two percent increase in UV radiation. Continuous exposure to UV radiation affects humans, animals and plants, and can lead to skin problems (ageing, cancer), depression of the immune system, and corneal cataracts (an eye disease that often leads to blindness). Increased UV radiation may also lead to a massive die-off of phytoplankton (a CO_2 'sink') and therefore to increased global warming.
- disturbance of the thermal structure of the atmosphere, probably resulting in changes in atmospheric circulation;
- reduction of the ozone greenhouse effect: ozone is considered to be a greenhouse gas. A depleted ozone layer may partially dampen the greenhouse effect. Therefore, efforts to tackle ozone depletion may result in increased global warming;
- changes in tropospheric ozone and in the oxidising capacity of the troposphere.

International targets for the reduction of ODS have resulted in the almost complete phasing out of CFCs, halons and carbon tetrachloride in the EU. Methyl chloroform and methyl bromide will be phased out by 2005 and HCFCs by 2015.

Compared to the previous publication, several changes are introduced in this chapter:

- Indicator OD-1 for the first time shows the banks of halons still in use or in stock.
- The indicator on NO_x emissions from aircraft is removed, as IPCC studies have shed new light on the role of NO_x in the upper troposphere and lower stratosphere.
- Indicators OD-5 and OD-6 have been renumbered as OD-4 and OD-5.
- Indicator OD-5 has been slightly renamed to better reflect the data shown.

OD-1: Emissions of bromofluorocarbons (halons)

Definition and purpose

Halons are among the most important ozone-depleting substances. The purpose of this indicator is to monitor the emissions of bromofluorocarbons (halon-1211, halon-1301 and halon-2402: Montreal Protocol Annex A, Group II substances), which are almost exclusively used as fire extinguishing agents.

Emissions of halons are extremely difficult to estimate and therefore apparent consumption is used as a proxy. It should be noted that apparent consumption for a given year is not the same as emission or release, since halons incorporated into products will be released after some delay.

Apparent consumption is calculated as the aggregate of *production + imports - exports ± stock change.*

Apparent consumption of bromofluorocarbons (Halons 1211, 1301, 2402) in the EU[1)]

tonnes

Halon 1211, 1301, 2402	1986 EU-12	1989 EU-12	1992 EU-12	1993 EU-12	1994 EU-12	1995 EU-15	1996 EU-15	1997 EU-15
Apparent consumption	6 818	8 678	4 028	2 131	- 26	0	0	0
EU production	13 777	14 150	6 807	3 481	0	0	0	0
EU imports	67	643	613	186	0	0	0	0
EU sales	7 409	8 344	4 576	2 701	1	1	0	0
EU exports	7 026	6 115	3 392	1 536	26	0	0	0

Source: European Commission, Directorate General for Environment (Statistical fact sheet-Ozone Depleting Substances)

1) Data for the former German Democratic Republic are included from 01.01.1991.

Methodology and data problems

Statistics on production and trade in halons for specific countries are not generally available for publication for commercial confidentiality reasons, as these substances are manufactured by a small number of companies and national figures would effectively reveal the production of individual companies. Therefore data is provided for EU-12 or EU-15 only. In all cases, data refer to halons produced and traded as such. Halon trade figures exclude halons incorporated into products. Even after the cessation of halon trade, halons contained in products may continue to leak or continue to be emitted, if they are not recuperated from these products.

For a long time there was no information on the quantities of halons still in use in products or equipment. This information has recently become available for professional fire-fighting equipment, the major use of halons.

Ideally, emissions of individual halons should be multiplied by their Ozone Depletion Potentials[1] (ODP) and totalled. However, the available data groups the three halons together and is given in metric units. Therefore, it is not possible to convert these sets of data into ODP-weighted units.

[1] Ozone Depletion Potentials:
CFC-11 = 1.0 (Reference)
Halon-1301 = 10.0; Halon-1211 = 3.0; Halon-2402 = 6.0

OD-1: Emissions of bromofluorocarbons (halons)

Relevant Sectors: **Services**

Targets

Council Decision 88/540/EEC[1] approved the 1985 Vienna Convention for the protection of the ozone layer, which provided a framework for international protection of the ozone layer. At the same time it approved the 1987 Montreal Protocol, which imposed a series of controls on the production and consumption of ozone depleting substances.

The Montreal Protocol required industrialised countries to phase out halons completely by January 1994 (zero production and consumption). EU countries have reached this target.

Regulations 2037/2000[2], 2038/20002[2], and 2039/20002[2] amend Regulation 3093/94[3] to bring EU legislation in line with the latest changes of the provisions of the Montreal Protocol.

Bromofluocarbons stocks (Halons 1211 and 1301) (1999)[1)]

tonnes

	1211 installed	1301 installed	1211/1301 installed	1211 stock	1301 stock	1211/1301 stock	1211 total	1301 total	1211/1301 total	TOTAL total	future annual demand
EU	3 650	5 290	11 180	210	640	275	3 860	5 930	11 455	21 245	104-117
B	:	:	:	:	:	:	:	:	:	:	:
DK			75			5	0	0	80	80	0
D			5				0	0	5	5	2
EL	:	:	:	:	:	:	:	:	:	:	:
E	3 500	2 500		30	40		3 530	2 540	0	6 070	20
F	0	2 500		0	200		0	2 700	0	2 700	30-50 until end 2003 thereafter 0
IRL	:	:	:	:	:	:	:	:	:	:	:
I			10 000			0	0	0	10 000	10 000	0
L	:	:	:	:	:	:	:	:	:	:	:
NL			1 100			270	0	0	1 370	1 370	10 until end 2003 thereafter critical uses
A	:	:	:	:	:	:	:	:	:	:	
P	:	:	:	:	:	:	:	:	:	:	
FIN	:	:	:	:	:	:	:	:	:	:	
S	:	:	:	:	:	:	:	:	:	:	
UK	150	290		180	400		330	690	0	1 020	1211: 12 -- 1301: 10-15
							0	0	0	0	
IS	:	:	:	:	:	:	:	:	:	:	
NO	:	:	:	:	:	:	:	:	:	:	
CH			250			20	0	0	270	270	<20 until 2002 thereafter 0

Source: European Commission/Eurofeu

1) Conversion to ODP-tonnes is not possible as halon 1211 and 1301 data sets are mixed (different ODP values). Halon 2402 is not reported, but plays no major role.

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

Public awareness regarding the effects of halons on the ozone layer has led to consumer reactions which, combined with the existence of less dangerous substitutes, have led to a rapid reduction of the quantities produced and consumed. By 1994, all EU production and import of halons had come to an end. However, halons may still be released from older products when they reach the end of their life cycle.

Eurofeu, the European Fire-fighters Association, has inventoried the halons installed and in stock for professional fire fighting equipment (the majority of halon stocks), and has estimated future need by the fire fighting industry. This future demand can be met as Regulation 2037/2000 provides for certain exceptions in production and sales. Halon for these special applications can only come from gas stockpiled during system/hardware decommissioning process either by Member States or authorised private companies.

[1] Official Journal L 297, 31/10/1988

[2] Official Journal L 244, 29/09/2000

[3] Official Journal L 333, 22/12/1994

OD-2: Emissions of chlorofluorocarbons (CFCs)

Definition and purpose

The main purpose of this indicator is to monitor the emissions of all chlorofluorocarbons (CFCs).

CFCs are among the most important ozone-depleting substances. The indicator is linked to the indicators on other ozone-depleting substances, as well as to those on *Climate Change*. CFCs are greenhouse gases with a relatively high global warming potential. Furthermore, ozone is also a greenhouse gas, and greenhouse gases are believed to affect stratospheric ozone depletion.

CFCs are man-made compounds and are used, for instance, as aerosol propellants, cooling agents in refrigerators, cleaning agents and plastic foam blowing agents. Emissions of chlorofluorocarbons should include total emissions of the CFCs covered by the Montreal Protocol, Annex A, Group I, and Annex B, Group I. Emissions of individual CFCs are multiplied by their Ozone Depletion Potential[1] and then summed. Therefore, the unit of measure is ODP-tonnes (CFC-11 equivalents) per year.

Emissions of chlorofluorocarbons (CFCs 11, 12, 113, 114, 115) [1)]

ODP tonnes

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
					EU–12						EU–15		
CFC 11	125 054	132 282	117 553	82 044	67 169	64 555	60 809	60 077	51 825	46 121	44 217	40 009	35 913
CFC 12	98 591	100 145	93 987	66 747	49 099	39 994	36 130	32 925	23 851	13 907	8 575	2 637	0
CFC 113	32 857	35 035	37 714	35 303	33 274	29 817	25 143	17 345	8 003	464	447	430	414
CFC 114	6 622	6 382	5 548	4 130	3 028	2 421	2 012	2 449	1 450	188	84	0	0
CFC 115	1 417	1 436	1 495	1 586	1 689	1 743	1 862	1 903	1 751	1 391	1 032	1 032	1 032

Source: McCulloch & Midgley

1) 1997 and 1998 data are extrapolated.

Methodology and data problems

Given that real emissions or releases are very difficult to estimate, reports on CFCs normally show apparent consumption levels instead of figures on emissions. Apparent consumption is calculated as the aggregate of *production + imports - exports ± stock change*. However, figures on apparent consumption can be misleading, as releases from CFCs contained in equipment, such as refrigerators, or in other products, are not taken into consideration. The sets of data shown in this report, calculated by McCulloch & Midgley[2], incorporate such releases. The figures were arrived at by multiplying sales by end-use category with release factors specific to said end-use category. In most cases, precision is believed to be better than ±20 %.

The figures only cover the five CFCs in Annex A, group I. There are no sets of data available for the ten CFCs in Annex B, Group 1 of the Montreal Protocol.

Emissions are not calculated for each year. In consultation with McCulloch & Midgley, figures for 1997 and 1998 were extrapolated from the trends shown in the last 2-3 years (1994-1996), rather than undertaking a full or partial recalculation.

1 Ozone Depletion Potentials:
CFC-11 = 1.0 (Reference)
CFC-12, 13 = 1.0; CFC-111, 112 = 1.0; CFC-113 = 0.8; CFC-114 = 1.0; CFC-115 = 0.6; CFC-211 up to and including 217 = 1.0

2 In an article entitled 'Estimated Historic Emissions Of Fluorocarbons from the European Union' (Atm. Env. Vol.32, No.9 pp. 1571-1580)

OD-2: Emissions of chlorofluorocarbons (CFCs)

Relevant Sectors: **Industry**

Targets

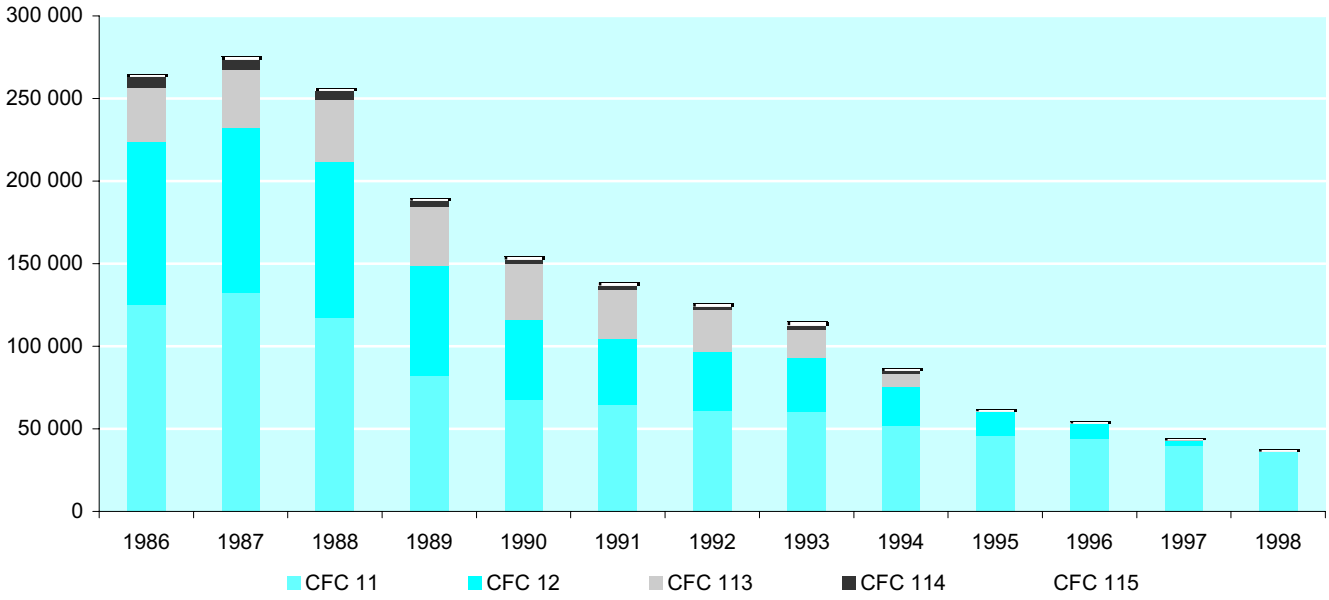
Council Decision 88/540/EEC[1] approved the 1985 Vienna Convention, which provided agreement on measures for the protection of the ozone layer. At the same time it approved the 1987 Montreal Protocol, which imposed a series of controls on the production and consumption of ozone depleting substances, which should lead to a 50% reduction in the production and consumption of CFCs by the year 2000.

In 1998 the Environment Council adopted the Commission proposal COM (1998) 398 final, providing for an immediate ban on sales of CFCs.

Regulations 2037/2000[2], 2038/2000[2], and 2039/2000[2] amend Regulation 3093/94 to bring EU legislation in line with the latest changes of the provisions of the Montreal Protocol.

Emissions of chlorofluorocarbons (CFC-11, -12, -113, -114, -115) - EU[1)]

ODP tonnes



Source: McCulloch&Midgley

1) 1986-1994 = EU-12, 1995-1996 = EU-15.

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

The EU has made significant progress towards its commitment to phase out CFC production and consumption. However, the figures include emissions of CFCs that are still used in equipment and which are not affected by this phase out process. These emissions will continue for some time, even after apparent consumption is fully reduced to zero. Other substances that are believed to be less damaging to the ozone layer, at least in the longer term, have replaced the CFCs used in certain applications. This process is presented in OD-3.

1 Official Journal L 297, 31/10/1988
2 Official Journal L 244, 29/09/2000
3 Official Journal L 333, 22/12/1994

OD-3: Emissions of hydrochlorofluorocarbons (HCFCs)

Definition and purpose

The main purpose of this indicator is to monitor the emissions of HCFCs. Use of HCFCs is allowed as an alternative to the fully halogenated CFCs. The stratospheric ozone depletion potential of HCFCs is less than that of CFCs. However, the effect may be more severe in the short term. HCFCs are viewed as transitional alternatives to CFCs as chlorine-free alternatives are sought for and introduced. Until now, only sets of data for sales, uses or apparent consumption were available as proxies for emissions. However, estimates of emissions are now available. The difference between the two approaches is striking.

Included here are total emissions of HCFCs (Montreal Protocol Annex C, Group I). Emissions of individual HCFCs are multiplied by their Ozone Depletion Potentials and totalled. Therefore, the unit of measure is ODP tonnes (tonnes of CFC-11 equivalent emissions) per year.

HCFCs sales - EU-15 [1)]

ODP tonnes

	HCFC 22	HCFC 141b	HCFC 142b	HCFC 123	HCFC 124	Total
1986	1 356	0	0	0	0	1 356
1987	1 423	0	0	0	0	1 423
1988	1 672	0	0	0	0	1 672
1989	1 777	0	0	0	0	1 777
1990	1 943	0	0	0	0	1 943
1991	2 047	264	178	9	2	2 500
1992	2 284	527	356	18	4	3 190
1993	2 401	865	584	30	7	3 887
1994	2 578	1 606	1 086	56	13	5 339
1995	2 914	2 596	1 755	90	20	7 375
1996	2 846	2 618	1 651	87	20	7 222
1997	3 051	:	:	:	:	:
1998	2 983	:	:	:	:	:

*Source: McCulloch&Midgley (adapted by E*M*A*I*L)*

1) HCFC-22 sales figures - source: European Commission.

HCFCs emissions - EU-15 [2) 3)]

ODP tonnes

	HCFC 22	HCFC 141b	HCFC 142b	HCFC 123	HCFC 124	Total
1986	1 012	0	0	0	0	1 012
1987	1 062	0	0	0	0	1 062
1988	1 166	0	0	0	0	1 166
1989	1 294	0	0	0	0	1 294
1990	1 444	0	0	0	0	1 444
1991	1 542	110	39	2	2	1 696
1992	1 613	220	85	6	2	1 926
1993	1 644	352	137	12	4	2 149
1994	1 732	671	247	22	7	2 678
1995	1 826	1 078	403	38	13	3 358
1996	1 923	990	332	52	15	3 311
1997	2 033	990	332	52	15	3 421
1998	2 125	990	332	52	15	3 514

*Source: McCulloch&Midgley (adapted by E*M*A*I*L)*

2) HCFC 22: 1997-98 linear extrapolation (sales are still growing)

3) HCFC 141b, 142b, 123 and 124: 1997-98 presumed constant because of a sales limit.

Methodology and data problems

The HCFC emission figures shown here were weighted using 100 year Ozone Depletion Potentials[1]. However this underestimates their short-term contribution to the depletion of the ozone layer[2] by a factor of 4 for HCFC-22 and a factor of 2 for HCFC-124 and 142b.

As the reduction of consumption is a Community matter under the Montreal Protocol, the sets of data do not allow for a breakdown by country. The figures presented above only cover 5 HCFCs of the 40 listed in the Montreal Protocol.

1 Long-term Ozone Depletion Potentials of HCFCs vary between 0.001 to 0.1 relative to CFC11 (1.0)

2 Short-term ODPs of HCFCs vary from 0.1-0.5

OD-3: Emissions of hydrochlorofluorocarbons (HCFCs)

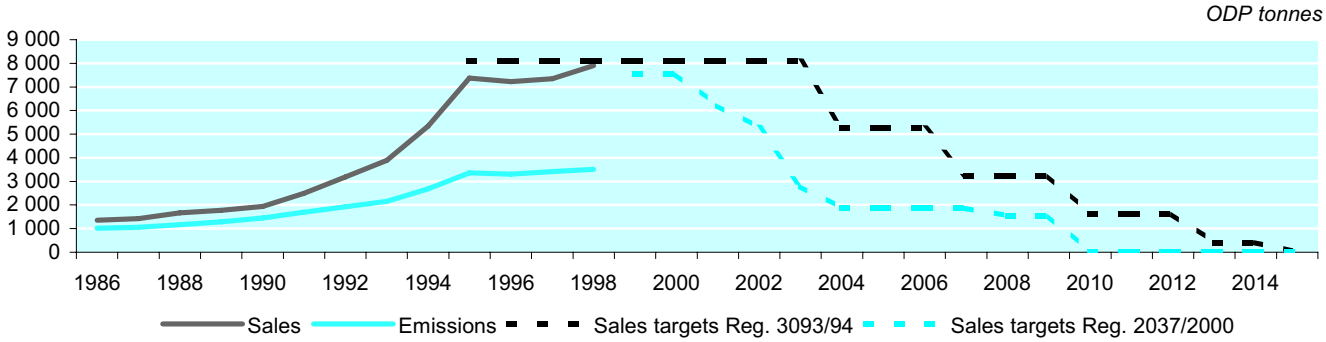
Relevant Sectors: **Industry**

Targets

Council Decision 88/540/EEC[1] approved the 1985 Vienna Convention and the 1987 Montreal Protocol.

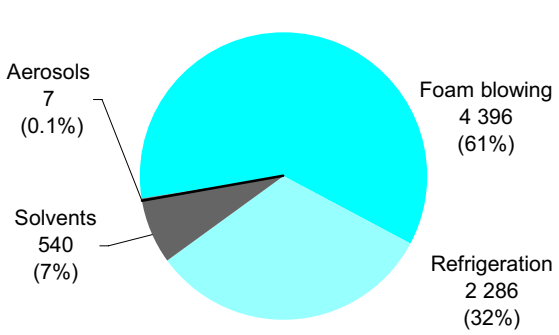
Regulations 2037/2000[2], 2038/2000[2], and 2039/2000[2] amend Regulation 3093/94[3] and set out a schedule to phase out HCFC production, i.e. compared to the 1997 production level, a reduction of 65% by 2008, 80% by 2014, 85% by 2020, and a complete phase out by 2025.

HCFC sales & emissions



Source: Ozone Secretariat, European Commission (Directorate General for Environment), McCulloch & Midgley[4])

HCFC use by application - EU-15 (1996)



*Source: McCulloch & Midgley[4]) (adapted by E*M*A*I*L)*

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

HFCs replace CFCs, but cannot be used in the same (old, leaky) installations. HCFCs are used in new and less emitting technologies. Hence less than half the amount of HCFCs sold is actually emitted.

As there are almost no stocks, consumption is more or less synonymous with sales. Consumption[5] figures for all 40 HCFCs and sales figures for the group of 5 HCFCs depicted here differ very little, hence it can be deduced that the remaining 35 HCFCs add relatively little to the problem of Ozone Depletion.

No breakdown of consumption by economic sector is available. It is possible, however, to show a breakdown by application of the HCFCs. The breakdown is presented in ODP tonnes.

1 Official Journal L 297, 31/10/1988
2 Official Journal L 244, 29/09/2000
3 Official Journal L 333, 22/12/1994
4 Estimated Historic Emissions of Fluorocarbons from the European Union. Atm. Environ. Vol. 32, No 9.
5 Consumption is defined by the Ozone Secretariat as 'production plus imports minus exports.' Production is defined as 'production minus amount destroyed minus feedstock.'

OD-4: Emissions of chlorinated carbons

Definition and purpose

The main purpose of this indicator is to monitor anthropogenic emissions of chlorinated carbons, namely carbon tetrachloride (CCl_4; CTC) and 1,1,1-trichloroethane (methyl chloroform; CH_3CCl_3), Montreal Protocol Annex B, Group II and III substances. These man-made gases are major source gases for stratospheric chlorine, and hence stratospheric ozone destruction. Carbon tetrachloride is used as a fire-extinguishing agent and in pesticides and dry cleaning agents. 1,1,1-trichloroethane is used for cleaning metal.

The emissions of the two individual compounds are multiplied by their Ozone Depletion potential[1] and then summed. Therefore, the unit of measure is ODP tonnes (tonnes of CFC-11 equivalent emissions) per year. No estimates of emissions are available for chlorinated carbons as no research into this has been found.

Chlorinated carbons sales - EU-15[1)2)]

ODP tonnes

	Carbon tetrachloride			1,1,1-trichloroethane		
EU-15	Production	Export	Sales	Production	Export	Sales
1989	63 763	13 345	26 608	20 875	7 277	12 880
1990	32 271	16 031	23 522	21 470	9 597	12 262
1991	14 750	7 662	11 189	18 245	6 831	10 513
1992	12 560	4 901	9 604	18 237	9 687	9 105
1993	4 117	1 110	3 156	10 799	4 273	6 716
1994	2 754	664	1 905	8 360	3 789	5 637
1995	4 706	7 887	0	7 813	3 509	4 425
1996	463	1 297	0	:	:	:
1997	34 525	14 473	353	:	:	:
1998	38 017	370	187	:	:	:
1999	40 666	3 212	146	:	:	:

Source: European Commission, Directorate General for Environment (Statistical Fact Sheet - Ozone Depleting Substances)

1) 1995 to 1998 data: EU sales and exports include 'essential uses'.
2) 1997 and 1998 data on production and export of CCl4 include sales for basic domestic needs in developing ('Article 5') countries.

Methodology and data problems

For reasons of confidentiality of individual company data, the 1996-1998 figures for 1,1,1-trichloroethane cannot be shown.

The inclusion of sales and exports 'for essential uses' in the figures from 1995 onward makes it impossible to judge if the target of a complete phase out was indeed reached by 1 January 1995.

The industry sector is the economic sector involved in the production and export of carbon tetrachloride and 1,1,1-trichloroethane. Insight into the final use of these products, however, is not available.

1 Ozone Depletion Potentials:
CFC-11 = 1.0 (Reference)
CCl4 = 1.1
CH4CCl3 = 0.1

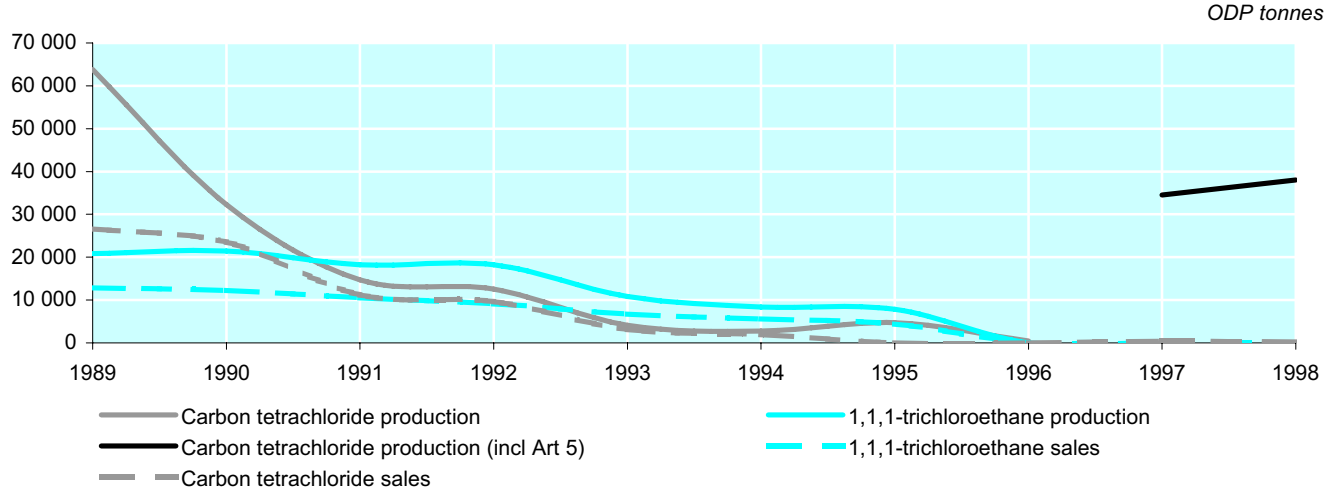
OD-4: Emissions of chlorinated carbons

Relevant Sectors: **Industry**

Targets

EU-15 countries agreed to phase out carbon tetrachloride completely by 1995 and 1,1,1-trichloroethane by 1 January 1996 (zero production and consumption, with possible exemption for essential uses). Production of carbon tetrachloride and 1,1,1 trichloroethane is prohibited as of 1995 and 1996 respectively, except for essential uses within the EU. Production in EU countries may amount to 15 % of its 1989 level in order to provide for basic domestic needs in developing countries.

Chlorinated carbons production and sales - EU-15



Source: European Commission, Directorate General for Environment

Relevance: Green	Accuracy: Green	Time Rep.: Green	Spatial Rep.: Green

Comments

The large differences in ODP values of carbon tetrachloride (1.1) and 1,1,1 trichloroethane (0.1) can cause confusion between metric data and ODP weighted data. All data presented here are ODP weighted.

The phasing-out of production and consumption (and thus of emissions) of chlorinated carbons has been successful over the years. However, the data availability for 1996-1998 does not allow for a complete evaluation. Data for 1,1,1-trichloroethane are lacking and the data for carbon tetrachloride suddenly include production and sales for basic domestic needs in developing countries.

Production for feedstock is not controlled under the Montreal Protocol. The EU carbon tetrachloride production figures exclude EU feedstock use but include exports for basic domestic needs in Article 5 countries (basic domestic needs), process agent use and feedstock use. Exports, however, only include the amounts exported for basic domestic needs and may include some exports to non-article-5 countries. Basic domestic needs seem to have fallen dramatically between 1997 and 1998.

OD-5: Emissions of industrially produced methyl bromide (CH_3Br)

Definition and purpose

Methyl bromide (CH_3Br; MBr), a major anthropogenic source for stratospheric bromine, is a significant ozone-depleting compound. While other anthropogenic sources (biomass burning, combustion of leaded petrol) are known to exist, the main purpose of this indicator is to monitor the emissions of industrially produced MBr, found under Montreal Protocol Annex E, Group I.

MBr is mainly used in agriculture as a soil fumigant. Other uses are quarantine and pre-shipment (QPS), disinfection of stored and perishable products, and as feedstock. As exact emissions are difficult to calculate, the emissions of MBr are presumed to equal the amount used, multiplied by its long-term Ozone Depletion Potential (ODP). Therefore, the unit of measurement is ODP tonnes (tonnes of CFC-11-equivalent emissions) per year. The long-term ODP for methyl bromide is 0.6, as opposed to its short-term ODP, which exceeds 10. Therefore, the sets of data presented here show a serious underestimation of damage to the ozone layer in the short term.

Methyl bromide situation - EU

ODP tonnes

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
EU-12 Use	7 490	8 294	9 438	9 154	10 324	9 463	9 578	:	:	:	:	:	:
EU-15 Use	:	:	:	:	:	:	:	9 698	:	9 925	11 030	11 484	7 819
Consumption	:	:	:	:	:	11 553	:	:	:	10 557	10 907	10 664	

Source: European Commission (DG Environment), UN Ozone Secretariat

Methodology and data problems

The table above refers to industrially produced methyl bromide only. No adequate data and/or emission coefficients have been found for biomass burning and emissions from leaded fuel. The latter are currently of less importance as the use of leaded fuel is diminishing rapidly and new anti-knock agents produce less MBr. For biomass burning, some studies have been conducted for Africa and South America, but no relevant sources have been found for Europe.

The above table has been constructed from the European Commission study Methyl Bromide Background - final report and data from the UN Ozone Secretariat.

Use is defined as 'utilisation minus feedstocks'.

Consumption is defined as 'production minus destroyed minus production for feedstock minus production for chemical processing agent plus imports minus exports'.

OD-5: Emissions of industrially produced methyl bromide (CH_3Br)

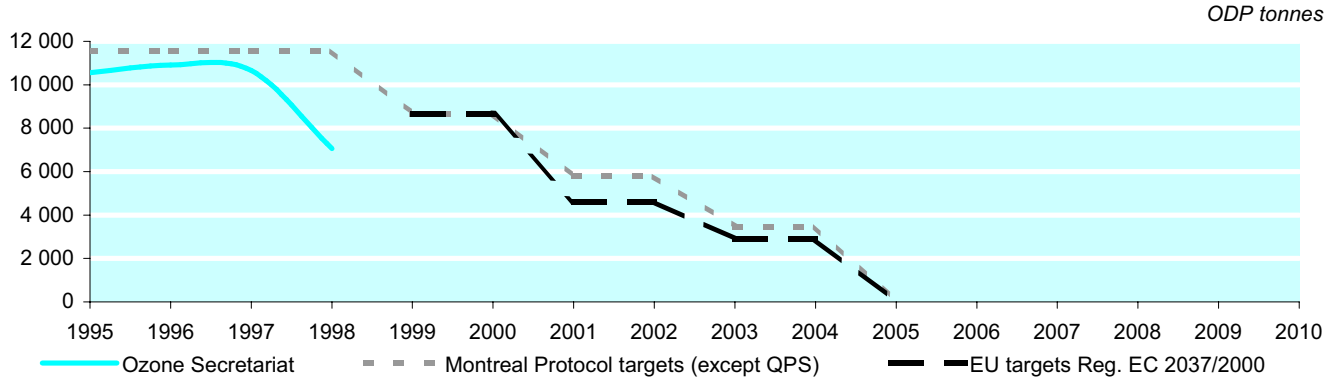
Relevant Sectors: **Agriculture, Industry**

Targets

Under the Montreal Protocol (MP), adopted in the EU by Council Decision 88/540/EEC[1], the current MBr phase out schedule for developed countries is a cut by 1999 to 25% below 1991 levels, a 50% cut by 2001, a 70% cut by 2003 and a total phase out by 2005. The use of MBr for quarantine and pre-shipment currently remains exempt from control under the Protocol.

Regulation EC 2037/2000[2] allows production and placing on the market of 75% of the 1991 ODP weighted levels as of 1999, and imposes a cut to 40% by 2001, to 25% by 2003 and a total phase out as of 2005, except for critical uses. It also imposes a freeze on the use of MBr for quarantine and pre-shipment commencing on 1 January 2001, based on the average amount of MBr imported and produced in the years 1996-98.

Methyl bromide consumption - EU



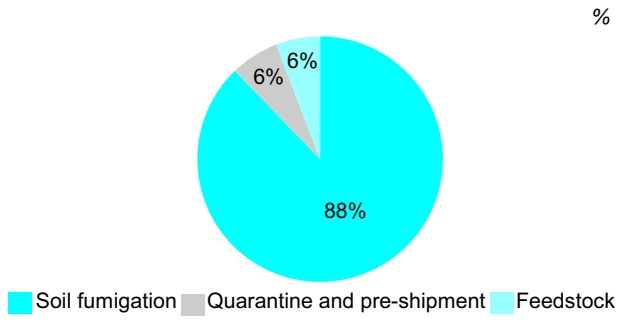
Source: UN Ozone Secretariat; EU targets

Relevance: Green	Accuracy: Green	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

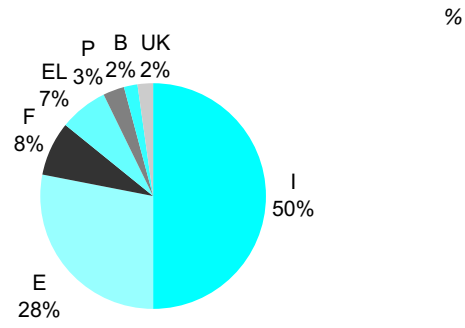
There is a growing availability of alternatives for MBr. The EU has succeeded in limiting its consumption of MBr to 1991 levels, and the first signs of a phasing out in the use of MBr are now evident, although there are large differences between Member States. Almost 70% of the MBr used in the EU is used to control soil-borne pests in three crops: open field tomatoes (37%), open field strawberries (21%) and cucurbits (e.g. melons & cucumbers) (11%). For that reason, the major users are Italy and Spain, who purchase about 82% of all MBr. Other uses are quarantine and pre-shipment treatment of foodstuffs and timber exports. In NL, S, FIN, A, D, L, and DK use is now severely restricted or banned. No data are available for IRL.

Methyl bromide use by application - EU (1997)



Source: European Commission (DG Environment)

Soil fumigation by country (1997) 1)



Source: European Commission (DG Environment)

1) S, FIN, DK, NL, A, D, L ≃ 0

[1] Official Journal L 297, 31/10/1988

[2] Official Journal L 244, 29/09/2000

URBAN ENVIRONMENTAL PROBLEMS

Introduction

In Europe, more than two-thirds of the total population live in urban areas. Situated within natural ecosystems, cities affect and are affected by natural cycles. They import water, energy and materials, which are transformed into goods and services and ultimately returned to the environment in the form of emissions and waste. The high concentrations of people make cities major contri-butors to local, regional and global environmental change, and have an amplified impact on environmental pressures, such as air pollution, waste, waste water, land use, odour and noise nuisance.

The EU's Fifth Environmental Action Programme has no specific targets for the urban environment, though developments in four of the target sectors of the Programme (transport, tourism, energy and industry), and action taken in the policy fields of air, noise, water and waste have a significant impact on the quality of the urban environment.

Of particular importance are the activities to develop co-operation between cities in the promotion of local *Agenda 21* plans, among which the European Commission's Sustainable Cities project (1993) which aims to:

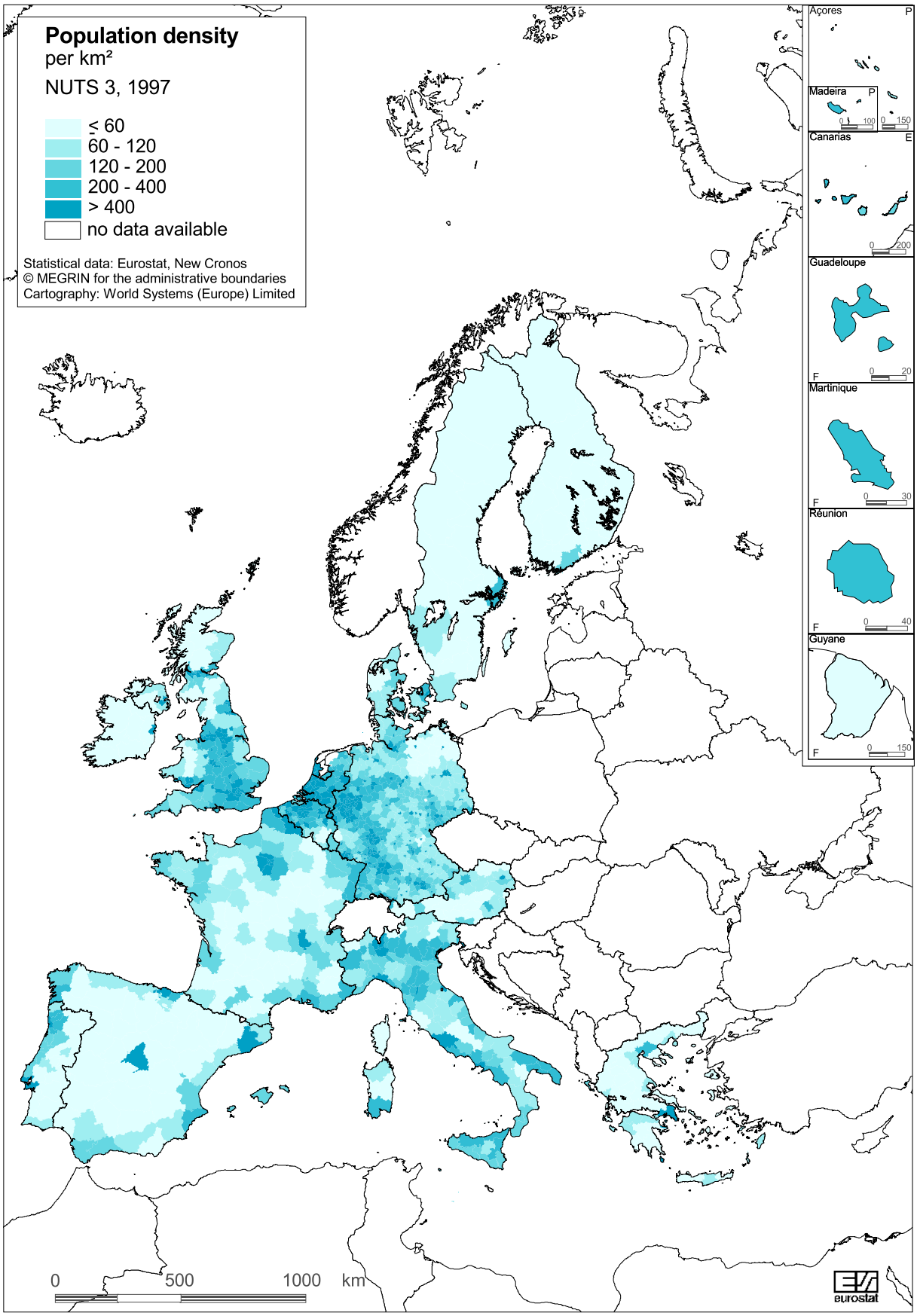
- promote new ideas on sustainability in European urban areas,
- foster a wide exchange of experience,
- disseminate good practices on sustainability at urban level, and
- formulate recommendations aimed at influencing policy at EU, Member State and regional and local levels.

Development of indicators for the policy field *Urban Environmental Problems* is 'work in progress', since in many cases the presentation of urban environmental indicators is hampered by conceptual difficulties (such as the definition of urban, or the lack of a harmonised method for noise measurement) and difficulties in finding suitable data for urban areas only.

Because of these limitations, this publication presents data for only three 'urban' indicators, on Energy consumption *(UP-1),* Municipal waste *(UP-2)* and non-treated urban waste water *(UP-3);* even for these there are some methodological or data problems, which are documented in the text for each indicator.

The other indicators identified as important for Urban areas, i.e. Car share of urban passenger transport *(UP-4),* Population endangered by noise from urban traffic *(UP-5)* and Land use change from natural to built-up area *(UP-6),* all suffered from insurmountable problems, both conceptual and of data availability. Therefore, although an attempt to present data for these indicators was made in the first publication, they have been dropped in this edition.

Apart from a general updating of the figures, other changes include the introduction of a partial sectoral breakdown for UP-1 'Urban energy consumption'. For the others, it was not possible to have a breakdown of the contribution of the different sectors of the economy to the problem.


Population density
per km²
NUTS 3, 1997
≤ 60
60 - 120
120 - 200
200 - 400
> 400
no data available
Statistical data: Eurostat, New Cronos
© MEGRIN for the administrative boundaries
Cartography: World Systems (Europe) Limited
Açores
P
Madeira
P
0 100
0 150
Canarias
E
0 200
Guadeloupe
F
0 20
Martinique
F
0 30
Réunion
F
0 40
Guyane
F
0 150
0
500
1000
km
eurostat

UP-1: Urban energy consumption

Definition and purpose

Energy consumption, and in particular the combustion of fossil fuels, is a major contributor to urban air pollution. Fuel combustion is the major source of emissions of SO_2, NO_x, CO and particles into the atmosphere, and thus to the formation of tropospheric ozone, the major urban air quality problem. The purpose of this indicator is to monitor trends in energy consumption by end uses and sources.

It is not possible to distinguish urban energy consumption from energy consumption in the country as a whole. As a proxy, the indicator shows the energy consumption of all economic sectors, except those which are essentially non-urban (mining, air transport, agriculture and fisheries). It therefore assumes, simplistically, that the per capita quantity of energy consumed for industrial purposes, for land transport, for services and households, does not vary much between urban and non-urban areas.

The consumption of energy covers the annual final consumption of energy in the form of electricity, fuel and heat, and is expressed in kg of oil equivalent. Therefore it does not include the fossil fuels used to generate electricity, but rather the electricity consumed by the final consumer. Use of electricity does not generally contribute to urban environmental problems, unless of course the electricity is generated locally, from fossil fuels. However, electricity is included in this indicator, as the demand by urban (and other) populations for electricity does produce environmental impacts elsewhere.

The indicator is measured in units per capita to allow for direct comparisons between countries.

Urban energy use per capita

kg oe per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
EU-15	2 296	2 330	2 365	2 365	2 363	2 371	2 416	2 404	2 399	2 375	2 416	2 512	2 491	2 524
B	2 963	3 049	3 082	3 128	3 098	3 100	3 253	3 316	3 241	3 308	3 372	3 584	3 584	3 667
DK	2 791	2 734	2 789	2 704	2 732	2 792	2 812	2 760	2 803	2 841	2 885	2 979	2 868	2 851
D	3 020	3 060	3 079	3 016	2 918	2 873	2 813	2 759	2 717	2 660	2 714	2 794	2 731	2 725
EL	1 262	1 234	1 318	1 370	1 423	1 436	1 454	1 453	1 469	1 475	1 514	1 613	1 648	1 730
E	1 239	1 250	1 278	1 382	1 404	1 456	1 546	1 538	1 516	1 591	1 606	1 661	1 722	1 808
F	2 376	2 385	2 409	2 358	2 393	2 405	2 506	2 503	2 507	2 391	2 443	2 565	2 505	2 560
I	1 755	1 858	1 890	1 899	1 969	2 013	1 999	2 006	1 993	2 129	2 155	2 274	2 377	2 497
IT	1 706	1 725	1 818	1 855	1 931	1 948	1 997	1 998	1 994	1 957	2 036	2 046	2 110	2 146
L	8 113	7 971	7 819	8 035	8 576	8 750	9 290	9 112	9 137	8 870	7 740	7 846	7 727	7 496
NL	2 946	3 012	2 978	2 864	2 796	2 893	3 016	2 969	3 054	2 987	3 077	3 321	3 160	3 151
A	2 534	2 543	2 547	2 526	2 529	2 591	2 700	2 608	2 594	2 529	2 634	2 751	2 832	2 813
P	953	948	1 003	1 062	1 074	1 131	1 186	1 245	1 271	1 316	1 364	1 430	1 506	1 571
FIN	3 782	3 870	4 072	4 064	4 147	4 203	4 113	4 196	4 312	4 347	4 313	4 328	4 469	4 590
S	3 736	3 795	3 787	3 735	3 659	3 569	3 565	3 538	3 707	3 795	3 819	3 860	3 781	3 799
UK	2 247	2 325	2 344	2 387	2 383	2 373	2 445	2 449	2 432	2 438	2 416	2 574	2 505	2 520

Source: Eurostat

Methodology and data problems

In Eurostat's energy balances, final energy consumption corresponds to the quantity of energy delivered to the final consumer for all energy purposes. The data is considered very reliable.

It is not possible to distinguish urban energy consumption from energy consumption in the country as a whole. However, given that it is estimated that more than two thirds of the population of Europe live in urban areas, it is assumed that on a per capita basis, final energy consumption for the total population will not vary much from that of urban populations, and will follow similar trends.

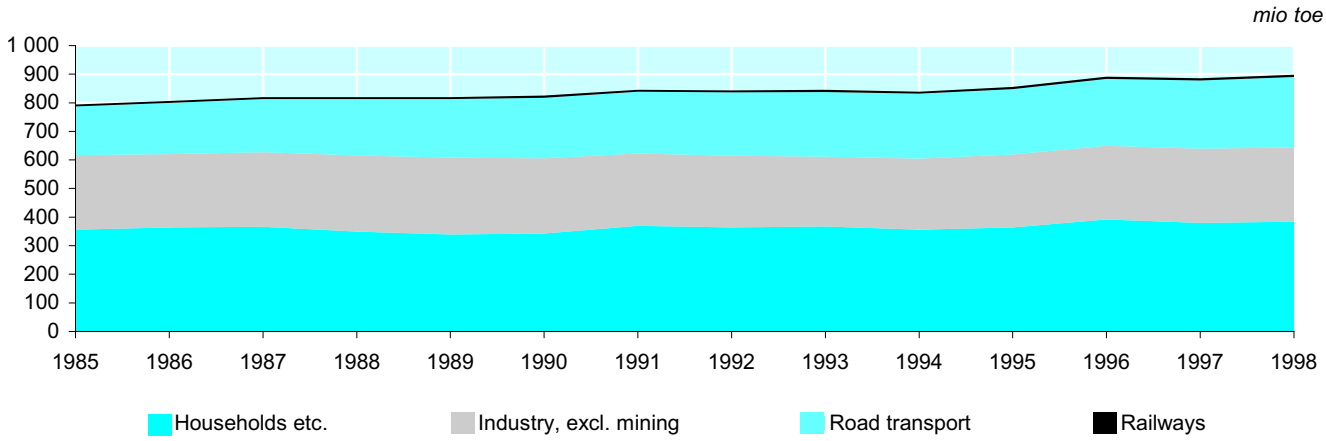
UP-1: Urban energy consumption

Relevant Sectors: Households, Services, Tourism, Transport

Targets

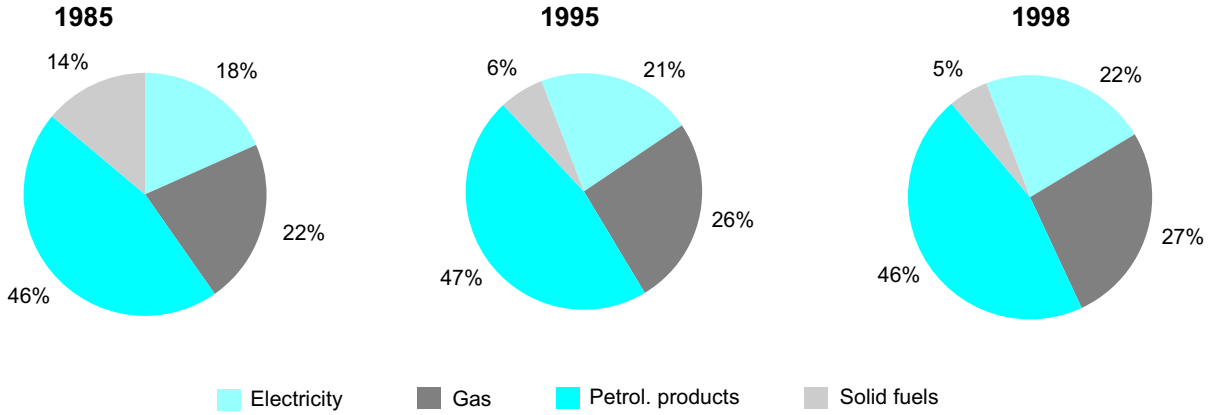
There are no international targets for this indicator. However, in the context of the initiatives of Local Agenda 21, many targets have been formulated at the level of individual cities.

Final energy consumption by sector



Source: Eurostat

Final energy consumption by fuel type - EU-15



Source: Eurostat

Relevance: Yellow	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

There has been a slow but steady increase in energy use since 1985 in all countries, except Germany. Households and services, excluding transport, account for 45 % of this energy consumption in the EU, varying from 30 % in Spain to 57 % in the Netherlands and Denmark. Road transport represents 27 % of consumption on average, varying from 16 % in Finland to 37 % in Spain.

The use of coal and other solid fuels, mainly for space heating but also in industry, has fallen considerably since 1985 to account for only 5% of final energy consumption in 1998, while the use of gas for heating and cooking now accounts for more than a quarter. The reliance on electricity has also grown, so that it now makes up 22% of the energy supplied to (mainly) urban consumers.

UP-2: Non-recycled municipal waste

Definition and purpose

Waste which is not recycled places significant pressure on the environment in terms of loss of resources (valuable materials locked into waste products), contamination of soils and water through leaching of toxic substances, and of the atmosphere, for example methane emissions from decomposition of organic waste in landfill sites. This has direct and indirect effects on the environment and on human health. The impacts are influenced by the type of waste produced and the waste management methods employed.

This indicator shows the amount of non-recycled municipal waste, collected by or on behalf of municipalities. Municipal waste includes waste from households and from commercial activities, office buildings, etc. i.e. types of waste which have similar properties because of their nature or composition. These cover the following main categories: paper, paperboard & paper products, plastics, glass, metals, food waste, garden waste and similar materials.

The data refer to landfilled or incinerated municipal waste and exclude industrial or demolition waste, sludge, hazardous waste and residues from waste incineration.

Non-recycled municipal waste [1) 2) 3)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
B	:	380	371	370	367	355	322	306	279	:
DK	:	:	:	380	396	391	390	380	380	:
D	678	:	:	449	:	:	:	:	:	:
EL	296	:	:	:	:	:	:	340	:	:
E	257	:	317	325	320	327	315	:	:	:
F	:	:	:	:	:	:	:	:	581	:
IRL	:	:	:	:	:	398	:	:	478	:
I	:	:	:	:	:	419	405	400	395	:
L	359	369	364	526	496	509	509	449	437	:
NL	:	395	:	:	330	:	286	:	318	317
A	250	249	241	224	204	202	198	:	:	:
P	:	:	:	316	365	343	354	384	408	:
FIN	493	:	389	333	258	268	:	329	:	:
S	317	:	:	:	286	:	:	:	305	:
UK	:	:	:	:	:	:	:	:	:	:
IS	:	:	574	579	566	566	556	578	580	591
NO	:	:	476	460	483	540	506	467	502	:
CH	529	517	494	486	464	450	436	434	431	450

Source: Eurostat

1) B: estimates by National Statistical Institute, household waste only.
2) L: provisional data for 1995, 1996, 1997.
3) NL, NO and CH: include residues from other operations which are landfilled.

Methodology and data problems

The amount of non-recycled municipal waste depends on the definition of municipal waste that is applied within the country and on the type of collection system used. At the moment there is no uniform definition of municipal waste and the types of collection systems are very different. In some Member States, high amounts of commercial and industrial waste may be included in municipal waste because they are collected by the same system, while not in others. For some Member States the decrease in municipal waste may be caused by a fall in the use of the collection system by commercial and industrial activities and the increasing use of other discharge options.

UP-2: Non-recycled municipal waste

Relevant Sectors: **Households, Services, Tourism**

Targets

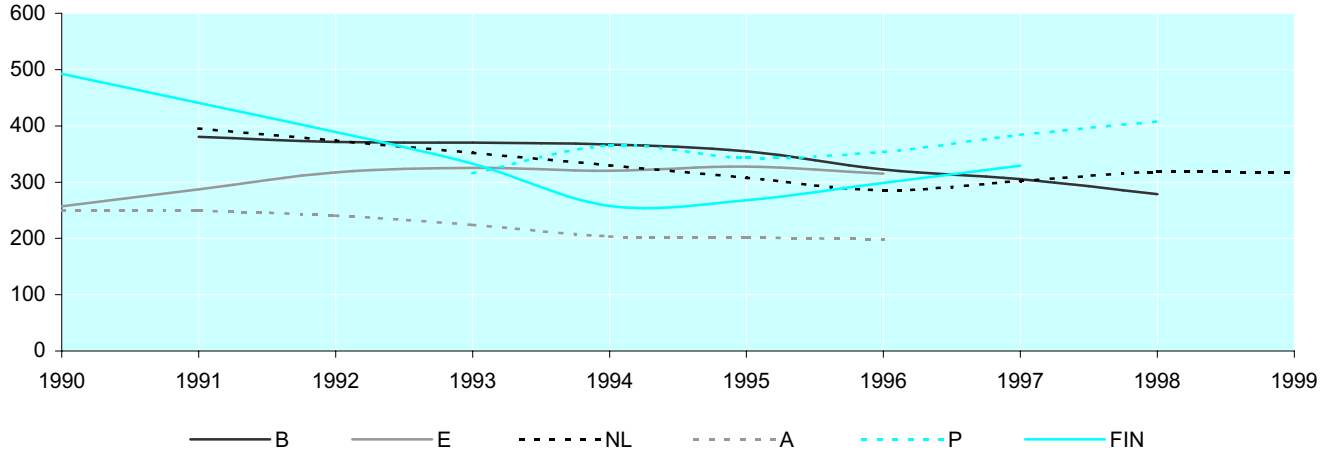
Agenda 21 recommends that by the year 2000 all industrialised countries should have a national programme for efficient waste reuse and recycling *(see WA-6)*.

The 5EAP set a target of stabilisation by the year 2000 of the amount of municipal waste generated in Member States to levels not exceeding 300 kg per capita per year (1985 levels). Also, it calls for waste which cannot be recycled or reused to be disposed of, ideally, by combustion as a fuel; failing that, by incineration or, as a last resort, to be sent to landfill sites. Some countries have set national targets: for example Austria's target is to keep solid waste production at or below 1993 levels.

Council Directive 94/62/EC[1] on packaging and packaging waste sets a target for Member States, to be reached by June 2001, of recovery of at least 50% of packaging waste by weight (except EL, IRL, P).

Non-recycled municipal waste - selected Member States

kg per capita



Source: Eurostat

Relevance: Green	Accuracy: Yellow	Time Rep.: Yellow	Spatial Rep.: Yellow

Comments

The figures for non-recycled municipal waste are calculated from data on incinerated and landfilled municipal waste, and therefore exclude waste that is composted, as this is considered a type of recycling. The amount of waste recycled is very dependent on the availability of recycling facilities within a reasonable distance, and on the cost of separate collection for recycling and delivery to these facilities.

The amount of municipal waste which is not recycled ranges from around 300 to almost 600 kg par capita, with an average of around 400 kg. However, the absolute values should be interpreted carefully because of different definitions of municipal wastes in the Member States. Although there are many gaps in the data, the figures suggest that Greece, Spain, the Netherlands, Austria, Finland and Sweden fall below 350 kg of non-recycled waste per capita, although the trends in these Member States are different. As can be seen from the table and as illustrated in the graph, some Member States reporting high levels of waste in the early nineties have successfully reduced the amount of non-recycled waste, whereas Spain, Portugal and Greece, initially at low levels compared to other countries, have seen an increase.

Although the total amount of municipal waste generated *(see WA-4)* shows an increase in Belgium, Italy, the Netherlands and Austria, increased recycling has resulted in a reduction in the amount of non-recycled municipal waste in these countries.

[1] OJ L 365, 31/12/1994 p. 0010 - 0023

UP-3: Non-treated urban waste water

Definition and purpose

The discharge of non-treated urban waste water is a major cause of pollution of surface water, leading to eutrophication problems, increased bacterial concentrations, oxygen deficiency, increased concentration of nutrients, as well as pollution by heavy metals and polyaromatic hydrocarbons (PAHs). In urban areas, severe contamination can occur due to sewer overflows or by direct rain runoff through separate sewer systems.

The purpose of this indicator is to monitor the degree of treatment of (urban) waste water. The simple indicator is defined as the percentage of population connected to either public or independent sewage treatment plants. The inverse (population not connected to treatment plants) would be a better indicator, but the data availability makes this more difficult. The percentage of population not connected to waste water treatment plants is linked to inadequate waste water management and treatment infrastructure in cities and in the rest of the country.

In general, there are three levels of waste water treatment, ranging from primary treatment to the most advanced tertiary treatment. In several major cities the waste water of a large proportion of the population is still not submitted to primary or secondary sewage treatment. The most advanced - tertiary treatment - is available for only a small percentage of the population in the EU. A more complex indicator weighting the different types of treatment according to their ability to remove the most important pollutants has also been constructed.

Population connected to waste water treatment plants [1)]

%

	1980	1985	1990	1995	1996	1997	1998	1999	1980	1985	1990	1995	1996	1997	1998	1999
	% connected to public treatment plants								% connected to independent treatment plants							
EU-15	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
B	:	:	:	29	30	35	38	:	:	:	:	:	:	:	:	:
DK	:	79	85	87	87	88	89	:	:	:	13	13	13	12	11	:
D	:	:	86	89	:	:	:	:	:	:	11	8	:	:	:	:
EL	:	:	:	55	:	56	:	:	:	:	:	:	:	32	:	:
E	18	29	48	48	:	:	:	:	:	:	:	:	:	:	:	:
F	:	:	69	77	:	:	:	:	:	:	:	:	:	:	:	:
IRL	11	:	44	58	:	:	:	:	22	:	34	32	:	:	:	:
I	30	61	61	63	:	:	:	:	:	:	:	:	:	:	:	:
L	81	83	90	88	:	:	:	93	:	:	10	13	:	:	:	7
NL	72	86	93	97	97	97	98	98	14	7	5	3	3	3	2	2
A	38	65	72	75	:	:	81	:	:	35	28	24	:	:	19	:
P	2	4	21	:	:	:	:	:	20	:	45	:	:	:	:	:
FIN	65	72	76	77	78	78	79	80	31	27	24	22	22	22	21	20
S	82	94	94	93	:	:	93	:	0	0	:	7	:	:	7	:
UK	82	83	87	84	87	84	:	:	5	4	5	4	4	6	:	:
IS	:	:	2	4	4	4	8	16	:	:	10	10	10	10	10	10
NO	34	42	57	67	67	70	73	73	20	27	23	20	20	20	20	20
CH	73	84	90	94	:	95	96	96	:	:	:	6	:	5	5	4

Source: Eurostat

1) B: provisional data.

Methodology and data problems

Major problems are the lack of data and the quality of available information. In the case where data is missing for independent treatment, it is not clear if this is because none of the population is connected to independent treatment plants, or simply that data has not been reported. Data on urban waste water is collected at local level. However a full data set is not reported to OECD/Eurostat. Thus, the calculation of the indicator is not restricted to urban areas but representative of national levels. Ideally, the indicator should include the industrial sector and rain runoff in urban areas, as these are important sources of pollution to water.

No information was supplied on the location of the areas connected to treatment plants. Therefore it is not possible to say if the increased volume of waste water generated by the heavy tourist influx in countries such as France, Spain, Portugal and Greece is likely to be treated or discharged into the sea without treatment.

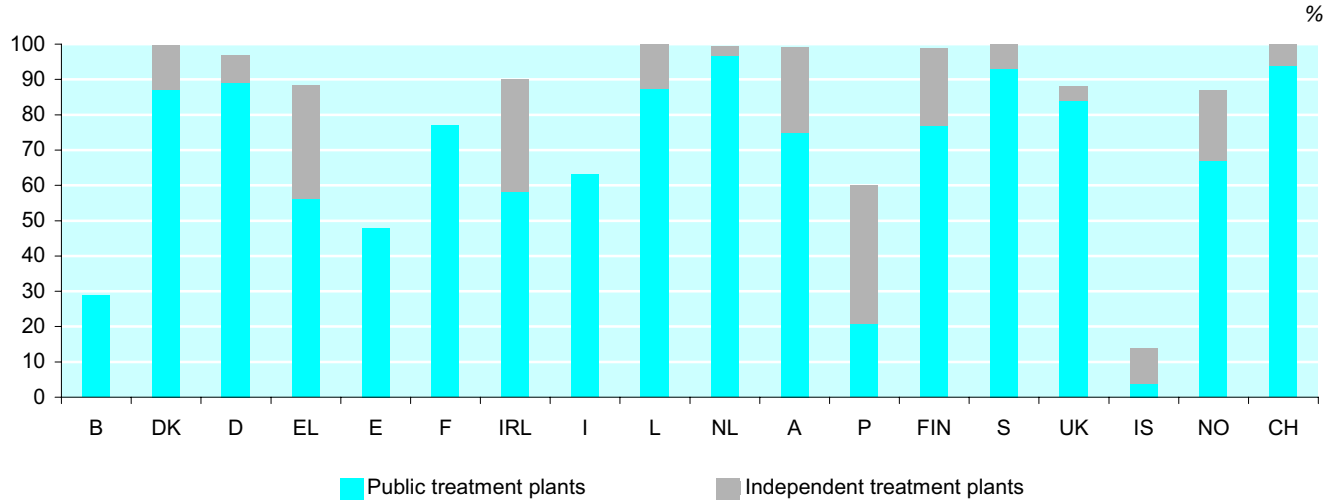
UP-3: Non-treated urban waste water

Relevant Sectors: Households, Industry, Services

Targets

The Directive on Urban Waste Water Treatment sets deadlines for applying waste water treatment before discharge in agglomerations of more than 2000 population equivalents. The basic requirement is secondary treatment level. However, treatment has to be more stringent (secondary plus tertiary treatment) for discharges identified as sensitive by Member States and which occur in the relevant catchment areas. The time limit for implementation of the Directive is 31.12.1998, 31.12.2000 or 31.12.2005, depending on the size of the agglomeration and the sensitivity of the receiving body.

Population connected to waste water treatment plants (1995) [1) 2)]



Source: Eurostat

1) B: provisional data.
2) EL: 1997 data, P: 1994 data.

Relevance: Yellow	Accuracy: Yellow	Time Rep.: Green	Spatial Rep.: Green

Comments

The percentage of non-treated waste water has drastically decreased since 1970. In Denmark, Luxembourg, Netherlands, Austria, Sweden and Finland more or less the whole population is connected to some type of waste water treatment plant. Nonetheless, there are still countries where more than 50% of the population is not connected to sewage treatment (Belgium, Spain). A major improvement is seen in Ireland, where in 1980 the waste water from 67% of the population was discharges into the sea without treatment. Now this is 10% or less.

In general, there are significant differences between countries in the level of waste water treatment, with some countries, such as Spain Greece and Ireland, not going much beyond secondary treatment, while others, such as Denmark, Germany, Finland and Sweden, have invested heavily in advanced (tertiary) treatment. In order to reflect these differences in treatment levels in countries, an index of waste water treatment has been calculated *(see next page)*.

As more countries comply with the Directive on Urban Waste Water Treatment, the indicator will show a decreasing trend, especially in those countries with a higher treatment deficit.

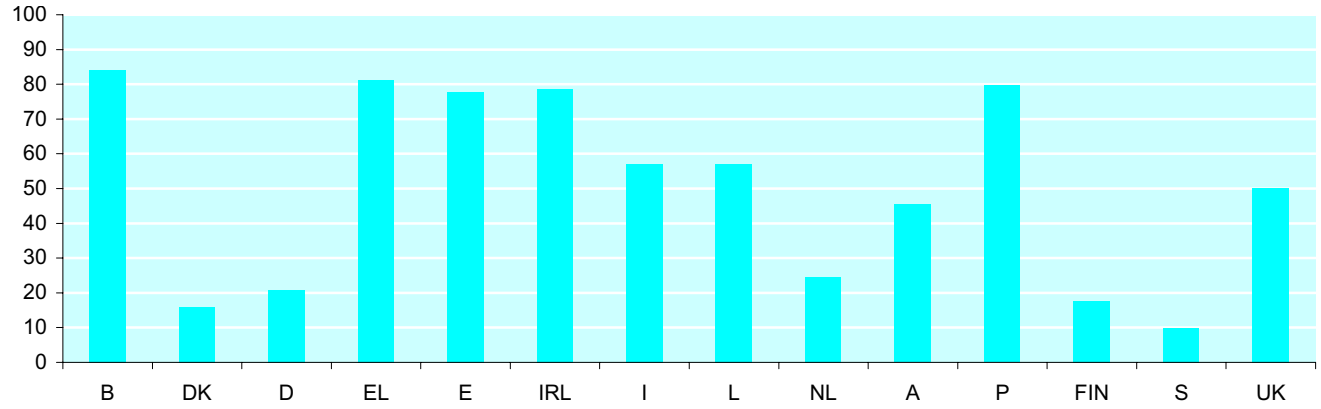
[1] Council Directive 91/271/EEC of 21 May 1991, O J L 135, 30/05/1991 p. 0040 - 0052

UP-3: Non-treated urban waste water

The index of waste water treatment

The three graphs below illustrate the overall level of waste water treatment. The sets of data are calculated by attributing a weight to the different types of treatment, based on the theoretical removal efficiency for nitrogen, phosphorus and BOD for each type of treatment. The removal efficiencies are averages, and the same weights have been used for all Member States. These weights are: 0 for tertiary treatment (which represents best available technology), 0.49 for secondary treatment, 0.86 for primary treatment, and 1 for no treatment. The weights are applied to the percentage of population connected to each type of treatment plant, and the percentage of the population without treatment. The result is an index from 0 to 100, where 0 means that all waste water is subject to tertiary level treatment, and 100 represents no treatment of any waste water at all.

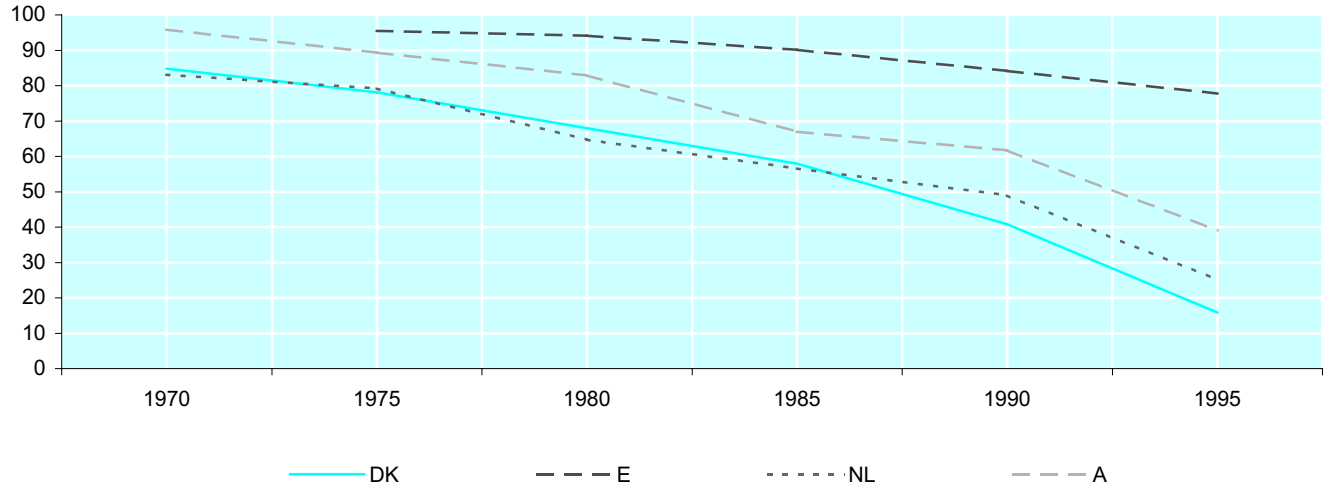
Index of municipal waste water treatment (1995) [1) 2)]



Source: Eurostat, adapted by TAU

1) 100= no treatment is applied; 0= all waste water receives tertiary treatment.
2) P: 1994 data.

Index of municipal waste water treatment - selected Member States [1)]



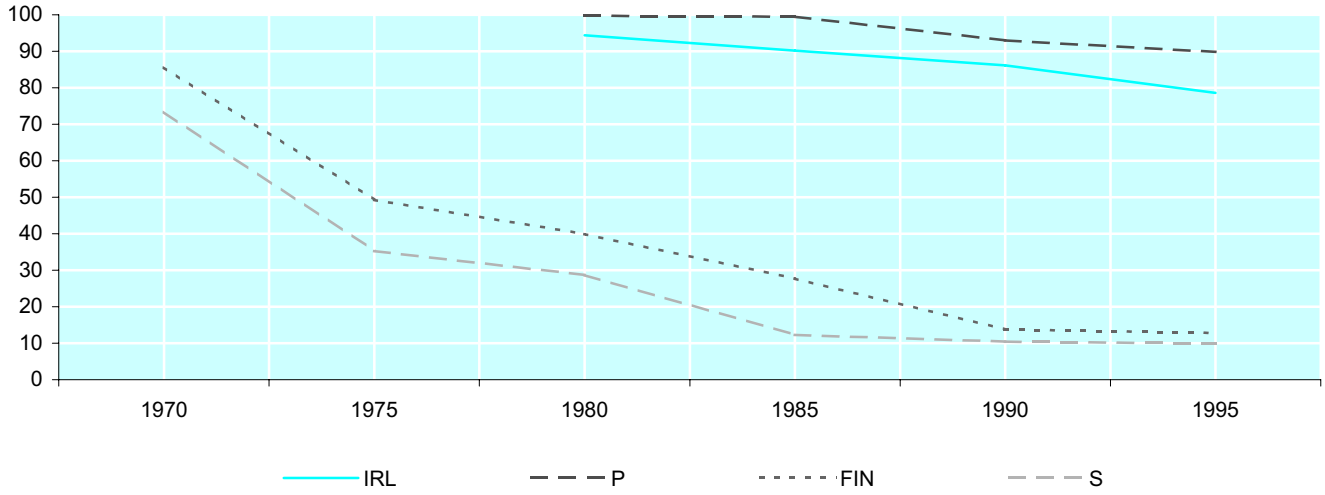
Source: Eurostat, adapted by TAU

1) 100 = no treatment is applied, 0 =all waste water receives tertiary treatment.

UP-3: Non-treated urban waste water

Relevant Sectors: Households, Industry, Services

Index of municipal waste water treatment - selected Member States [1)]



Source: Eurostat, adapted by TAU

1) 100= no treatment is applied; 0= all waste water receives tertiary treatment.

Comments

As the same weights have been used in the estimations for all Member States, the figure for those with more efficient treatment systems should be lower. In reality, efficiencies differ from one country to another, therefore the index should be used to illustrate trends in each Member State, rather than to compare countries.

The index of municipal waste water treatment in several countries shows a marked decrease since 1970 as more of the population are connected to treatment plants and more efficient treatment technologies are introduced. The overall situation shows great improvement, especially in Finland, Sweden, Germany, the Netherlands and Denmark.

ANNEXES

ANNEX 1: ABBREVIATIONS, ACRONYMS & SYMBOLS

Abbreviations, Acronyms & Symbols

-	Nil (amount close to zero)
.	Not applicable
:	No data available
¦	Break in time series (e.g. due to German reunification)
1,1,1-trichloroethane	Methyl chloroform, a chlorinated carbon
5EAP	EC Fifth Environmental Action Programme (O.J. C 138 of 17.5.93)
6EAP	EC Sixth Environmental Action Programme (COM (2001) 31 final)
a	Annum (Year)
A	Austria
AFEAS	Alternative Fluorocarbon Environmental Acceptability Study
APPE	Association of Petrochemicals Producers in Europe
As	Arsenic
As-EEQ	Arsenic Ecotoxicology Equivalent
As-TEQ	Arsenic Toxicology Equivalent
B	Belgium
BOD	Biochemical Oxygen Demand
C	Carbon
CAP	Common Agricultural Policy
CCl4	Carbon tetrachloride, a chlorinated carbon
Cd	Cadmium
CFCs	Chlorofluorocarbons
CH3Br	Methyl bromide
CH3CCl3	Methyl chloroform, a chlorinated carbon
CH4	Methane
CLC	CORINE Land Cover database
CLRTAP	UNECE Convention on Long Range Transboundary Air Pollution
CO	Carbon monoxide
CO2	Carbon dioxide
CONCAVE	Oil Companies' European Organisation
CORINAIR	CORine INventories AIR (EEA)
CORINE	CO-oRdination of INformation on the Environment (EEA)
Cr	Chromium
Cu	Copper
D	Germany
DHI	DHI Water and Environment; Hørsholm, Denmark (former name of the company: VKI)
DK	Denmark
Dobris+3	Europe's Environment: The Second Assessment (EEA 1998)
E	Spain
E*M*A*I*L	Environment Management And Information Liaison; Leiden, the Netherlands
EC	European Community
ECPA	European Crop Protection Association
EEA	European Environment Agency
EEQ	Ecotoxicity-Equivalent
EFCTC	European Fluorocarbon Producers Technical Committee
EL	Greece
EMEP	Co-operative programme for monitoring and evaluation of the long range transmission of air pollution in Europe
ETC	European Topic Centre (EEA)
ETC-W	ETC Waste
EU	European Union
EU-12	EU with 12 Member States (B, DK, D, EL, E, F, IRL, I, L, NL, A, P)
EU-15	EU with 15 Member States (EU-12 + FIN, S, A)
Eurostat	Statistical Office of the European Communities, European Commission, Luxembourg

Abbreviations, Acronyms & Symbols

EWC	European Waste Catalogue
F	France
FIN	Finland
g	Gramme
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Pollution (IMCO/FAW/UNESCO/WMO/IARA/UN/UNEP)
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
ha	Hectare
Halons	Bromofluorocarbons
HCFCs	Hydrochlorofluorocarbons
HELCOM	Helsinki Commission
HFCs	Hydrofluorocarbons
Hg	Mercury
HWL	EU Hazardous Waste List
I	Italy
ICP-Forest	UNECE International Co-operative Programme on Forests
ICZM	Integrated Coastal Zone Management
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Pollution Prevention Control
IRL	Ireland
IS	Iceland
ISWA	International Solid Waste Association
I-TEQ	International Toxic Equivalent
ITOPF	International Tanker Owners Pollution Federation
IUCLID	International Uniform Chemical Information Database
JRC	Joint Research Centre (European Commission); Ispra, Italy
kg	Kilogramme
kg oe	Kilogramme of oil equivalent
km	Kilometre
km2	Square kilometre
kt	Kilotonne
kWh	Kilowatt hour
l	Litre
L	Luxembourg
LACOAST	LAnd use in COASTal zones; a project of the JRC in Ispra, Italy
LPG	Liquified petroleum gas
LRTAP	UNECE Convention on Long-Range Transboundary Air Pollution
m3	Cubic metre
MARPOL	International Convention for the Prevention of Pollution from Ships
MBr	Methyl bromide
mg	Milligramme
Mio	Million
MOLAND	JRC project:
MP	Montreal Protocol
MWTP	Municipal waste water treatment plant
N	Nitrogen
N2O	Nitrous oxide
NACE	Nomenclature of Economic Activities in the European Union
NAI	Net annual increment
NATURA 2000	EU network of sites designated under the Birds & Habitats Directives.
NH3	Ammonia
Ni	Nickel

Abbreviations, Acronyms & Symbols

NL	Netherlands
NMVOCs	Non-methane volatile organic compounds
NO	Norway
NOx	Nitrogen oxides
NUTS	Nomenclature of Territorial Units for Statistics
ODP	Ozone Depletion Potential
ODP tonnes	ODP-weighted tonnes (metric tonnes * ODP)
oe	Oil Equivalent
OECD	Organization for Economic Co-operation and Development
Oeko-Institut	Öko Institut, Darmstadt branch; Germany
OJ	Official Journal of the European Communities (providing legal texts related to, e.g., environmental policies (Directives, Regulations, Resolutions, Decisions, etc.). Available on http://europa.eu.int/pol/env/index_en.htm. (Policies - Environment- Legislation in force or Legislation in the pipeline)
OSPAR	Oslo and Paris Commissions
PAHs	Polyaromatic hydrocarbons
Pb	Lead
PFCs	Perfluorocarbons
POPs	Persistent organic pollutants
PRODCOM	Production and consumption database and statistical nomenclature (Eurostat)
PVC	Polyvinylchloride
S	Sweden
SF6	Sulphurhexafluoride
SHYLOC	System for Hydrology using Land Observation for Model Calibration
SO2	Sulphur dioxide
SOx	Sulphur oxides
t	Tonne(s) (1000 kilogrammes)
TAU	TAU Consultora Ambiental; Madrid, Spain
TBFRA	Temperate and Boreal Forest Resources Assessment
TEQ	Toxicity-Equivalent
TNO	Netherlands Organisation for Applied Science
toe	Tonnes of oil equivalent
Tot-N	Total Nitrogen
Tot-P	Total Phosphorus
UBA	Umweltbundesamt
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
UV-B	Ultraviolet-B radiation
VOCs	Volatile organic compounds
WTO	World Trade Organization
Zn	Zinc
g-HCH	Gamma-Hexachlorocyclohexane (Lindane)
mg	Microgramme

ANNEX 2: EU-15 AND EFTA POPULATION

EU-15 and EFTA population

	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
EU-15	354 571 743	358 475 358	363 763 372	365 434 536	367 072 626	368 994 214	370 432 698	371 589 471	372 669 894	373 716 690	374 582 841	375 329 423
B	9 855 110	9 857 721	9 947 782	9 986 975	10 021 997	10 068 319	10 100 631	10 130 574	10 143 047	10 170 226	10 192 264	10 213 752
DK	5 122 065	5 111 108	5 135 409	5 146 469	5 162 126	5 180 614	5 196 642	5 215 718	5 251 027	5 275 121	5 294 860	5 313 577
D (incl. ex-GDR)	78 179 662	77 709 213	79 112 831	79 753 227	80 274 564	80 974 632	81 338 093	81 538 603	81 817 499	82 012 162	82 057 379	82 037 011
D (exc. ex-GDR)	61 439 338	61 049 256	62 679 035	63 725 653	64 484 787	65 289 234	65 739 665	66 007 213	67 643 057	67 880 084	:	:
EL	9 587 543	9 919 500	10 120 892	10 200 104	10 294 472	10 349 200	10 409 605	10 442 863	10 465 059	10 486 595	10 510 965	10 521 669
E	37 241 868	38 352 991	38 826 297	38 874 568	38 965 150	39 050 606	39 121 448	39 177 377	39 241 933	39 298 600	39 347 936	39 394 258
F	53 731 387	55 157 303	56 577 000	56 893 206	57 217 577	57 529 705	57 779 052	58 020 080	58 258 071	58 491 634	58 726 934	58 973 183
IRL	3 392 800	3 544 300	3 506 970	3 520 977	3 547 492	3 569 367	3 583 154	3 597 617	3 620 065	3 652 177	3 693 999	3 734 901
I	56 388 480	56 588 319	56 694 360	56 744 119	56 757 236	56 960 300	57 138 489	57 268 578	57 332 996	57 460 977	57 563 354	57 612 615
L	363 450	366 200	379 300	384 400	389 800	395 200	400 900	406 600	412 800	418 300	423 700	429 200
NL	14 091 014	14 453 833	14 892 574	15 010 445	15 129 150	15 239 182	15 341 553	15 424 122	15 493 889	15 567 107	15 654 192	15 760 225
A	7 545 539	7 574 364	7 689 529	7 768 944	7 867 796	7 962 003	8 015 027	8 039 865	8 054 802	8 067 812	8 075 425	8 082 819
P	9 713 570	10 008 530	9 919 690	9 877 480	9 864 890	9 869 170	9 892 160	9 912 140	9 920 760	9 934 110	9 957 270	9 979 450
FIN	4 771 292	4 893 748	4 974 383	4 998 478	5 029 002	5 054 982	5 077 912	5 098 754	5 116 826	5 132 320	5 147 349	5 159 646
S	8 303 010	8 342 621	8 527 036	8 590 630	8 644 119	8 692 013	8 745 109	8 816 381	8 837 496	8 844 499	8 847 625	8 854 322
UK	56 284 953	56 595 607	57 459 319	57 684 514	57 907 255	58 098 921	58 292 923	58 500 199	58 703 624	58 905 050	59 089 589	59 279 831
EFTA	10 635 229	10 869 027	11 189 203	11 285 421	11 405 516	11 499 380	11 588 759	11 665 036	11 731 192	11 775 077	11 817 765	:
IS	226 948	240 606	253 785	255 866	259 727	262 386	265 064	266 978	267 958	269 874	272 381	275 712
LI	25 808	26 680	28 452	29 032	29 387	29 868	30 310	30 629	30 923	31 143	31 320	:
NO	4 078 900	4 145 845	4 233 116	4 249 830	4 273 634	4 299 167	4 324 815	4 348 410	4 369 957	4 392 714	4 417 599	4 445 329
CH	6 303 573	6 455 896	6 673 850	6 750 693	6 842 768	6 907 959	6 968 570	7 019 019	7 062 354	7 081 346	7 096 465	7 123 537

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