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Towards environmental pressure indicators for the EU



8

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THEME 8
Environment and energy

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Acknowledgements

Eurostat

Within Eurostat, the persons responsible for this project were:

Jochen Jesinghaus (now at the Commission's Joint Research Centre, in Ispra, Italy), and
Rosemary Montgomery, Environment Statistics

The team behind the indicators

The international team of consultants whose work resulted in this publication was co-ordinated by:

TAU Consultora Ambiental; Madrid, Spain and
*E*M*A*I*L (Environment Management And Information Liaison); Leiden, Netherlands.*

The team further consisted of:

Oeko-Institute; Darmstadt, Germany
VKI; Hørsholm, Denmark
IIUE (the International Institute for the Urban Environment); Delft, Netherlands
IVAM Environmental Research; Amsterdam, Netherlands
Isabelle Guinomet (Consultant); Luxembourg

and overall coordination was provided by Catherine Kesy (Consultant); Luxembourg.

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It can be accessed through the Europa server (http://europa.eu.int).

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Foreword

The growing concern of European citizens for the quality of their environment is a message which comes over clearly from opinion polls and the level of media interest in environmental matters. The Community's environmental responsibilities are very substantial, both as the primary legislator for environmental protection and through the influence of its wider policies on the environment. These factors underline the need for an environmental information system which helps to measure progress towards a sustainable society.

A Communication[1] involving all the concerned Commission services, and among them Statistics and Environment General Directorates, designed a framework to address this objective. It foresaw the extension of the scope of the traditional National Accounts through the establishment of environmental accounts as well as the creation of environmental indicators to balance the usual economic indicators.

This first publication contains 60 indicators giving an overview of the pressure of human activities on our environment in ten policy fields. They cover not only the well known problems of air pollution or climate change, but also more difficult areas such as bio-diversity and dispersion of toxic substances. The document is a first attempt to provide an overview of various environmental disturbances, of interest to the European institutions, the Environment ministries, socio-economic actors (agriculture and business associations and others), NGOs and environmental data users at national and international level. These results represent a first stage of on-going work and are very dependent on data availability, which is in a state of constant improvement. Their publication should encourage all interested readers and users to comment and contribute to this process.

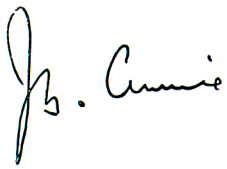
The current debate in academic and scientific circles on methods to produce synthetic indices which would allow the various pressures to be weighted and aggregated into a single index, is being followed with interest. Depending on how this debate develops, a possible further development of this work could be the aggregation of the 60 indicators into 10 indices, one for each policy field, allowing a better comparison with economic indices such as Gross Domestic Product (GDP). The GDP index, even though criticised, is so well known and accepted that it is usually considered simply as an indicator. Building up indices, which then become common indicators, is basically the dream of policy makers dealing with the environment.

This work will also provide an important contribution to the development of indicators for measuring the effectiveness of the integration of environmental concerns into different sector policies, as requested by the Cardiff and Vienna Summits. This will require the breakdown of these environmental indicators according to the main economic sectors. While this publication has not done this directly, it is clear that many of the indicators identified are significant when considering the impact of agriculture, transport, energy and other activities.

This integration process is an essential part of progress towards a more sustainable society, reflected in the Amsterdam Treaty, and taken increasingly into account in European Union actions.



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



James Currie
Director-General of DGXI
Environment, Nuclear safety and civil protection

[1] Communication from the Commission to the Council and the European Parliament on 'Directions for the EU on Environmental Indicators and Green National Accounts' (COM(94)670)

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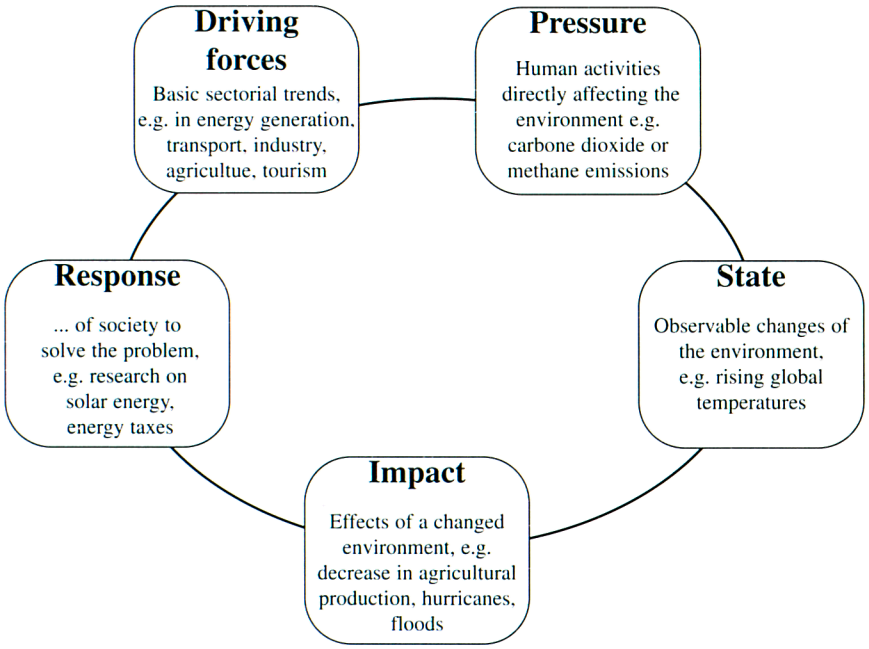
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Introduction

A European System of Environmental Pressure Indicators and Indices

The goal of this publication is to present the first results of the Environmental Pressure Indices project, which aims to give a comprehensive description of the most important human activities that have a negative impact on the environment. The project reflects the efforts undertaken by the European Commission to provide decision-makers and the general public with the information necessary for the design and monitoring of an adequate environment policy for the European Union. It is one of the main actions foreseen in the Communication from the Commission to the Council and the European Parliament on 'Directions for the EU on Environmental Indicators and Green National Accounting" (COM (94) 670 final, 21.12.94).
The concept of "pressures on the environment" is taken from the Driving force-Pressure-State-Impact-Response model (DPSIR):



After long debate among scientists and indicator experts, the DPSIR model has been adopted as the most appropriate way to structure environmental information by most Member States of the European Union and by international organisations dealing with environmental information, such as Eurostat, the European Environment Agency (EEA), and (since the early 1990s, as PSR model) by the OECD.

Within the DPSIR model, Eurostat focuses on Response (in particular, expenditure for environmental protection on the basis of the SERIEE manual), Driving forces (environmentally relevant sectoral trends e.g. in energy, transport, agriculture) and Pressure. Indicators of State and Impact are the domain of the European Environment Agency (EEA). In reality, borderlines are less clearly defined and follow practical considerations, and the EEA has provided many of the data for the current publication.
Thus Eurostat was charged with the development of a consistent and comprehensive system of environmental pressure indicators, to show the important trends for ten policy fields: *Air Pollution, Climate Change, Loss of Biodiversity, Marine Environment & Coastal Zones, Ozone Layer Depletion, Resource Depletion, Dispersion of Toxic Substances, Urban Environmental Problems, Waste, Water Pollution & Water Resources*. These policy fields are based on the "themes" of the European Community's Fifth Environmental Action Programme.
The possibility of condensing these indicators into ten indices, one for each policy field, is being explored. This will be relatively straightforward for fields such as Climate Change or Ozone Layer Depletion, but more challenging for other areas.

Identification of indicators

Eurostat's approach to identifying the most relevant indicators is unique. Instead of the usual approach of asking politicians which indicators they want for policy purposes, the decision was taken to ask the scientific and environmental community to identify the most important issues for each of the above-mentioned policy fields.

A panel of 2300 European environment experts (the Scientific Advisory Groups, SAGs), consisting mainly of senior natural scientists from all 15 EU Member States, was consulted. On the basis of the advice from the SAG surveys, which included, among others, an assessment of the policy relevance and the responsiveness of the proposed indicators, and after consultation with statisticians and indicator experts, a set of 100 quantitative indicators covering these issues was defined, i.e. 10 per policy field.

This current publication presents the first 60 indicators of this set, in the order of preference expressed by the experts in the SAGs. Approximately one third of the indicators are based on data collected by Eurostat through regular activities. Other indicators make use of data gathered and processed by other inter-national bodies, such as the European Environment Agency and its Topic Centres. The remaining indicators have been constructed by the international team of consultants for this project. Future editions may include some additional indicators, subject to data availability. However, Eurostat will focus on improving data quality and sectoral breakdown, and in particular on presenting the links between Pressure and Driving Force indicators.

Data quality and transparency

This publication presents the first 'real figures' for the indicators selected by the Scientific Advisory Groups. The indicators presented for the 15 EU countries come from various data sources, many of which have not yet been harmonised, and which use methodologies that are not always well-established. The reader should be aware that:

- the quality of the indicators varies, as does their reliability;
- some of the indicators presented here are still in the stage of development.

In order to provide guidance on the status of the indicators, a 'semaphore' coding of 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 (as formulated by the SAGs), 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).
- Comparability over time deals with the completeness of the time series and the consistency of methodology used over time.
- Comparability over space 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	Comp.Time: Green	Comp.Space: Yellow

where Green indicates no major problems with the indicator and Red means there are major reservations about this indicator.

These quality criteria serve not only to caution the reader, but also to provide a means for project transparency, describing the present state of the project (data, procedures), and forming the basis for improvement.

Over time the quality of all indicators will be improved in terms of coverage or sectoral breakdown and this should be reflected in the next edition. For some of the indicators new data sources are presently under development. In many cases this may prove to be a major leap forward. A few indicators, however, require significant data collection efforts and methodological work in the short and medium term, if they are to reflect the real pressure adequately.

A short reflection on indicators and their use

Although this report forms only a snapshot of work in progress and many improvements still need to be implemented, Eurostat hopes that the indicators presented here will open a discussion between data providers and indicator users, leading to a better compromise between the hesitation of statisticians to provide "less official" data to users not familiar with the problems behind such data, and the justified expectations of decision-makers and the public to be provided with figures supporting the democratic policy debate.

Statistics measure the real world with the highest possible reliability and sensitivity. Aggregated indicators, as presented in this report, differ from statistics as they serve different purposes (communication, macro-evaluation). In general their sensitivity need not be as high as that of statistics (but should nevertheless be as high as technically and economically feasible). As long as indicators really indicate what they are meant to indicate, they function well.

In this respect this project should serve several purposes:

· to fill in gaps of knowledge and insight.

· to provide comparisons between Member States that up to now were not possible.

· to provide the basis for further discussion and methodological developments.

· to provide added value to the results of many research projects.

The indicators presented in this report represent the state of the art, with considerable improvements lying ahead. Therefore, even if the semaphore shows a red colour once in a while, this neither impedes the present, nor the future success of this ambitious project. Information management projects often resemble an iceberg: many efforts, data sources, assumptions and other background information are hidden under the surface. Eurostat have tried hard to ensure visibility and will continue to do so in future.

Overview table of the 60 indicators presented in this publication

The indicators presented here have been selected on the basis of responses to the second survey among the Scientific Advisory Groups (SAG). The experts had been asked, inter alia, to select from the list of approx. 30 proposed indicators five indicators which they considered to be essential for describing the overall pressure in the respective policy field. The indicators are ranked in order of importance, i.e. indicators in the leftmost column (NO_x, CO_2, Protected area loss, Eutrophication, ...) have been most frequently selected by the SAG experts.

For a more detailed description of the selection process, please consult the project web site set up by the project team:

http://e-m-a-i-l.nu/tepi/

This site is maintained in close cooperation with Eurostat by the team that produced this publication and provides a general introduction to the Environmental Pressure Indices project, with background documents and many useful links to related activities e.g. in other Commission DGs and National Statistical Services.

Air Pollution	Emissions of nitrogen oxides (NO_X)	Emissions of NMVOC	Emissions of Sulphur dioxide (SO_2)	Emissions of particles	Consumption of gasoline & diesel oil by road vehs.	Primary energy consumption
Climate Change	Emissions of Carbon dioxide (CO_2)	Emissions of Methane (CH_4)	Emissions of nitrous oxide (N_2O)	Emissions of chloro-fluoro-carbons	Emissions of nitrogen oxides (NO_X)	Emissions of sulphur oxides (SO_X)
Loss of biodiversity	Protected area loss, damage and fragmentation	Wetland loss thrugh drainage	Agriculture intensity: area used for intensive..	Fragmen-tation of forest & landscapes	Clearance of natural & seminatural forest	Change in traditional land-use practice
Marine Environment and Coastal zones	Eutrophi-cation	Fishing pressure	Develop-ment along shore	Discharges of heavy metals	Oil pollution at coast & at sea	Discharges of halogenated organic compounds
Ozone Layer Depletion	Emissions of Bromo-fluoro-carbons	Emissions of chloro-fluoro-carbons	Emissions of hydro-chlorofluoro-carbons	Emissions of nitrogen oxides (NO_X)	Emissions of chlorinated carbons	Emissions of methyl bromide (CH_3Br)
Resource Depletion	Water consumption per capita	Use of energy per capita	Increase in territory permanently occupied	Nutrient balance of the soil	Electricity production from fossil fuels	Timber balance (new growth/ harvest)
Dispersion of Toxic Substances	Consumption of pesticides	Emissions of persistant organic pollutants	Consumption of toxic chemicals	Index of heavy metal emissions to water	Index of heavy metal emissions to air	Emissions of radioactive material
Urban Environmental problems	Energy consumption	Non-recycled municipal waste	Non-treated waste water	Share of private car transport	People endangered by noise emissions	Land use (Change from natural to built-up..)
Waste	Waste landfilled	Waste incinerated	Hazardous waste	Municipal waste	Waste per product	Waste recycled/ material recovered
Water pollution and water resources	Nutrient use (nitrogen & phosphorus)	Ground water abstraction	Pesticides used per hectare of agriculture area	Nitrogen used per hectare of agriculture area	Water treated/ water collected	Emissions of organic matter as BOD

A second web site is situated at the European Commission's Joint Research Centre:

http://esl.jrc.it/envind/.

This site is closely linked to the previous one, but focuses on the research aspects of the project, such as methodologies of aggregating the sixty indicators to ten Pressure Indices, linkages to economic and social indicators, and the potential to extend the current focus on pressures on the environment to "sustainability" indicators in the wider sense introduced by the United Nations Commission for Sustainable Development (UN CSD).

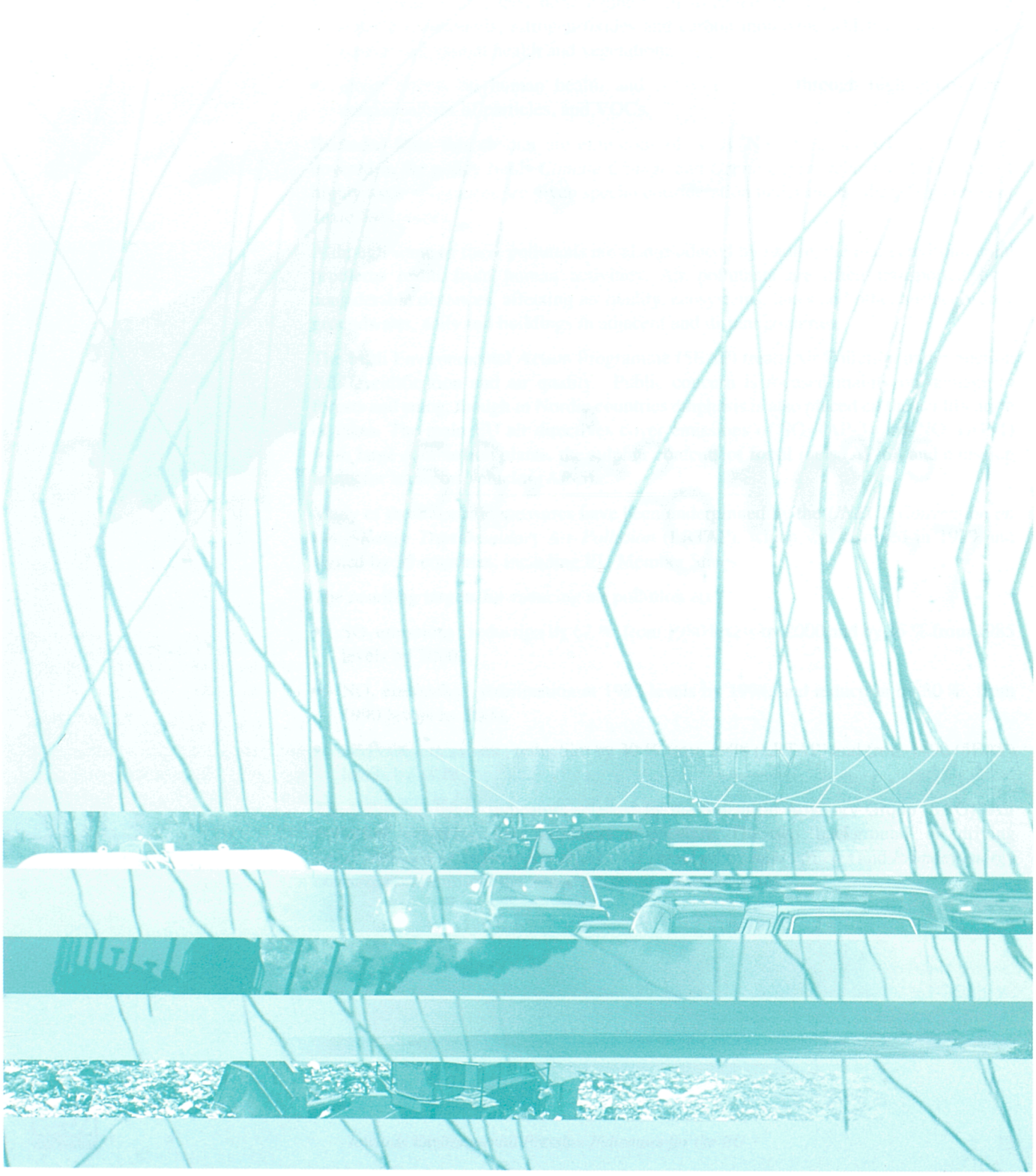
We hope that these web sites will become a forum for exchange of ideas and experiences, thus ensuring that the present publication can continuously be improved through the feedback from its users.

Call for comments and proposals

Eurostat would like to thank colleagues in other General Directorates of the European Commission, in national statistical offices and in the European Environment Agency who all provided valuable advice on how to make the best use of their data.

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 one or two of the fifteen EU Member States. Others were not yet at a stage that their results could be used in this publication but will hopefully contribute to the next edition. We may, of course, have missed a few initiatives and apologise for that. We look forward to your observations and suggestions for future development.

AIR POLLUTION



Introduction

The term 'air pollution' is used to describe substances that are artificially introduced into the air. Air pollution stems from gases and airborne particles which, in excess, are harmful to human health, buildings and ecosystems.

Four major impacts determine the classification of pollutants under the traditional policy field *Air Pollution*:

- the acidification of soil and water by pollutants such as sulphur oxides, nitrogen oxides and ammonia;
- the damage to buildings sensitive to the same acidifying substances;
- the formation of tropospheric ozone from so-called ozone precursors, e.g. volatile organic compounds, nitrogen oxides and carbon monoxide which indirectly affect human and animal health and vegetation;
- direct effects on human health and ecosystems e.g. through high atmospheric concentrations of particles, and VOCs.

Excluded from this chapter are emissions of CO_2, N_2O, CH_4 and CFCs, which are covered in the policy fields *Climate Change* and *Ozone Layer Depletion*. Emissions of highly toxic substances are given special consideration under the heading *Dispersion of Toxic Substances*.

Although some of these pollutants are also produced by nature, the main environmental problems result from human activities. Air pollutants are often transported over considerable distances, affecting air quality, ecosystems, lakes and other surface water, groundwater, soils and buildings in adjacent and distant countries.

The Fifth Environmental Action Programme (5EAP) treats Air Pollution under Section 5.2: 'Acidification and air quality'. Public concern is focused mainly on damage to forests and smog, though in Nordic countries emphasis is also placed on the acidification of lakes. 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 emission limits for transport vehicles (AP-5).

Many of these specific measures have been underpinned by the *UNECE Convention on Long-Range Transboundary Air Pollution* (LRTAP), which was adopted in 1979 and signed by 35 countries, including EU Member States.

The resulting targets for reducing air pollution are:

- SO_2 emissions : reduction by 62 % from 1980 levels by 2000 and by 35 % from 1985 levels by 2000,
- NO_x emissions : stabilization at 1987 levels by 1994, and reduction by 30 % from 1990 levels by 2000,
- NMVOC emissions : reduction by 30 % from 1988 (LRTAP) and from 1990 (5EAP) levels by 1999.

The following list of indicators selected by the Scientific Advisory Group (SAG) 'Air Pollution' comprises four indicators of pressure. The two 'background' or 'driving force' indicators *Consumption of petrol & diesel oil by road vehicles* and *Primary energy consumption* represent the major causes of these pressures.

AP-1: Emissions of nitrogen oxides (NO_x)

Definition

Nitrogen oxides (NO_x) normally include the nitrogen oxides NO and NO_2 as well as NO_2^{--} and NO_3^- ions e.g. dissolved in rain. For the sake of comparability, NO_x emissions are given here in units of NO_2.

Anthropogenic emissions of NO_x 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.

Data used for emission estimates are usually obtained through regular inspections by local authorities. When such measurements are not available, emissions can be estimated by multiplying the amount of fuel consumed with emission factors related to particular combustion processes.

Detailed methodologies (such as the EMEP/CORINAIR and IPCC) already exist for the estimation of NO_x emissions from the main human activities.

In urban areas with high traffic intensity, high ozone concentrations may be somewhat reduced by the chemical reaction of nitrogen oxide (NO) with ozone (O_3): $NO + O_3 \Rightarrow NO_2 + O_2$. Any beneficial effect of NO as an 'ozone scavenger' would be more than outweighed by the detrimental effect of NO_2 on human health and ecosystems.

NO_x emissions

kg NO_2 per capita

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 80-97 [1]
EU-15[2]	36	34	33	34	34	34	35	36	36	37	36	36	35	33	32	33	32	:	-8
B	45	:	:	:	:	33	32	34	35	36	34	34	35	34	34	34	33	:	-24
DK	53	47	52	50	53	58	62	61	59	56	55	62	53	53	52	48	55	:	5
D	43	42	41	42	43	42	42	42	41	38	34	31	28	26	25	*24*	*23*	*22*	-46
EL	23	:	:	:	:	31	:	:	:	:	34	34	34	34	35	35	36	:	75
E	25	:	:	25	:	22	22	23	23	26	30	32	32	31	:	:	:	:	29
F	34	29	28	27	27	29	29	29	29	31	32	34	32	30	30	29	28	:	:
IRL	24	25	25	24	24	24	28	32	35	36	33	34	35	34	33	32	32	:	39
I	28	:	:	:	28	28	30	31	33	36	36	37	37	35	:	:	:	:	26
L	63	:	:	60	:	60	:	:	:	:	60	:	:	63	57	49	48	:	-13
NL	41	41	39	40	40	40	41	41	41	40	39	38	37	35	33	32	31	29	-22
A	31	29	29	29	29	29	28	28	27	25	24	25	24	22	22	21	21	:	-27
P	17	:	:	19	:	:	:	:	:	:	22	23	25	24	26	37	:	:	:
FIN	62	58	56	54	53	56	56	58	59	61	58	58	56	56	55	51	52	51	-12
S	54	50	49	48	49	51	52	52	51	49	45	45	44	43	44	40	40	:	-21
UK	44	42	42	42	41	42	43	45	46	49	48	46	44	41	39	37	35	:	-16
IS[2]	60	:	91	92	91	85	92	97	100	100	103	104	109	111	110	106	110	105	:
NO	46	43	44	45	48	51	54	55	53	53	52	50	49	51	50	50	51	:	18
CH	27	27	27	27	27	28	27	27	26	25	25	24	22	21	19	19	19	18	-24

Source: Eurostat

Italics: Provisional data

1) Refers to % of change in total emissions between 1980 and 1997 or the latest year for which data are available.

2) The EU average and IS data include Eurostat estimates.

Problems

Good estimates of NO_x emissions require detailed information on the characteristics of combustion conditions, processes, the operating conditions of the engine or other combustion sources. Due to the complexity of influencing factors and to the fact that this data is often of rather poor quality, the resulting estimates are less reliable than those for SO_x emissions. In addition, the data do not always cover emissions from all mobile sources.

AP-1: Emissions of nitrogen oxides (NO_x)

Purpose

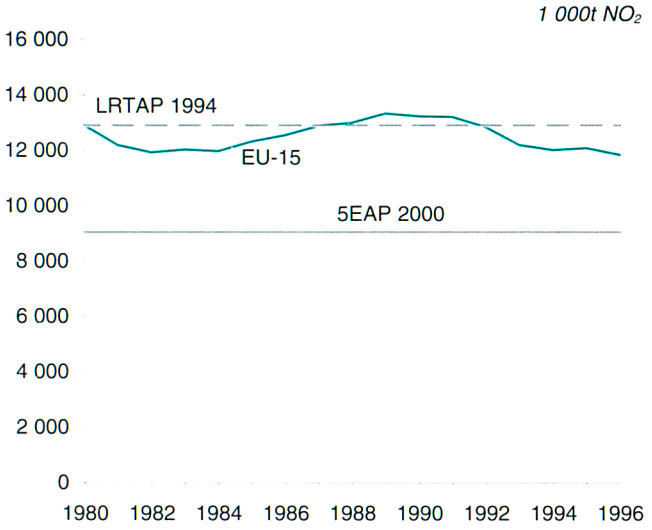
The purpose of this indicator is to track the release of nitrogen oxides into the atmosphere. Nitrogen oxide in the atmosphere can be transported over large distances and can be deposited many kilometres away from the source. These emissions are partly responsible for a series of problems, including 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 policy field *Urban Environmental Problems*.

Targets

In 1988, the Sofia Protocol of LRTAP Convention on the stabilisation of NO_x emissions to the 1987 level by 1994 was signed. At EU level, the target set by the 5EAP is for a 30 % reduction in emissions from the 1980 level.

A number of Directives target NO_x emissions, such as the Large Combustion Plant Directive (88/609/EEC) which requires NO_x emissions to be reduced by 30 % by the year 2000 compared to 1980, and other directives which concentrate on transport (70/220/EEC and 72/306/EEC).

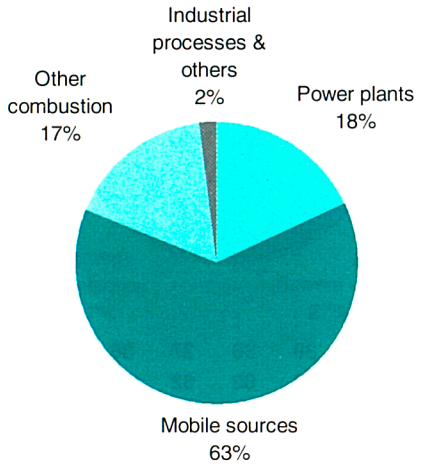
NO_x emissions trend - EU-15



Source: Eurostat

1) The EU-15 average includes Eurostat estimates

NO_x emissions by sector - EU-15 (1996)



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

The majority of anthropogenic NO_x emissions results from the combustion of fossil fuels in vehicles and machinery. Total emissions of NO_x have decreased by only 4 % since 1980, in spite of considerable efforts to introduce and improve abatement technologies for coal-fired power plants. The main obstacle to achieving the target of 30 % reduction is the strong increase in petrol and diesel fuel use for road transport (*see AP-5*). Because of the time lag involved before the existing stock of road vehicles is replaced by vehicles fitted with catalysers, the full impact of the introduction of catalysers has not yet been felt.

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

Definition

Emissions of volatile organic compounds are normally separated into methane and non-methane. Large amounts of methane (CH_4) are emitted to the atmosphere from agriculture, landfill sites and natural gas distribution networks. NMVOCs are mainly released from the use of fuels for transport and other energy purposes, and from the use of products containing organic solvents. Although the protocols of the UNECE Convention on LRTAP and the 5EAP targets aim at a reduction of emissions of all volatile organic compounds, it is now widely recognised that NMVOCs are more important ozone-precursors than methane.

The EMEP/CORINAIR and IPCC 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 collect in order to be able to apply these methodologies in full include the amounts of fuel consumed for energy purposes, as well as information on the storage and handling of fuels during transportation and distribution, and statistical data on the amount of solvent contained in a series of products (e.g. paint, dry-cleaning agents etc.).

NMVOC emissions

kg NMVOCs per capita

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 88-97 [1]
EU-15 [2]	42	42	42	42	42	42	42	43	43	43	43	40	39	38	36	35	35	:	-17
B	:	:	:	:	:	67	:	:	:	:	34	35	35	34	31	30	32	:	:
DK	25	26	27	25	28	33	33	34	34	34	31	30	29	27	28	27	26	:	-21
D	41	40	40	40	41	41	41	42	41	41	40	35	31	28	27	*24*	*23*	*22*	-44
EL	:	:	:	:	:	62	:	:	:	:	:	:	:	:	:	:	:	:	:
E	20	:	:	:	:	20	21	22	23	:	29	19	19	23	:	:	:	:	-2
F	:	:	:	:	:	:	:	:	:	:	52	51	50	47	46	44	44	:	:
IRL	23	:	:	:	:	18	:	:	:	:	56	57	56	56	49	49	49	:	:
I	:	:	:	:	:	40	41	42	43	44	44	45	46	:	:	:	:	:	7
L	30	:	:	:	:	55	:	:	:	:	52	:	:	45	47	44	43	:	:
NL	39	39	38	37	36	35	34	34	34	32	33	31	29	26	25	24	23	21	-33
A	63	62	62	62	63	63	64	65	65	63	61	57	53	51	49	49	48	:	-22
P	9	:	:	11	:	13	14	15	16	21	22	23	23	23	23	31	:	:	:
FIN	34	:	:	:	:	37	:	42	42	:	42	:	34	32	31	30	35	:	-13
S	:	:	:	:	:	:	:	:	66	:	61	:	58	:	53	51	51	:	-19
UK	43	42	43	43	44	44	45	45	46	47	46	45	43	41	40	38	36	:	-20
IS	24	:	44	43	43	43	45	49	50	50	50	55	54	52	53	45	45	38	-17
NO	43	44	45	48	51	55	59	61	58	66	71	70	77	80	82	85	84	:	51
CH	51	:	:	:	50	50	49	48	46	45	44	40	37	34	32	30	29	28	-36

Source: Eurostat

Italics: Provisional data

1) Refers to % of change in total emissions between 1988 and 1997 or the latest year for which data are available.

2) The EU-15 average includes Eurostat estimates.

Problems

Industrial processes, solvent use and fuel combustion are the main sources of NMVOC emissions, but the reliability of estimates of these emissions is generally low. This is mainly due to poor analytical statistical data on the use of solvents. In this case, Member States generally use a general 'solvent balance' (i.e. *production + imports - exports + stock change*) and default emission factors to obtain 'potential' total NMVOC emissions from the usage of solvents and other related products.

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

Purpose

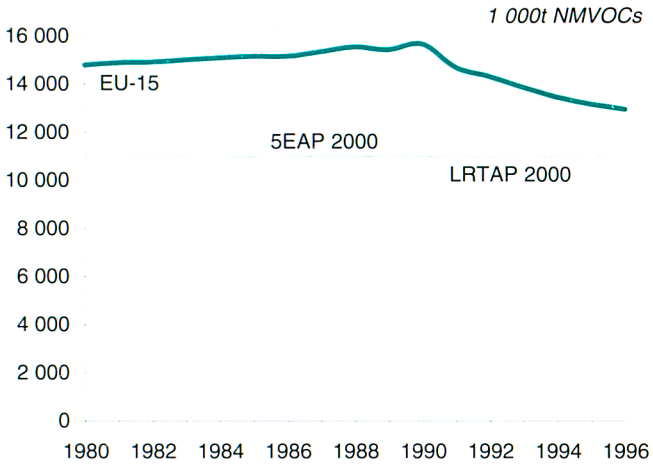
Together with nitrogen oxides, NMVOCs contribute to the formation of photo-oxidants and are thus responsible for photochemical smog, especially in summer. NMVOC emissions are directly related to the use of organic solvents, and to the production, transportation, distribution, storage and use of fossil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

Targets

The EU strategy to reduce NMVOC emissions focuses on emissions of industrial origin and from motor vehicles. According to the 1991 Geneva Protocol to the UNECE Convention on LRTAP on the reduction of VOC emissions, national VOC emissions should be reduced by at least 30 % during the period 1988-1999. The 5EAP set the same target but the reference period is 1990-2000.

The Solvent Directive (COM (96) 538 final of 18.2.1997) adopted by the Commission in November 1996 aims at a reduction of all emission sources of NMVOCs, including diffuse emissions, within a number of types of industries.

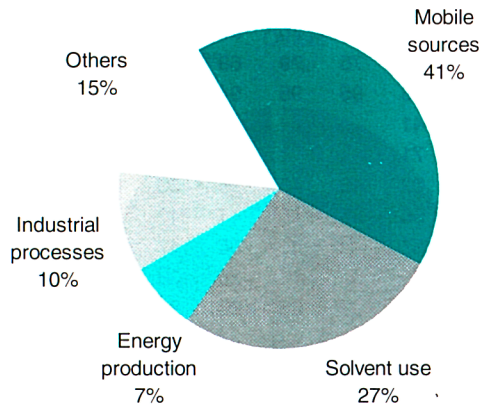
NMVOC emissions - EU-15 [1)]



Source: Eurostat

1) The EU-15 average includes Eurostat estimates.

Emissions by sector - EU[1)] (1996)



Source: Eurostat

1) Excluding Luxembourg

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

According to the figures estimated by Eurostat, total emissions of NMVOCs in the EU decreased by approximately 14 % between 1988 and 1996. Further decreases can be expected once the Solvent Directive (1996) is fully implemented.

In 1996 mobile sources, including road transport accounted for 41 % of NMVOCs emissions in the EU, followed by use of solvents (27 %) and industrial emissions (10 %).

AP-3: Emissions of sulphur dioxide (SO_2)

Definition

The main anthropogenic source of sulphur dioxide emissions is combustion of coal, lignite and oil. 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. The total amount of SO_2 emissions from transport is directly related to the amount of sulphur content of the 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.

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 outside Europe.

SO_2 emissions

kg SO_2 per capita

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 80-97 [1]
EU-15 [2]	73	64	62	62	58	55	54	53	48	48	45	41	37	34	32	30	27	:	-61%
B	84	72	70	57	51	41	38	37	36	33	32	33	31	29	25	24	24	:	-71%
DK	89	75	79	69	66	71	63	56	55	45	42	50	39	31	30	28	34	:	-61%
D	96	95	95	94	98	100	98	95	83	78	67	50	41	36	30	26	19	18	-80%
EL	41	:	:	:	:	50	:	:	:	:	50	54	54	53	51	53	52	:	36%
E	71	:	:	67	:	57	51	49	41	50	58	57	56	53	:	:	:	:	-23%
F	62	46	45	38	33	27	24	23	21	23	23	25	21	19	18	17	18	:	:
IRL	65	56	45	41	40	40	46	49	43	46	51	51	45	44	49	46	39	:	-36%
I	57	:	:	56	47	31	31	33	34	33	30	28	25	26	:	:	:	:	-54%
L	65	55	44	36	38	45	38	38	32	32	39	:	:	38	32	22	19	:	-66%
NL	35	32	28	22	20	18	18	17	17	14	14	11	11	11	10	9	9	8	-75%
A	53	46	44	33	29	26	23	21	15	13	12	11	8	7	7	7	6	:	-88%
P	27	:	:	31	:	20	23	22	21	:	29	29	35	29	26	36	:	:	:
FIN	122	111	100	77	75	78	67	67	61	49	52	39	28	24	23	19	21	20	-83%
S	61	52	45	36	36	32	32	27	27	19	16	13	12	12	11	11	11	:	-81%
UK	87	79	75	69	66	66	69	69	67	65	65	62	60	54	46	40	34	:	-59%
IS	38	78	34	35	38	31	33	29	34	33	32	28	31	33	30	30	32	31	:
NO	34	31	27	25	23	23	22	18	16	14	12	10	8	8	8	8	8	:	-76%
CH	18	17	16	14	13	12	11	10	8	8	6	6	6	5	4	5	5	5	-72%

Source: Eurostat

Italics: Provisional data

1) Refers to % of change in total emissions between 1980 and 1997 or the latest year for which data are available.

2) The EU-15 average includes Eurostat estimates.

Problems

When details of fuel sulphur content 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.

AP-3: Emissions of sulphur dioxide (SO_2)

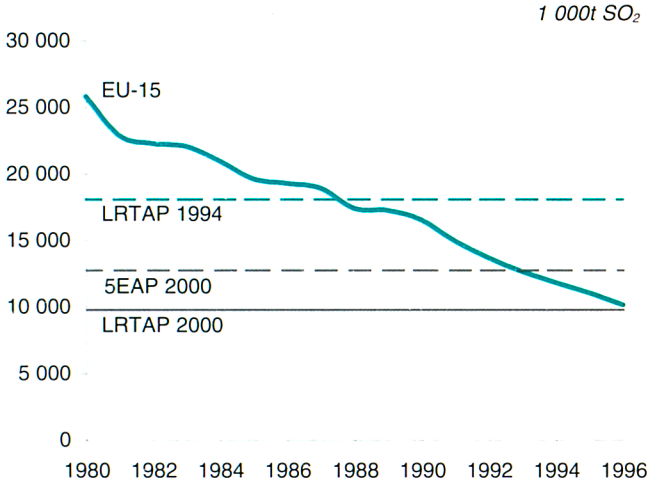
Purpose

The purpose of this indicator is to show trends in anthropogenic sulphur dioxide emissions. These arise primarily from the reaction of sulphur and oxygen during the combustion of fossil fuels. Sulphur dioxide emissions are partly responsible for acidification, and for the occurrence of winter smog episodes. SO_2 has also been found to contribute to visibility degradation due to high concentrations of aerosol sulphates in the atmosphere.

Targets

The 1985 protocol to the UNECE LRTAP convention on sulphur emissions set a target of a 30 % reduction of SO_2 emissions by 1993 compared to 1980 levels. The EU's 5EAP target for the year 2000 was set at a 35 % reduction compared to 1985. The second sulphur protocol of LRTAP, signed in 1994 and formally adopted by the EU in 1998 (Council Decision 98/686/EC), 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 62 % reduction by 2000 from the 1980 level.

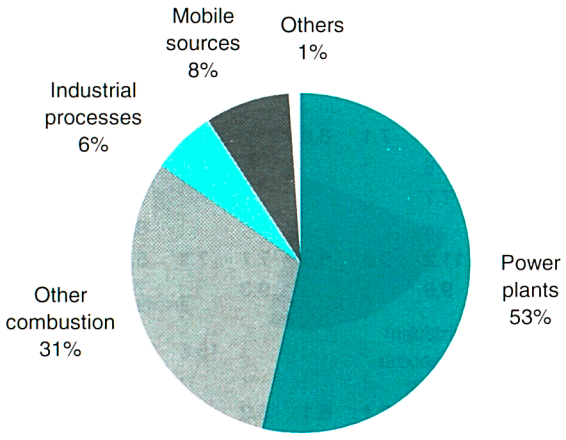
SO_2 emissions - EU-15 [1)]



Source: Eurostat

1) The EU-15 average includes Eurostat estimates.

SO_2 emissions by sector - EU-15 (1996)



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

There have been three stages of development in SO_2 emissions since 1950: a twofold increase between 1950 and 1970, a slower increase between 1970 and 1980 as a result of the first oil crisis, and since 1980, a decrease due to LRTAP Convention and European legislation reducing the sulphur content of fuels and to the introduction of flue gas desulphurisation equipment. Between 1980 and 1996 EU emissions have fallen by 61 %. Full implementation of current and proposed policies is expected to further decrease SO_x emissions in all areas by 2010.

In 1996, over half of EU emissions of SO_2 were due to combustion in energy transformation industries. Combustion in manufacturing industry and non-industrial plants represented 31 % of emissions.

AP-4: Emissions of particles

Definition

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 for energy production.

Particle emissions

kg per capita

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 80-97 [1]
EU [2]	12.0	11.8	11.4	11.2	11.4	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	33.6	32.1	32.2	33.7	34.2	33.6	33.4	32.3	31.1	25.5	14.2	9.4	7.4	6.3	*6.1*	*6.1*	*5.9*	-81%
EL	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
E	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
F	8.1	7.1	6.8	6.2	5.9	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	9.8	8.8	7.7	7.1	6.1	5.7	5.5	5.4	5.1	:	:	:	:	:	:	:	:	:
A	9.9	:	:	9.3	:	7.7	5.5	5.5	5.1	5.1	5.0	4.9	:	:	:	:	:	:	-49%
P	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
FIN	:	:	:	:	15.6	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	6.1	6.1	5.9	5.6	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	5.6	5.1	5.1	5.3	5.4	5.8	5.6	5.3	5.3	5.6	5.2	5.1	5.7	6.2	5.9	6.2	:	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

Italics: Provisional data

1) Refers to % of change in total emissions between 1980 and 1997 or the latest year for which data are available.

2) The EU average includes Eurostat estimates. DK, E, EL, P and S are excluded from the average.

Problems

Until about 10 years ago, interest was mainly in total particles and the potential soiling effect. Nowadays the focus has moved to the very fine breathable particles known as PM_{10} and $PM_{2.5}$ (particles of less than 10 or 2.5 µm in diameter, respectively) due to concerns over their probable impact on human health. Differences in national definitions and methodologies, including differences in size thresholds, mean that 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 is currently underway to improve and standardise methods to calculate this indicator.

AP-4: Emissions of particles

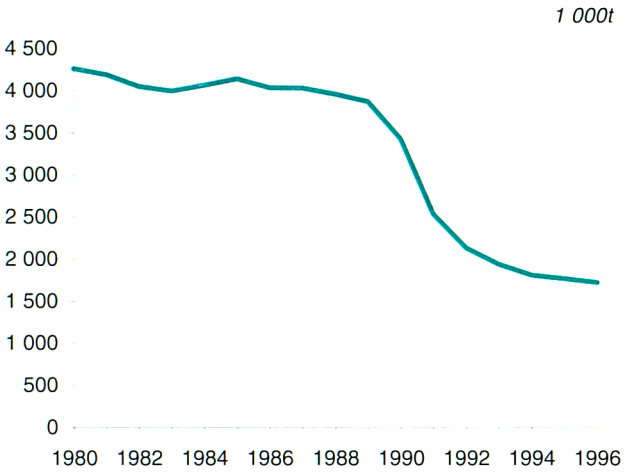
Purpose

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, the pollutants cannot dilute 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 increased 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.

Targets

No targets have been set in this field.

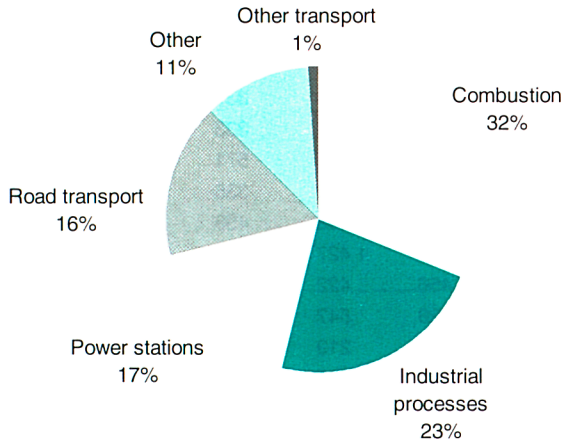
Particle emissions - selected Member States [1)]



Source: Eurostat

1) Includes Eurostat estimates. DK, E, EL, P and S are excluded.

Particle emissions by sector - selected Member States (1990) [1)]



Source: Eurostat

1) B, DK, D, E, EL and P are excluded.

Relevancy: Green	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

Emissions of particles have decreased significantly over the last two decades, mainly due to a decline of the use of coal for heating and power generation. The table opposite shows that for most of those countries which have 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. As far as the sectoral pattern of emissions is concerned, the data are currently not comparable between Member States. Even for countries having similar populations and economic development, such as Germany, France and the UK, there are serious differences due to variations in calculation methods and definitions rather than in the emissions themselves. For example in the mid 1990s, road emissions represented 11 % of the total in Germany but 26 % in the UK and 44 % in France.

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

Definition

The amount of petrol and diesel oil used directly by road transport. Data on petrol and diesel oil used for road transport are readily available. In order to make the link to air pollution these fuel quantities should be disaggregated into specific amounts for each vehicle category. This can be done by considering the composition of the vehicle fleet (categories identified by age and technology used), and specific consumption rates. Further information is also needed on driving patterns, on the mileage for the transportation of both persons and goods and on the use of catalytic converters on road vehicles. Agreed detailed methodologies (e.g. the COPERT program, part of the CORINAIR software) already exist for such a disaggregation procedure.

Petrol and diesel oil consumption by road vehicles

kg oe per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
EU-15	467	490	507	538	558	576	582	596	606	604	608	621
B	512	567	588	641	656	641	646	668	682	693	693	704
DK	534	517	533	542	577	621	620	632	642	672	678	682
D	520	548	572	590	600	635	646	654	667	653	664	656
EL	306	323	337	353	372	382	406	411	419	422	435	455
E	306	319	333	408	434	455	478	505	496	515	520	551
F	532	555	571	602	621	638	628	636	663	641	642	666
IRL	398	392	335	392	420	443	456	482	485	503	479	598
I	419	448	453	475	497	506	517	546	554	551	560	561
L	1 376	1 427	1 583	1 659	1 942	2 283	2 685	2 896	2 892	2 901	2 715	2 754
NL	456	422	432	447	467	473	472	493	504	512	526	562
A	528	547	551	587	605	617	673	663	664	657	666	665
P	206	219	240	266	284	305	331	362	381	399	414	440
FIN	592	631	673	681	721	730	706	701	686	700	687	668
S	643	685	701	737	757	712	700	724	709	732	729	722
UK	506	537	560	594	618	632	625	627	635	631	629	651

Source: Eurostat

Problems

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

To make the link to air pollution, the level of detail required for the mileage and/or the composition of the fleet is not always readily available for various categories of vehicles. In these cases the allocation of petrol and diesel oil are completed by assuming default mean values either from the literature or from studies for countries with comparable conditions.

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

Purpose

This indicator is considered as one of the main driving forces leading to pressures on the environment from transportation, which is the major source for a number of pollutants emitted into the atmosphere.

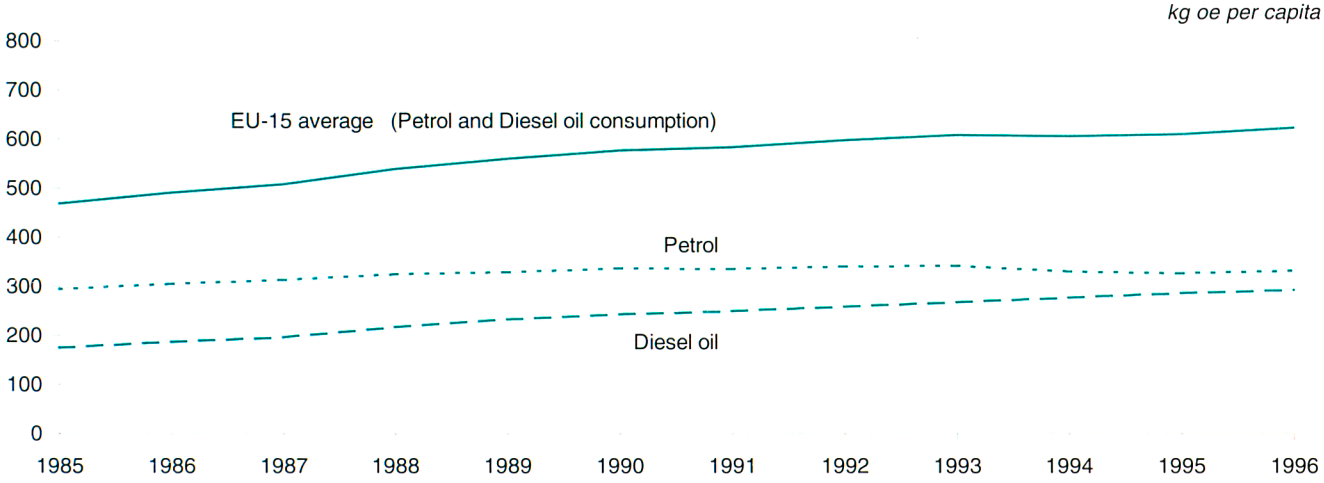
In the last few years, it has become apparent that present consumption patterns cannot be sustained. Switching to less polluting fuels is currently being promoted with the use of liquefied petroleum gas and natural gas as alternatives for buses and passenger cars.

The current rate of usage of both petrol and diesel oil by road vehicles imposes an additional demand on oil resources. Therefore, this indicator is related to indicators for the policy field *Resource Depletion* that refer to the extraction of mineral resources and their use as a fuel.

Targets

The Commission has reached environmental agreements with the automobile industry, which aim at further improving the fuel efficiency of new passenger cars as part of an overall strategy to achieve an average CO_2 emission target for new cars of 120 g/km (equivalent to a fuel consumption of 5 l/100km for petrol cars and of 4.5 l/100km for diesel cars). However, even if fuel-efficient cars gain a significant share of total sales, their positive impact on total fuel consumption could be more than offset by a rising demand for bigger cars and off-road vehicles.

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



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

The consumption of petroleum products in the EU-15 for road transport represented around 40 % of the total inland market consumption of petroleum products in 1996. Of this transport-related consumption, petrol accounted for 53 % and diesel oil for 46 %. (LPG accounted for approximately 1 % of 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 the individual EU Member States (with an average of approximately 600 kg oe per capita in 1995, depending on the country).

AP-6: Primary energy consumption

Definition

Statistics on gross inland energy consumption show the gross fuel inputs for Member States, broken down by type of fuel source. It is a key aggregate in the energy balances. It represents the quantity of energy necessary to satisfy energy demand for a given country, and is calculated as follows:

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

Gross inland energy consumption

toe per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
EU-15	3.4	3.4	3.5	3.5	3.5	3.6	3.7	3.6	3.6	3.6	3.7	3.8
B	4.4	4.6	4.6	4.6	4.7	4.7	4.9	5.0	4.8	4.9	4.9	5.3
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
D	4.4	4.4	4.4	4.4	4.3	4.4	4.3	4.2	4.1	4.1	4.1	4.3
EL	1.9	1.9	1.9	2.1	2.2	2.2	2.2	2.3	2.2	2.3	2.4	2.4
E	1.9	1.9	2.0	2.2	2.2	2.3	2.4	2.4	2.3	2.5	2.6	2.6
F	3.7	3.7	3.8	3.7	3.9	3.9	4.1	4.0	4.1	3.9	4.0	4.3
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
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
L	8.5	8.4	8.2	8.5	9.0	9.3	9.7	9.7	9.7	9.3	8.1	8.2
NL	4.2	4.4	4.5	4.4	4.4	4.5	4.6	4.6	4.6	4.6	4.7	4.9
A	3.1	3.2	3.3	3.2	3.2	3.3	3.5	3.2	3.2	3.2	3.3	3.4
P	1.2	1.3	1.4	1.5	1.7	1.7	1.8	1.9	1.9	1.9	2.0	2.0
FIN	5.5	5.7	6.1	5.7	5.9	5.7	5.8	5.6	5.8	6.0	5.7	6.0
S	5.6	5.9	5.8	5.8	5.6	5.5	5.6	5.3	5.3	5.6	5.6	5.8
UK	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.8	3.8	4.0

Source: Eurostat

Problems

No problems were encountered in preparing this indicator.

AP-6: Primary energy consumption

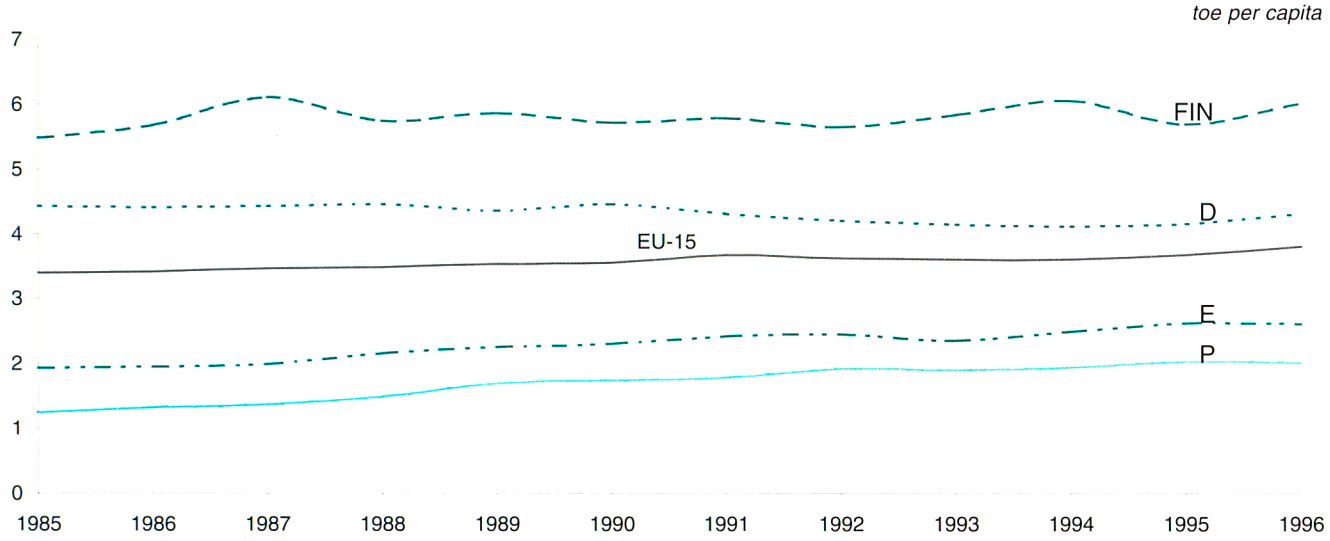
Purpose

Energy drives the economies of highly industrialised countries. However, the production and use of energy are also closely related to many pressures on the environment. The indicator 'Primary energy consumption' thus shows trends for the most important *driving force* behind the indicators selected by the expert panel for *Air Pollution*. 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 in energy consumption continues to rise at the same pace as economic growth.

Targets

No targets have been set in this field.

Primary energy consumption - EU-15



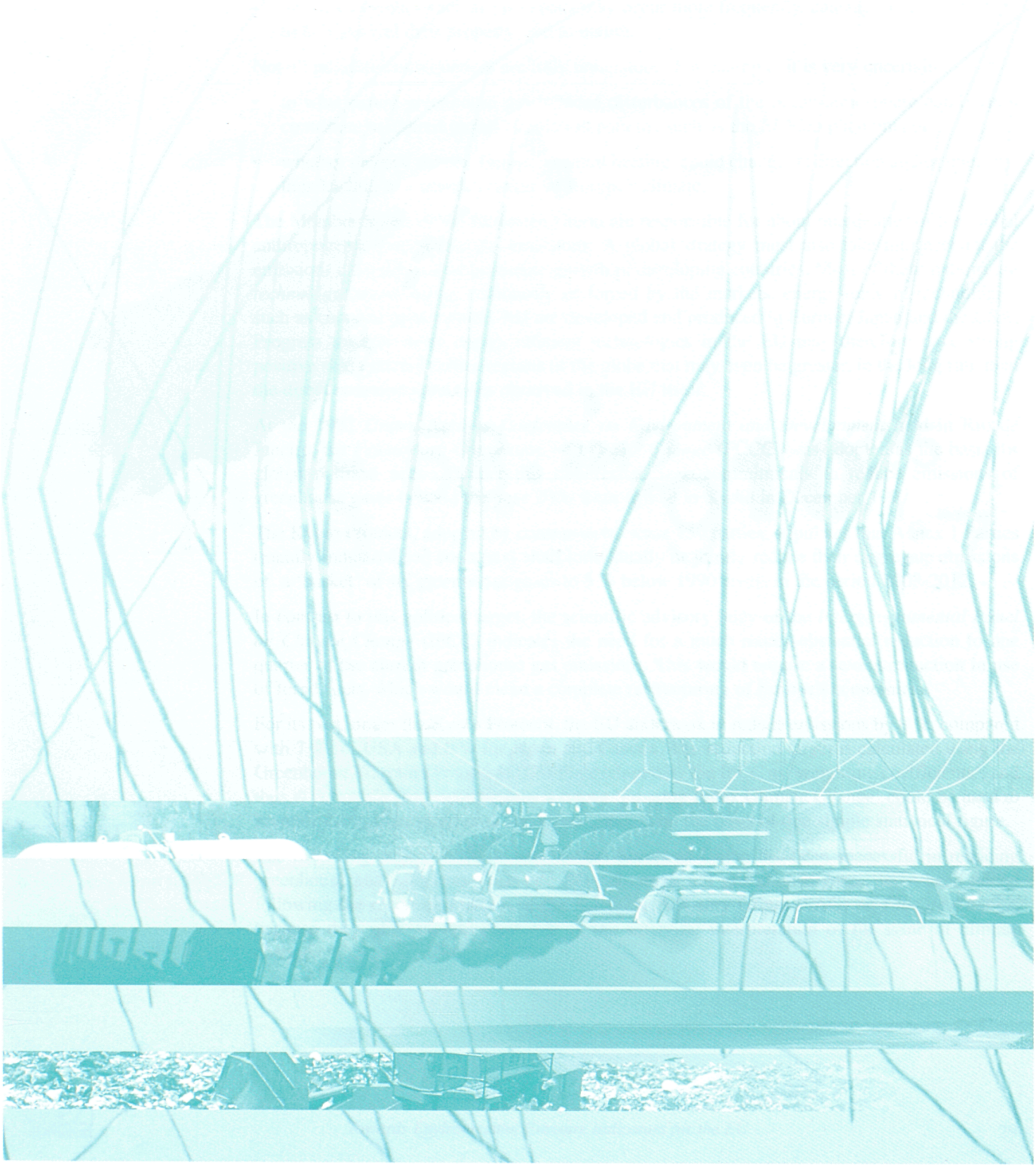
Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: 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. In the north, long winters increase the heating needs of buildings, while in the south hot summers may require air conditioning. National energy consumption per inhabitant can also be very high due to large scale production of basic chemicals, metals or pulp and paper, which consume comparatively high amounts of energy. Since 1985, the consumption trend has shown a small but steady yearly increase.

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 could not exist on Earth. Through the release of greenhouse gases such as CO_2, methane, CFCs and N_2O caused by human activities, our climate will change. How fast, and where exactly, is still controversial, but there is consensus in the scientific community that the consequences may be serious:

- the expected rise in sea levels may threaten islands and nations with low coast lines;
- changes in rainfall levels and patterns may affect natural vegetation, agriculture and forestry;
- the loss of biodiversity may be accelerated if climate zones move so fast that species (e.g. in rain forests) cannot follow them;
- weather extremes such as hurricanes may occur more frequently, causing immense damage to humans and their property, and to nature.

Not all possible consequences are fully understood. For example, it is very uncertain:

- to what extent greenhouse gas-induced disturbances of the ocean-atmosphere equilibrium contribute to altered global circulation patterns such as the *El Niño* phenomenon;
- whether the gulf stream, Europe's central heating, could change its direction and/or intensity, thus leading to a drastic *cooling* of Europe's climate;

The Member States of the European Union are responsible for about one quarter of the global anthropogenic greenhouse gas emissions. A global strategy must also take into account the emissions caused by rapid economic growth in developing countries. Most of these nations are *technology buyers* using, voluntarily or forced by the markets, energy-relevant technologies such as cars and power plants that are developed and produced in Europe, Japan and the USA. Progress towards more energy-efficient technologies in the EU may therefore have strong positive side-effects in other regions of the globe that may even be greater, in the long run, than the direct emission reductions observed in the EU itself.

At the 1992 *United Nations Conference on Environment and Development* held in Rio de Janeiro, the *Framework Convention on Climate Change* (FCCC) was adopted as the basis for global political action. Under this convention, new commitments to reduce emissions of greenhouse gases beyond the year 2000 were agreed in Kyoto in December 1997.

The Kyoto Protocol, adopted by consensus by some 150 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 in the period 2008-2012.

In contrast to this political target, the scientific advisory body of the *Intergovernmental Panel on Climate Change* (IPCC) indicates the need for a much more substantial reduction to one quarter of the current greenhouse gas emissions. This would require a severe reduction in use of fossil fuels, which would mean a complete restructuring of Europe's economies.

For its part, under the Kyoto Protocol, the EU undertook to reduce emissions by 8 %, compared with 7 % for USA and 6 % for Japan and Canada. The reduction target is calculated using the Greenhouse Warming Potentials (GWP) developed by the IPCC as 'weighting coefficients', and thus is perhaps a first example how a future 'Pressure Index Climate Change' could be used to monitor the implementation of the Kyoto process on the basis of one simple statistical figure.

The following indicators show how far the European Union has been successful in reducing greenhouse gas emissions. NO_x and SO_2, although not greenhouse gases, have been added following the recommendations of the Scientific Advisory Group (SAG) on *Climate Change*, because they play an important role in the scientific interpretation of the issue of climate change.

CC-1: Emissions of carbon dioxide (CO_2)

Definition

The main source of carbon dioxide (CO_2) emissions is fossil fuel combustion. Total anthropogenic CO_2 emissions result from the use of energy, from industrial processes, solvent and other product use, agriculture, land use change and forestry, and waste. 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, and are used by Eurostat to calculate CO_2 emissions from fossil fuel combustion.

The methodology used by Eurostat to calculate carbon dioxide emissions from fossil fuel combustion is straightforward. The amount of each fuel consumed, expressed in terajoules, is multiplied by the emission factor for the given fuel: *emission = fuel consumed X emission factor.*

The estimates for EU Member States presented here have been calculated from Eurostat's own energy balance sheets. The same set of emission factors (IPCC default factors) is used for each country and all years.

The indicator covers only emissions from fossil fuel combustion (excluding gas flaring). They do not cover emissions due to chemical conversions from industrial processes such as cement production which is another source of CO_2 emissions (approximately 5 % of all CO_2 emissions according to Corinair).

Removals of CO_2 via sinks such as afforestation, are also not taken into account in the indicator.

CO_2 emissions from fossil fuel combustion

t CO_2 per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
EU-15	8	8	8	8	8	8	9	8	8	8	8	8
B	10	10	10	10	10	11	11	11	11	11	11	12
DK	12	12	12	11	10	10	12	11	11	12	11	14
D	13	13	13	13	12	12	11	11	11	10	11	11
EL	6	6	6	7	7	7	7	7	7	7	7	8
E	5	5	5	5	5	5	6	6	5	6	6	6
F	7	6	6	6	6	6	6	6	6	6	6	6
IRL	7	8	8	8	8	9	9	9	9	9	9	10
I	6	6	6	7	7	7	7	7	7	7	7	7
L	27	27	25	26	28	28	29	28	28	27	21	21
NL	10	10	10	10	10	10	10	10	11	10	11	11
A	7	7	7	7	7	7	7	7	7	7	7	7
P	3	3	3	3	4	4	4	5	4	4	5	4
FIN	10	10	10	10	10	10	10	10	11	12	11	12
S	7	7	7	7	6	6	6	6	6	6	6	7
UK	10	10	10	10	10	10	10	10	9	9	9	9

Source: Eurostat

Problems

There are no problems for these figures, as the data are available in standardised formats and using internationally agreed methodologies. The main differences between the Eurostat approach and CORINAIR are the inclusion of non-energy related sources (representing almost 5 % of the total national emissions) and CO_2 sinks in CORINAIR. Furthermore, CORINAIR uses nationally specific emission factors, while Eurostat uses international IPCC coefficients.

Nonetheless, there is a good agreement between the combustion-related CO_2 emissions estimated with CORINAIR and those estimated by Eurostat.

CC-1: Emissions of carbon dioxide (CO_2)

Purpose

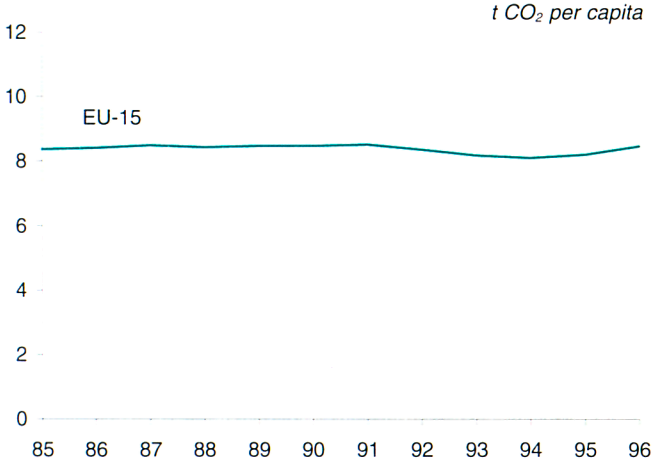
The main purpose of this indicator is to monitor total anthropogenic net emissions of CO_2, the most important greenhouse gas after water vapor. The scientific community acknowledges that atmospheric concentrations of CO_2 continue to increase and that 'the balance of evidence suggests a discernible human influence on global climate'[1]. Future climate change is expected to have major impacts on e.g. agriculture, water resources, ecosystems and human health. This indicator is linked to the indicators of other greenhouse gases, as well as to those in the area of *Ozone Layer Depletion*.

Targets

The current target of the UNFCCC for CO_2 and other greenhouse gas emissions, applicable for the industrialised countries, is to aim at returning emissions to 1990 levels in the year 2000. The European Union has adopted the target to reduce CO_2 emissions to 1990 levels by the year 2000. Additionally, the EU has agreed on an 8 % reduction in emissions of a basket of six greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) by the period 2008-2012 compared with 1990 levels (Kyoto, 1997).

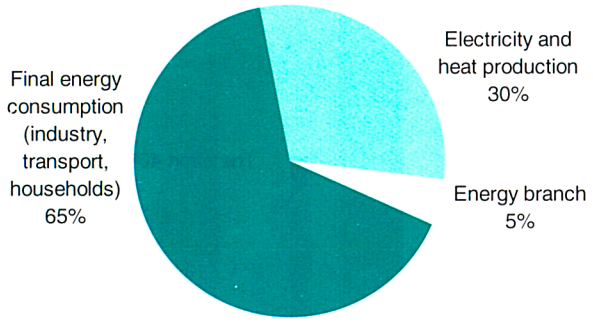
The Commission has also reached environmental agreements with the automobile industry, which plan further improvements in the fuel efficiency of new passenger cars as part of an overall strategy to achieve an average CO_2 emission target for new cars of 120 g/km (equivalent to a fuel consumption of 5 l/100km for petrol cars and of 4.5 l/100km for diesel cars).

CO_2 emissions from fossil fuel combustion- EU-15



Source: Eurostat

CO_2 emissions by sector - EU-15 (1996)



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

CO_2 emissions from fossil fuels in 1996 were 3 149 Mio tonnes for EU-15. The USA alone account for 36 % of carbon emissions among industrialised countries, and 23 % or 1.39 billion tonnes of the carbon emissions world-wide.

Before 1980, CO_2 emissions were proportional to economic growth. The energy price increase during the second oil crisis in 1979-80, however, led to a decoupling of GNP and CO_2 emissions, as a result of the introduction of more energy-efficient technologies. More recently there has been a major shift from coal to natural gas for energy purposes, with a resulting reduction in CO_2 emissions. Economic growth, and in particular the growth of the transport sector, may lead to new increases in emissions in the medium term.

1) *IPCC 1996: the Second Assessment Report of the Intergovernmental Panel on Climate Change. Summary for Policy-Makers.*

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

The global carbon cycle is a chain of large carbon flows and reservoirs. Hundreds of billions of tonnes of carbon in the form of CO_2 are absorbed by the oceans or trees (sinks) or are emitted to the atmosphere annually through natural processes.

Since the Industrial Revolution, the natural equilibrium of the carbon chain has been increasingly compromised. Atmospheric concentrations of CO_2 have risen by about 30 % from a pre-industrial level of about 280 ppmv to 358 ppmv in 1995. This growth is mainly due to fossil fuel combustion. Fossil fuels are consumed to produce electricity and in district heating plants, as well as by the final consumer, i.e. for heat and power in industry, in households and for transport.

- CO_2 emissions due to electricity and heat production

The electricity and heat production sector represents 30 % of total inland emissions of CO_2. In 1996, 98 % of this was due to thermal power stations. These emissions were 4.5 % lower than in 1990.

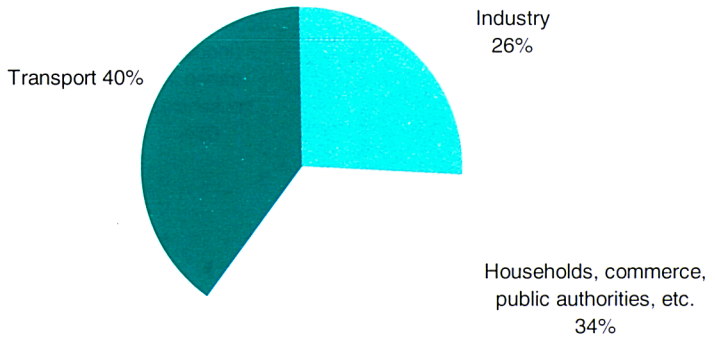
- CO_2 emissions from the energy branch

The energy branch covers energy consumed during coal and lignite mining and conditioning, oil and gas extraction, consumption by refineries, pipelines, etc. These energy related activities account for roughly 5 % of total inland emissions of CO_2 in EU-15, of which 77 % are produced through liquid fuel combustion, 15 % by natural gas and 8 % by solid fuels. Since 1990 emissions from the energy branch have increased by 12.3 %.

- CO_2 emissions due to final energy consumption

Final energy consumption represents the consumption by industry, households and for transport and accounts for 65 % of total inland emissions of CO_2 within the EU-15 (1996 figures) *(see also pie chart on previous page)*.

Breakdown by sector - EU-15 (1996)



Source: Eurostat

The transport sector accounts for about 40 % of EU-15 CO_2 emissions from final energy consumption. Virtually all of the energy consumed in this sector comes from petroleum-based products such as gasoline for automobiles and other vehicles (responsible for two thirds of these emissions), diesel fuel for the trucking industry and jet fuel for aircraft. The air transport sector has seen an increase of 24 % in its emissions since 1980, the largest increase for any sector.

The households and commercial sectors account for about 22 % of total inland emissions of CO_2 and 34 % of the emissions due to final energy consumption. The emissions are largely due to the consumption of natural gas and oil, primarily for meeting heating and cooking needs.

Industry accounts for 17 % of total inland emissions of CO_2 and 26 % of the emissions due to final energy consumption.

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

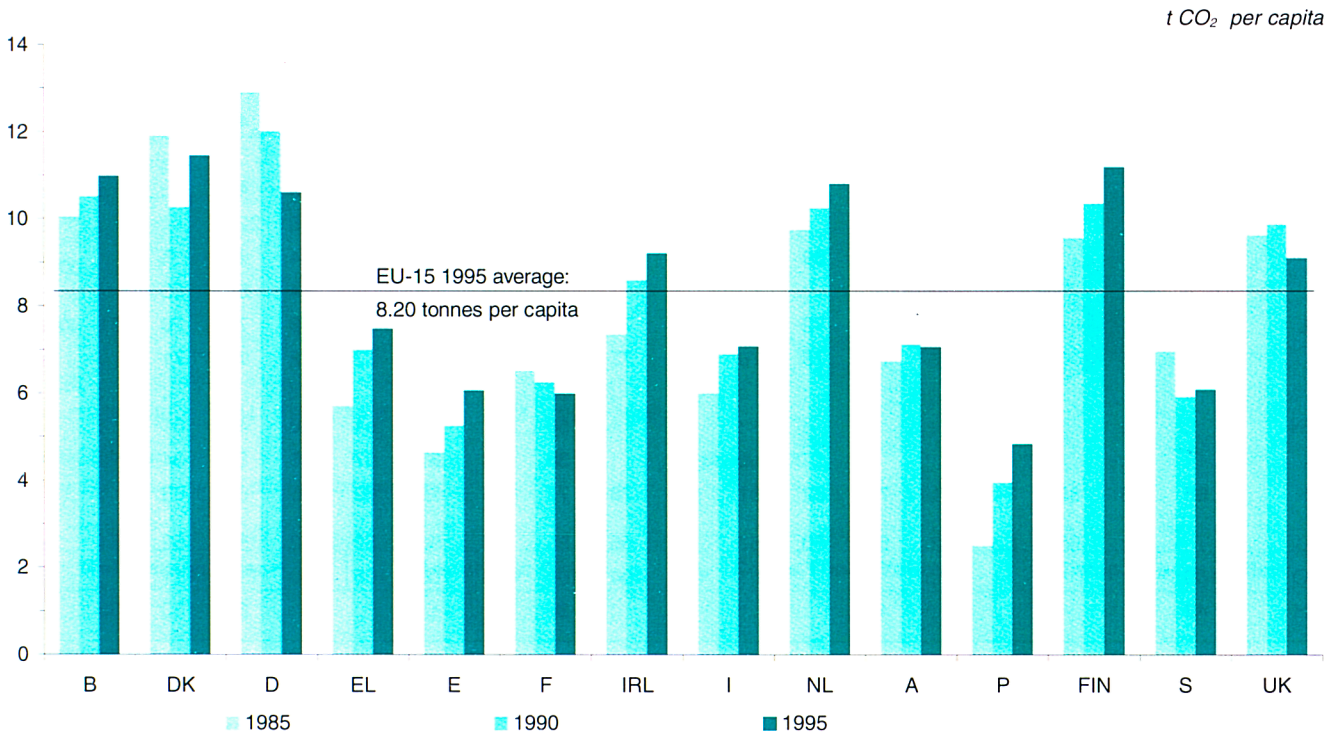
- CO_2 emissions due to fossil fuel consumption

Fossil fuels are separated in 3 types: solid fuels, liquid fuels and natural gas. The amount of carbon in fossil fuels varies significantly by fuel type. For example, coal contains the highest amount of carbon per unit of energy, natural gas has about 45 % less than coal, and petroleum has about 20 % less.

Carbon dioxide is the most significant greenhouse gas emitted, and the combustion of fossil fuels accounts for 98 % of these emissions. In 1996, EU-15 fossil fuel combustion emitted 3 149.1 million tonnes of CO_2. Total emissions due to consumption of fossil fuels increased by 2 % during 1990-96.

The continued increase in emissions related to natural gas consumption, up 39.9 % in 1996 compared to 1990, was more than offset by a reduction in emissions from solid fuels of 21.3 % during the same period. Increased consumption of liquid fuels led to an increase of 8.2 % in total inland emissions of CO_2 with an increase of 9.6 % in the households and commercial sectors and 11.9 % in the transport sector.

Emissions of CO_2 from fossil fuel combustion - EU-15



Source: Eurostat

Impacts of changes in forest management and land use on CO_2 emissions

How the Earth's land resources are managed can alter the natural balance of trace gas emissions and absorption. Land-use policies include clearance of forested areas to create cropland or pasture, restocking a logged forest, wetland loss through drainage, or allowing a pasture to revert to a grassland or forest.

Forests are an important terrestrial sink for CO_2. Because approximately half the dry weight of wood is carbon, as trees add mass to trunks, limbs, and roots, carbon is stored in relatively long-lived biomass instead of being released to the atmosphere. Soils and vegetative cover also provide potential sinks for carbon emissions.

CC-2: Emissions of methane (CH_4)

Definition

The main sources of methane (CH_4) are agriculture (mainly flooded rice paddies and livestock), waste landfill sites, coal mining and natural gas production and transportation. CH_4 is not only a direct greenhouse gas, but also a precursor of tropospheric ozone which contributes to the greenhouse effect.

The 1996 IPCC 'Guidelines for National Greenhouse Gas Inventories' have been formally adopted by the Parties to the UNFCCC as the international method of estimating emissions.

CH_4 emissions

kg per capita

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 90-97 [1]
EU-15 [2]	74	73	73	73	70	72	71	70	70	69	64	63	61	60	57	56	55	:	-12%
B	:	:	:	:	:	:	:	:	:	:	126	:	:	:	125	:	:	:	:
DK	93	94	93	92	91	89	87	85	83	83	82	83	83	86	82	82	81	:	1%
D	76	75	73	73	73	74	74	72	71	70	70	63	58	53	49	48	*44*	*43*	-36%
EL	:	:	:	:	:	:	:	:	:	:	43	43	42	42	43	43	44	:	5%
E	:	:	:	:	:	:	:	:	:	:	56	56	58	59	:	:	:	:	6%
F	:	:	:	:	:	:	:	:	:	:	52	52	50	50	49	48	:	:	-6%
IRL	:	:	:	:	:	:	:	:	:	:	231	225	226	225	225	225	:	:	0%
I	:	:	:	:	:	67	69	70	70	70	45	:	:	:	44	44	:	:	-1%
L	:	:	:	:	:	:	:	:	:	:	63	:	:	:	54	54	55	:	-4%
NL	69	61	61	70	72	81	72	71	69	70	86	87	83	80	78	76	76	71	-14%
A	75	75	75	76	77	78	78	78	78	77	76	74	72	72	72	72	71	:	-2%
P	:	:	:	:	:	:	:	:	:	:	26	:	:	:	:	:	:	:	:
FIN	:	:	:	:	:	:	:	:	:	:	50	:	51	51	50	49	51	:	4%
S	:	:	:	:	:	:	:	:	:	:	38	38	37	37	35	34	34	:	-9%
UK	86	85	85	84	71	79	82	81	79	78	77	76	75	69	65	64	63	:	-16%
IS	:	:	65	62	62	62	60	57	56	55	55	54	52	52	52	51	52	51	-2%
NO	100	:	:	:	:	:	:	103	101	104	104	104	106	105	110	113	111	:	10%
CH	49	:	:	:	:	44	:	:	:	:	36	:	:	:	:	33	33	33	-5%

Source: Eurostat

Italics: Provisional data

1) Refers to % of change in total emissions between 1990 and 1997 or the latest year for which data are available.

2) The EU-15 average includes Eurostat estimates.

Problems

Data are available in standardised formats, using internationally agreed methodologies but numerous gaps remain. However the coverage of the sources included differs from one Member State to the other. This should improve as countries apply the IPCC guidelines.

CC-2: Emissions of methane (CH_4)

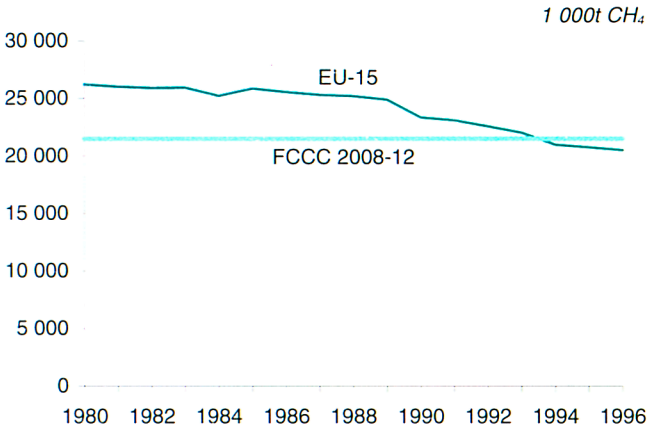
Purpose

The main purpose of this indicator is to monitor total anthropogenic methane emissions. Although bigger than those of CO_2, total CH_4 emissions are relatively small compared with total CO_2 emissions, CH_4 has a high Global Warming Potential (21 assuming a 100-year time horizon) and they are the second biggest contributor to anthropogenic *Climate Change*. Being chemically active, methane enters into complex chemical reactions in the atmosphere, influencing also the ozone levels in the troposphere and stratosphere. Methane indirect effect on global warming resulting from these chemical reactions could be comparable in magnitude to its direct effect, although considerable uncertainty remains.

Targets

The EU has agreed an 8 % reduction in emissions of a basket of 6 greenhouse gases by the period 2008-2012 compared with 1990 levels (Kyoto, 1997).

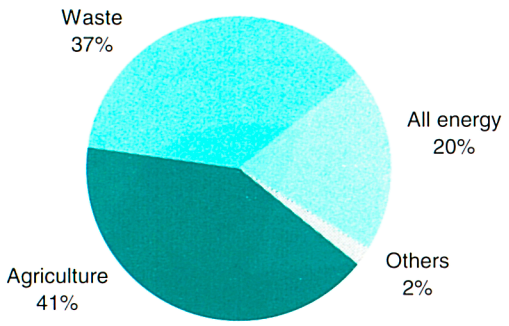
CH_4 emissions - EU-15 1)



Source: Eurostat

1) The EU-15 average includes Eurostat estimates.

CH_4 emissions by sector - EU-15 (1996)



Source: FCCC

Relevancy: Green	Accuracy: Green	Comp.Time: Yellow	Comp.Space: Yellow

Comments

Large amounts of methane are emitted to the atmosphere from agriculture (41 %), from waste (37 %) and from all energy transformation (20 %).

The table opposite shows a significant decrease in total anthropogenic methane emissions in EU-15 between 1990 and 1996. This reflects reductions in livestock numbers, as a result of the 1992 reform of the Common Agricultural Policy, and an increase in the capture of the gas from waste landfill sites, which is considered a renewable energy source. The EU's ALTENER programme aims to increase the use of landfill gas as a fuel, and therefore should lead to further reductions in emissions from this source in the future.

CC-3: Emissions of nitrous oxide (N_2O)

Definition

The main sources of anthropogenic N_2O are intensive agriculture, which uses high levels of fertilisers, 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, since they cannot normally be influenced by political measures. The 1996 IPCC 'Guidelines for National Greenhouse Gas Inventories' have been formally adopted by the Parties to the UNFCCC as the international method to estimate emissions.

N_2O emissions

kg N_2O per capita

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 90-96 [1]
EU-15	:	:	:	:	:	:	:	:	:	:	3.1	:	:	:	2.9	2.9	2.9	:	-4%
B	:	:	:	:	:	:	:	:	:	:	3.1	:	:	:	3.2	3.4	3.5	:	14%
DK	:	:	:	:	:	:	:	:	:	:	6.6	:	:	:	6.3	6.3	:	:	-3%
D	:	:	:	:	:	:	:	:	:	:	2.8	:	:	:	2.7	2.6	:	:	-7%
EL	:	:	:	:	:	:	:	:	:	:	2.9	:	:	:	2.8	2.7	2.8	:	-2%
E	:	:	:	:	:	:	:	:	:	:	2.4	:	:	:	2.2	2.2	:	:	-8%
F	:	:	:	:	:	:	:	:	:	:	3.2	:	:	:	2.9	3.0	:	:	-5%
IRL	:	:	:	:	:	:	:	:	:	:	8.4	:	:	:	7.2	7.3	7.2	:	-11%
I	:	:	:	:	:	:	:	:	:	:	2.9	:	:	:	2.8	2.8	:	:	-2%
L	:	:	:	:	:	:	:	:	:	:	:	:	:	:	1.7	1.7	1.7	:	:
NL	:	:	:	:	:	:	:	:	:	:	4.3	:	:	:	4.6	4.7	4.7	:	13%
A	:	:	:	:	:	:	:	:	:	:	1.5	:	:	:	1.6	1.6	:	:	10%
P	:	:	:	:	:	:	:	:	:	:	1.5	:	:	:	1.5	1.5	:	:	1%
FIN	:	:	:	:	:	:	:	:	:	:	3.6	:	:	:	3.5	3.5	:	:	0%
S	:	:	:	:	:	:	:	:	:	:	1.1	:	:	:	1.1	1.0	1.1	:	9%
UK	:	:	:	:	:	:	:	:	:	:	3.7	:	:	:	3.2	3.1	3.2	:	-12%
IS	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
NO	:	:	:	:	:	:	:	:	:	:	3.5	:	:	:	3.2	3.2	:	:	-7%
CH	:	:	:	:	:	:	:	:	:	:	1.7	:	:	:	1.7	1.7	:	:	3%

Source: FCCC

1) Refers to % of change in total emissions between 1990 and 1996 or the latest year for which data are available.

Problems

The uncertainty in estimates of N_2O emissions is relatively large.

CC-3: Emissions of nitrous oxide (N_2O)

Purpose

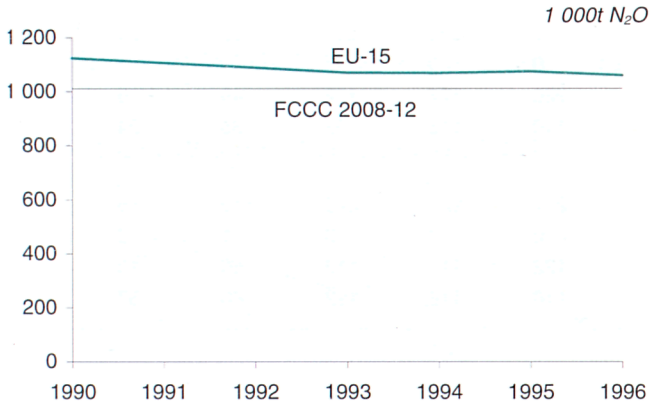
The main purpose of this indicator is to monitor total anthropogenic N_2O emissions. N_2O is one of the major greenhouse gases, and its radiative forcing capacity is high. The Global Warming Potential for N_2O is approximately 310 times bigger than that of CO_2, assuming a 100 years time horizon (IPCC second assessment report, 1996).

Nitrous oxide emissions are produced mostly by denitrification processes in anaerobic environments with a high nitrate load, such as soils and sediments in polluted waterbodies. N_2O is also released in limited quantities by the use of fossil fuels. The indicator is linked to the indicators of other greenhouse gases, as well as those in the area of *Ozone Layer Depletion*. Due to its long lifetime, N_2O can reach the stratosphere and influence the ozone layer through chemical reactions.

Targets

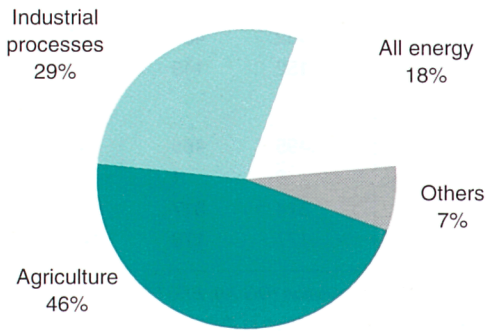
The current target for industrialised countries is to return to 1990 emission levels in the year 2000 (Towards Sustainability). Additionally, the EU agreed an 8 % reduction in emissions of the greenhouse gases by 2008-2012 compared with 1990 levels in the context of the UNFCCC (Kyoto, 1997).

N_2O emissions - EU-15 [1)]



Source: FCCC

N_2O emissions by sector - EU-15 (1996)



Source: FCCC

Relevancy: Green	Accuracy: Green	Comp.Time: Yellow	Comp.Space: Yellow

Comments

At country level no general trend for N_2O emissions can be drawn. Half of anthropogenic emissions result from agriculture, land use change and forestry (50 %), followed by industrial processes (29 %) and various contributions from combustion in energy and transformation industries (9 %), transport (6 %), industrial combustion (3 %), etc. Improvements in agricultural practices are needed to tackle the problem seriously.

CC-4: Emissions of chlorofluorocarbons (CFCs)

Definition

Statistics on chlorofluorocarbons (CFCs) are compiled and disseminated by UNEP, which provides the secretariat for the Montreal Protocol, the international agreement to control the production and use of CFCs, halons and other halogenated organic compounds which damage the ozone layer. At EU level, this data is compiled by the European Commission.

The available data refer to apparent consumption and not emissions. Apparent consumption is calculated as *production + imports - exports ± stocks change*. In practice, since real emissions or releases of CFCs are very difficult to estimate, these apparent consumption figures are often quoted instead of emission data.

CFC-11 and CFC-12 production and trade - EU

g per capita

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	EU-12	EU-12	EU-12	EU-12	EU-12	EU–12 [1)]	EU–12 [1)]	EU–12 [1)]	EU–12 [1)]	EU–15	EU–15
CFC 11											
EU production	602	622	582	483	340	336	292	234	83	24	32
EU imports	1	1	1	:	:	0	0	:	:	1	:
EU sales	452	483	443	318	247	226	177	152	49	5	6
EU exports	152	149	139	156	103	110	116	92	35	24	28
CFC 12											
EU production	495	485	441	363	271	227	228	228	119	56	53
EU imports	0	1	1	0	0	0	0	0	1	3	0
EU sales	314	317	294	208	149	122	112	113	56	10	9
EU exports	177	176	144	156	117	116	116	122	66	57	42

Source: European Commission (DG XI), EFCTC.

1) Data from producer companies in the former German Democratic Republic are included from 01.01.1991.

Problems

Statistics on CFC production and consumption for specific countries are not generally available for reasons of commercial confidentiality. CFCs are manufactured by a small number of companies, and national figures would effectively reveal the production of individual companies. However, aggregated data for the whole EU have been made available by the European Fluorocarbon Producers Technical Committee (EFCTC), and these data form the basis for the statistics published here.

In all cases, the data refer to CFCs produced and traded as such, and not to other products, such as refrigerators, containing CFCs. It should be noted that apparent consumption for a given year is not the same as emission or release, since CFCs incorporated into products will be released into the atmosphere after some delay, if appropriate waste recycling techniques are not available.

CC-4: Emissions of chlorofluorocarbons (CFCs)

Purpose

The main purpose of this indicator is to monitor total CFC emissions. Although emissions of CFCs are relatively small, they have a very large radiative forcing capacity, or Global Warming Potential. CFCs are man-made compounds used mainly in refrigerators and other cooling facilities (e.g. air conditioning). Many of the alternatives currently used, such as hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), have smaller or no effects on the ozone layer but have large Global Warming Potentials. CFCs and HCFCs absorb infrared radiation (a direct cooling effect) and also destroy ozone in the lower atmosphere, which is an indirect cooling effect since ozone is a strong greenhouse gas. However, the direct warming effects are much larger than the indirect cooling effects.

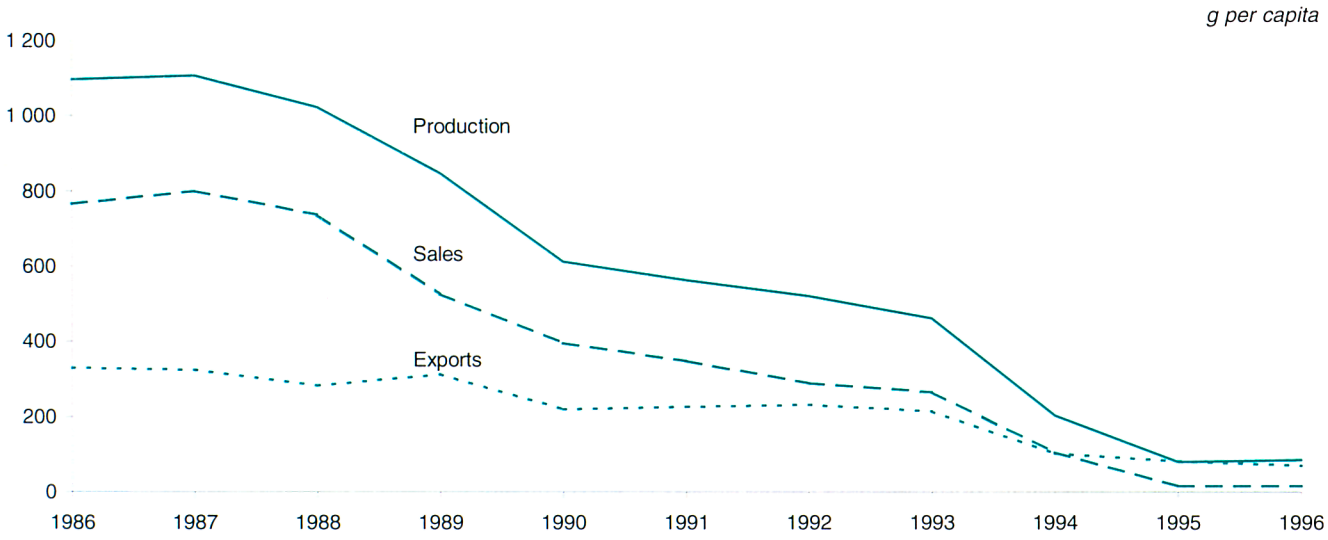
It should be noted that CFCs are not included in the United Nations Framework Convention on Climate Change, since these are covered in the Montreal Protocol (1987) and its Amendments and Adjustments (1990 London; 1992 Copenhagen; and 1995 Vienna).

Targets

In the EU, the production and supply of CFCs is regulated under EC Regulation 3093/94. This obliged Member States to phase-out production and consumption of CFCs by January 1995, although limited production for essential uses, approved by the Montreal Protocol is allowed.

Under the Montreal Protocol, developing countries may continue to produce up to 15 % of their 1986 level (Annex A substances)[2] or 1989 level (Annex B substances)[3], to satisfy their basic domestic needs. These countries must phase out CFCs by 2010.

CFC-11 and 12 production and trade - EU



Source: European Commission (DG XI), EFCTC.

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

These data show that the EU has made significant progress towards its commitment to phase out CFC consumption by 1995, due, inter alia, to the limited number of industries and applications requiring CFCs and a high level of public awareness on this issue. Production of CFCs increased rapidly until 1987, but levels of key CFCs have since fallen considerably, due to the controls introduced under the Montreal Protocol to protect the stratospheric ozone layer.

[2] CFCs included in Annex A to the Montreal Protocol include CFC-11, 12, 113, 114 and 115.
[3] CFCs included in Annex B to the Montreal Protocol include CFC-13, 111, 112 and 211 up to and including 217.

CC-5: Emissions of nitrogen oxides (NO_x)

Definition

The 1996 IPCC 'Guidelines for National Greenhouse Gas Inventories' have been formally adopted by the Parties to the UNFCCC as the international method to estimate emissions. However, countries may also apply EMEP/Corinair estimation methods.

In the chapter *Air pollution* (AP-1) a more detailed definition of this indicator is presented.

NO_x emissions

kg NO_2 per capita

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 80-97 [1]
EU-15[2]	36	34	33	34	34	34	35	36	36	37	36	36	35	33	32	33	32	:	-8%
B	45	:	:	:	:	33	32	34	35	36	34	34	35	34	34	34	33	:	-24%
DK	53	47	52	50	53	58	62	61	59	56	55	62	53	53	52	48	55	:	5%
D	43	42	41	42	43	42	42	42	41	38	34	31	28	26	25	*24*	*23*	*22*	-46%
EL	23	:	:	:	:	31	:	:	:	:	34	34	34	34	35	35	36	:	75%
E	25	:	:	25	:	22	22	23	23	26	30	32	32	31	:	:	:	:	29%
F	34	29	28	27	27	29	29	29	29	31	32	34	32	30	30	29	28	:	:
IRL	24	25	25	24	24	24	28	32	35	36	33	34	35	34	33	32	32	:	39%
I	28	:	:	:	28	28	30	31	33	36	36	37	37	35	:	:	:	:	26%
L	63	:	:	60	:	60	:	:	:	:	60	:	:	63	57	49	48	:	-13%
NL	41	41	39	40	40	40	41	41	41	40	39	38	37	35	33	32	31	29	-22%
A	31	29	29	29	29	29	28	28	27	25	24	25	24	22	22	21	21	:	-27%
P	17	:	:	19	:	:	:	:	:	:	22	23	25	24	26	37	:	:	:
FIN	62	58	56	54	53	56	56	58	59	61	58	58	56	56	55	51	52	51	-12%
S	54	50	49	48	49	51	52	52	51	49	45	45	44	43	44	40	40	:	-21%
UK	44	42	42	42	41	42	43	45	46	49	48	46	44	41	39	37	35	:	-16%
IS[2]	60	:	91	92	91	85	92	97	100	100	103	104	109	111	110	106	110	105	:
NO	46	43	44	45	48	51	54	55	53	53	52	50	49	51	50	50	51	:	18%
CH	27	27	27	27	27	28	27	27	26	25	25	24	22	21	19	19	19	18	-24%

Source: Eurostat

Italics: Provisional data

1) Refers to % of change in total emissions between 1980 and 1997 or the latest year for which data are available.

2) The EU-15 average and IS data include Eurostat estimates.

Problems

The Global Warming Potential for the indirect effects of NO_x is not yet quantified.

CC-5: Emissions of nitrogen oxides (NO_x)

Purpose

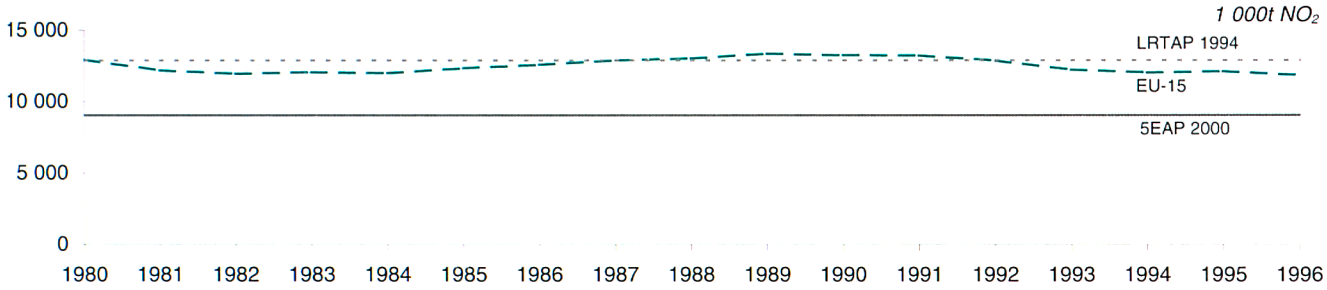
The main purpose of this indicator is to monitor total anthropogenic NO_x emissions. NO_x is not a direct greenhouse gas, but it promotes the formation of tropospheric ozone and thus contributes indirectly to radiative forcing. The quantification of the Global Warming Potential for NO_x is not yet possible (see Problems), since not all atmospheric processes are well understood. The main sources of NO_x are anthropogenic and related to the combustion of fossil fuels. Cleaner technologies can significantly reduce emissions.

Targets

In 1988, the Sofia Protocol of LRTAP Convention on the stabilisation of NO_x emissions to the 1987 level by 1994 was signed. At EU level, the target set by the 5EAP is for a 30 % reduction in emissions from the 1980 level.

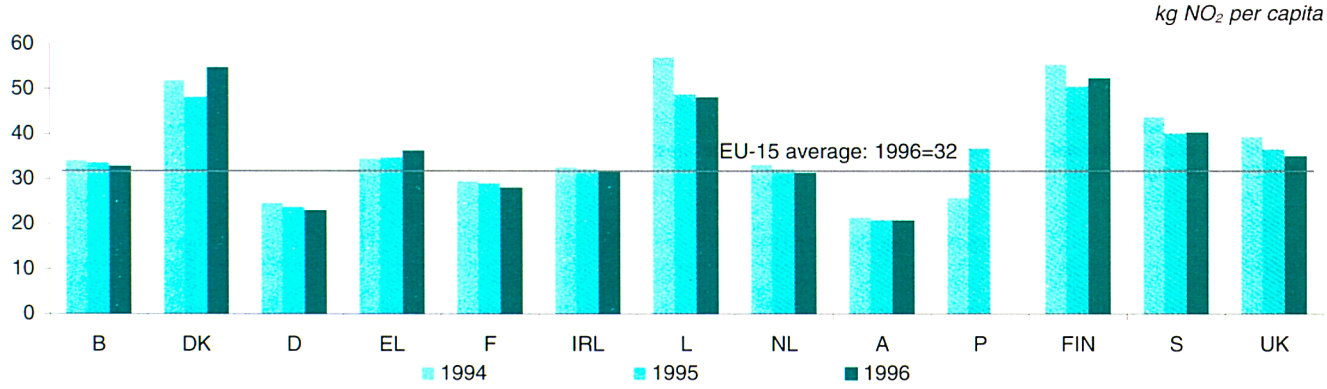
A number of Directives target NO_x emissions, such as the Large Combustion Plant Directive (88/609/EEC) which requires NO_x emissions to be reduced by 30 % by the year 2000 compared to 1980, and other directives which concentrate on transport (70/220/EEC and 72/306/EEC).

NO_x emissions - EU-15



Source: Eurostat
1) The EU-15 average includes Eurostat estimates

NO_x emissions by Member State (1994, 1995 and 1996)



Source: Eurostat
1) The EU-15 average includes Eurostat estimates

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

In 1996 the estimated EU average for NO_x emissions was 32 kg per capita, down from 36 in 1980. In absolute terms 1996 emissions are down only by 8 % on 1980, leaving much ground to be covered if the 2000 target is to be reached. Increases in emissions since 1980 are particularly important in Italy (+26 %), and Spain (+29 %), which reflects the growing prosperity and car ownership in these countries.

CC-6: Emissions of sulphur oxides (SO_x)

Definition

SO_x normally include the sulphur oxides SO_2 and SO_3 as well as SO_3^- and SO_4^- ions, sulphuric acid (H_2SO_4) and hydrogen sulphide (H_2S). Sulphur oxides are mainly emitted by fossil fuel combustion (e.g. power stations, diesel engines). SO_x emissions are the largest anthropogenic source of aerosols. Over heavily industrialised regions, aerosol cooling may counteract nearly all of the local warming effect of greenhouse gas emissions.

Eurostat does not estimate SO_x emissions but receives the data directly from Member States (measured in SO_2 units).

SO_x emissions

kg SO_2 per capita

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 80-97 [1]
EU-15 [2]	73	64	62	62	58	55	54	53	48	48	45	41	37	34	32	30	27	*:*	-61%
B	84	72	70	57	51	41	38	37	36	33	32	33	31	29	25	24	24	:	-71%
DK	89	75	79	69	66	71	63	56	55	45	42	50	39	31	30	28	34	:	-61%
D	96	95	95	94	98	100	98	95	83	78	67	50	41	36	30	*26*	*19*	*18*	-80%
EL	41	:	:	:	:	50	:	:	:	:	50	54	54	53	51	53	52	:	36%
E	71	:	:	67	:	57	51	49	41	50	58	57	56	53	:	:	:	:	-23%
F	62	46	45	38	33	27	24	23	21	23	23	25	21	19	18	17	18	:	:
IRL	65	56	45	41	40	40	46	49	43	46	51	51	45	44	49	46	39	:	-36%
I	57	:	:	56	47	31	31	33	34	33	30	28	25	26	:	:	:	:	-54%
L	65	55	44	36	38	45	38	38	32	32	39	:	:	38	32	22	19	:	-66%
NL	35	32	28	22	20	18	18	17	17	14	14	11	11	11	10	9	9	8	-75%
A	53	46	44	33	29	26	23	21	15	13	12	11	8	7	7	7	6	:	-88%
P	27	:	:	31	:	20	23	22	21	:	29	29	35	29	26	36	:	:	:
FIN	122	111	100	77	75	78	67	67	61	49	52	39	28	24	23	19	21	20	-83%
S	61	52	45	36	36	32	32	27	27	19	16	13	12	12	11	11	11	:	-81%
UK	87	79	75	69	66	66	69	69	67	65	65	62	60	54	46	40	34	:	-59%
IS	38	78	34	35	38	31	33	29	34	33	32	28	31	33	30	30	32	31	:
NO	34	31	27	25	23	23	22	18	16	14	12	10	8	8	8	8	8	:	-76%
CH	18	17	16	14	13	12	11	10	8	8	6	6	6	5	4	5	5	5	-72%

Source: Eurostat

Italics: Provisional data

1) Refers to % of change in total emissions between 1980 and 1997 or the latest year for which data are available.

2) The EU-15 average includes Eurostat estimates.

Problems

The cooling effect of aerosols varies geographically and is very difficult to quantify. Defining a weighting factor to add this indicator to the other climate change indicators will therefore be difficult. Moreover, SO_x aerosol emissions may also be included in the aggregated indicator for particles.

CC-6: Emissions of sulphur oxides (SO_x)

Purpose

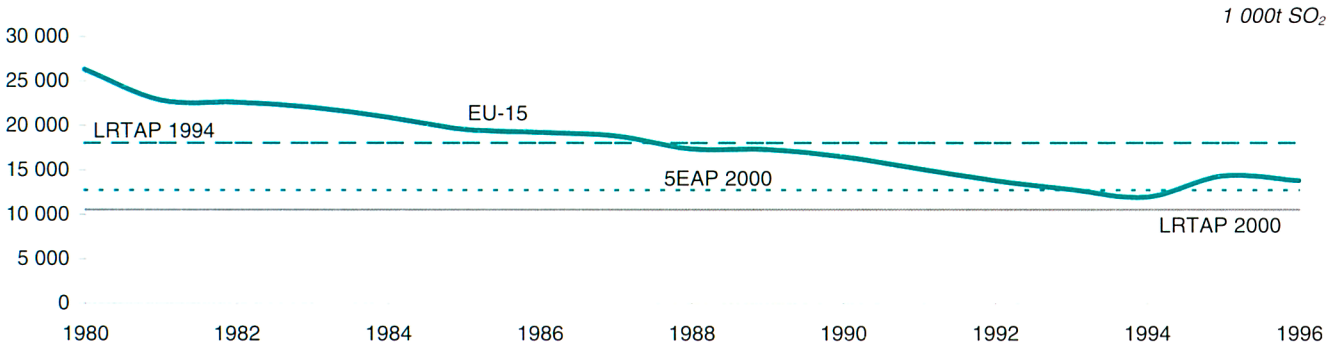
The main purpose of this indicator is to monitor total emissions of SO_x, which produce sulphate aerosols in the troposphere. These aerosols cool the climate in two ways: directly by scattering and absorbing radiation, and indirectly by providing seeds for cloud formation. Although SO_x emissions are the largest anthropogenic source of aerosols, their cooling effect cannot be used as an argument for maintaining the current level of emissions. Negative effects of SO_x emissions, such as acidification and effects on human health, justify policies to reduce SO_x emissions.

The indicator is also related to the policy fields *Air Pollution* and *Urban Environmental Problems*.

Targets

The 1985 protocol to the UNECE LRTAP convention on sulphur emissions set a target of a 30 % reduction of SO_2 emissions by 1993 compared to 1980 levels. The EU's 5EAP target for the year 2000 was set at a 35 % reduction compared to 1985. The second sulphur protocol, signed in 1994 and formally adopted by the EU in 1998 (Council Decision 98/686/EC), 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 62 % reduction by 2000 from the 1980 level.

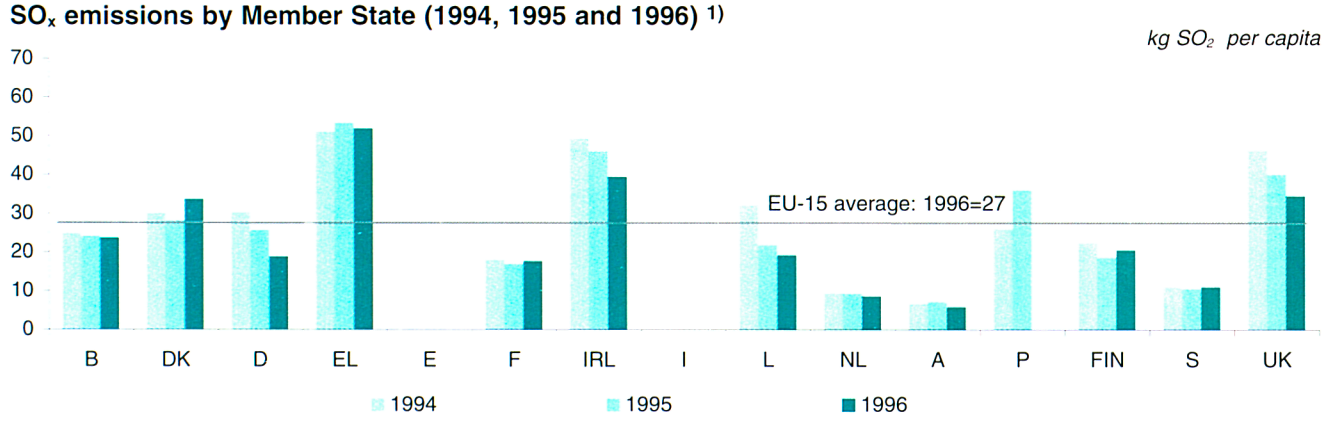
SO_x emissions - EU-15 [1)]



Source: Eurostat

1) The EU-15 average includes Eurostat estimates.

SO_x emissions by Member State (1994, 1995 and 1996) [1)]



Source: Eurostat

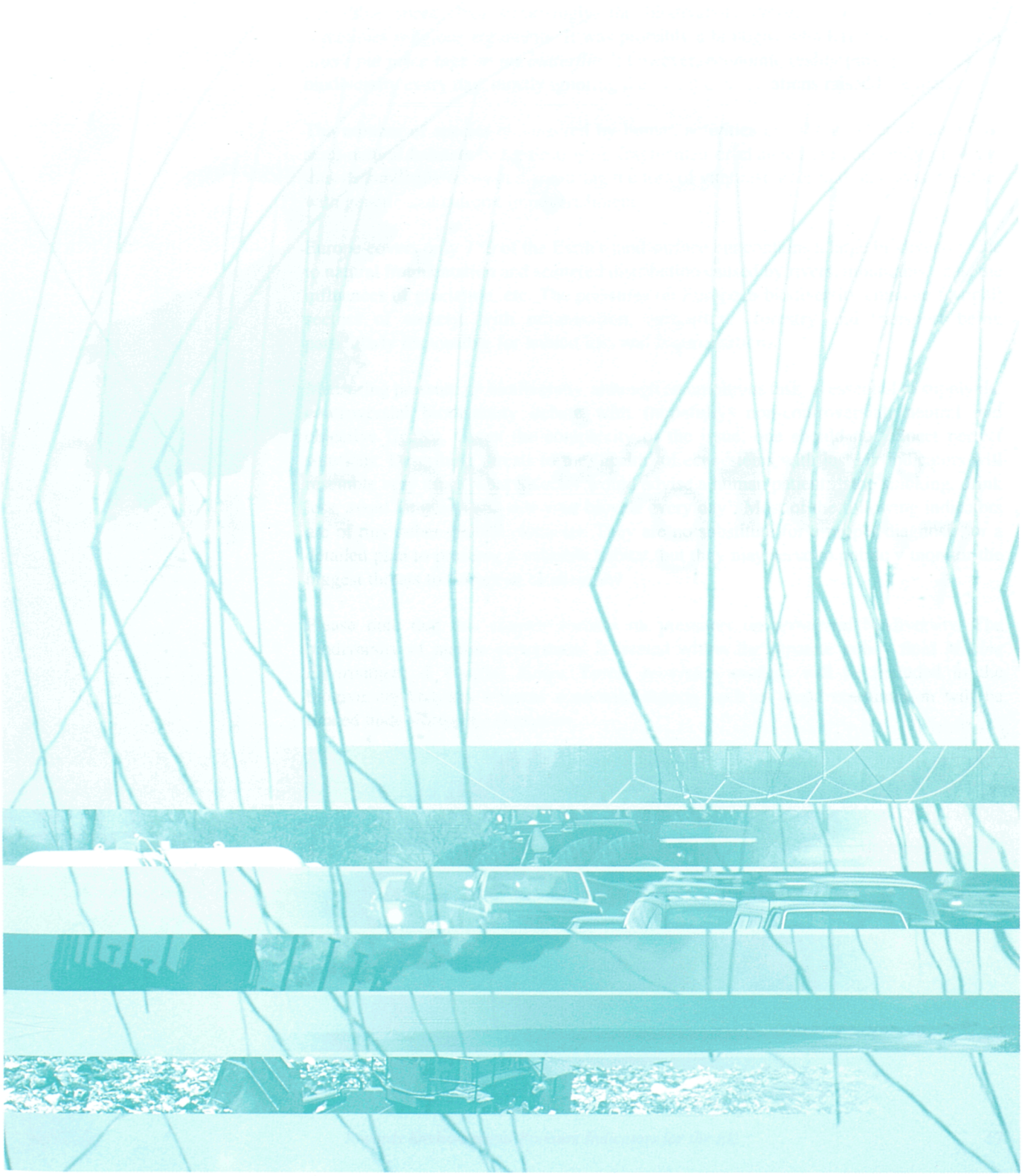
1) The EU-15 average includes Eurostat estimates.

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

Fuel combustion is the major source of SO_x emissions, therefore major fuel consumers, such as power stations and large industrial plants are among the main targets for reducing SO_x emissions. The other target is diesel fuel, the permitted sulphur content of which has been reduced considerably. The result is that overall EU emissions have been reduced by 48 % since 1980, with only Greece recording an increase in emissions over that period.

LOSS OF BIODIVERSITY



Introduction

The Global Convention on Biological Diversity, signed in 1992 at the Earth Summit, describes biodiversity as the *'variability among all living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'*.

Of the ten policy fields, *Loss of Biodiversity* is probably the most controversial. The diversity of nature is the result of an evolutionary process that started about two billion years ago. When looking, for example, at the destruction of rain forests over the last twenty years, it becomes obvious that mankind is destroying this heritage at an incredible speed. Not surprisingly, the biodiversity debate is laden with ethical, sometimes religious arguments. It was probably a biologist who has coined the saying *'don't put price tags on my butterflies'*; however, economic reality puts 'price tags' on biodiversity every day, mostly ignoring the moral considerations raised by experts.

The number of species endangered by human activities and the number of natural or semi-natural habitats being destroyed, fragmented or changed are constantly growing, thus destabilising ecosystems, causing the loss of vital resources and functions, together with genetic and cultural impoverishment.

Europe covers only 7 % of the Earth's land surface but contains a large biodiversity due to natural fragmentation and scattered distribution caused by rivers, mountains, seas, the influences of glaciation, etc. The pressures on European biodiversity emanate from all sectors of society, with urbanisation, agriculture, forestry and transport being particularly responsible for habitat loss and fragmentation.

Measuring pressure on biodiversity, although an ambitious task, is essential to supply the controversial biodiversity debate with (hopefully) non-controversial, neutral and objective figures. Given the complexity of the issue, one should not expect perfect solutions. Describing threats to the 'health' of ecosystems with just six indicators will resemble very much what a doctor would advise a human patient: 'stop smoking, drink less, avoid fat meals and ride your bicycle every day'. Most of the following indicators are of this rather general character. They are no substitute for a proper diagnosis, or a detailed plan to preserve a valuable habitat, but they may serve to publicly monitor the biggest threats to European biodiversity.

Please note that this chapter focuses on pressures on *terrestrial* biodiversity. The biodiversity of marine ecosystems is treated within the separate policy field *Marine Environment & Coastal Zones*. Forest *ecosystem* matters will be included in the biodiversity chapter, whereas economic aspects such as wood consumption will be treated under *Resource Depletion*.

LB-1: Protected area loss, damage and fragmentation

Definition

The indicator is defined as the loss, damage and fragmentation of designated protected areas (all categories) due to human activities.

This indicator represents the threats posed by habitat damage to biodiversity within protected areas. The data situation does not yet allow the full implementation of this concept. Therefore, for this first exercise, the operational definition is the percentage of designated sites potentially impacted by the Trans European Transport Network (TEN).

The proximity of major infrastructure (roads and railways) has several effects on biodiversity: it produces direct damage, such as territorial fragmentation, and indirect pressures, such as noise and emissions from increased traffic.

The designated sites have been selected because of their importance for nature conservation within the international community and the European Union. The percentage of sites near a TEN infrastructure has then been calculated; a site is considered 'impacted' or at risk, when part of it is located within 10 km or less of a TEN infrastructure.

This indicator has been calculated with data from the Strategic Environmental Assessment of the TEN (conducted by the Institut Français de l'Environnement, IFEN), which looks at the situation in 1996.

Nature conservation sites potentially impacted by the Trans-European Transport Network

% of sites impacted

	Bird Directive	Barcelona Convention	European Diploma	Biosphere Reserve	Biogenetic Reserve	World Heritage	Ramsar Convention	All types per country
EU-15	48.4	42.6	39.5	52.5	48.5	14.3	56.5	49.4
B	94.4	.	100.0	.	94.1	.	83.3	93.3
D	61.2	.	75.0	66.7	100.0	.	81.3	64.6
DK	32.4	.	.	.	.	.	33.3	32.6
EL	50.0	12.5	0.0	50.0	12.5	50.0	63.6	37.9
E	30.9	66.7	0.0	63.6	.	0.0	87.5	46.8
F	46.0	44.3	16.7	37.5	54.3	0.0	87.5	46.8
IRL	50.0	.	.	100.0	28.6	.	42.9	43.9
I	45.9	40.0	20.0	0.0	21.6	.	52.2	40.6
L	80.0	.	100.0	.	100.0	.	.	85.7
NL	60.0	.	0.0	0.0	77.8	.	60.0	64.4
A	.	.	50.0	75.0	66.7	.	85.7	68.7
P	35.3	.	0.0	100.0	30.0	.	100.0	37.5
FIN	.	.	.	0.0	.	.	18.2	16.7
S	.	.	25.0	100.0	31.7	.	43.3	36.8
UK	56.5	.	60.0	38.5	55.6	0.0	60.7	55.8

Source: SEA of the TEN (preliminary data) (adapted)

Problems

This way of aggregating data, based on a simple sum of the sites, does not reflect the degree of priority given by Member States or the quality of the sites. Only internationally designated sites have been taken into account because of a lack of data; however the most important sites are internationally designated, which mitigates this problem.

This indicator only considers threats from the transport infrastructure included in the TEN. The data should also be calculated for the rest of the transportation network and other sources of impacts should be included (energy, tourism, etc.). But the study of the TEN is the only data currently available.

There are no data for previous years that would allow a retrospective analysis.

LB-1: Protected area loss, damage and fragmentation

Purpose

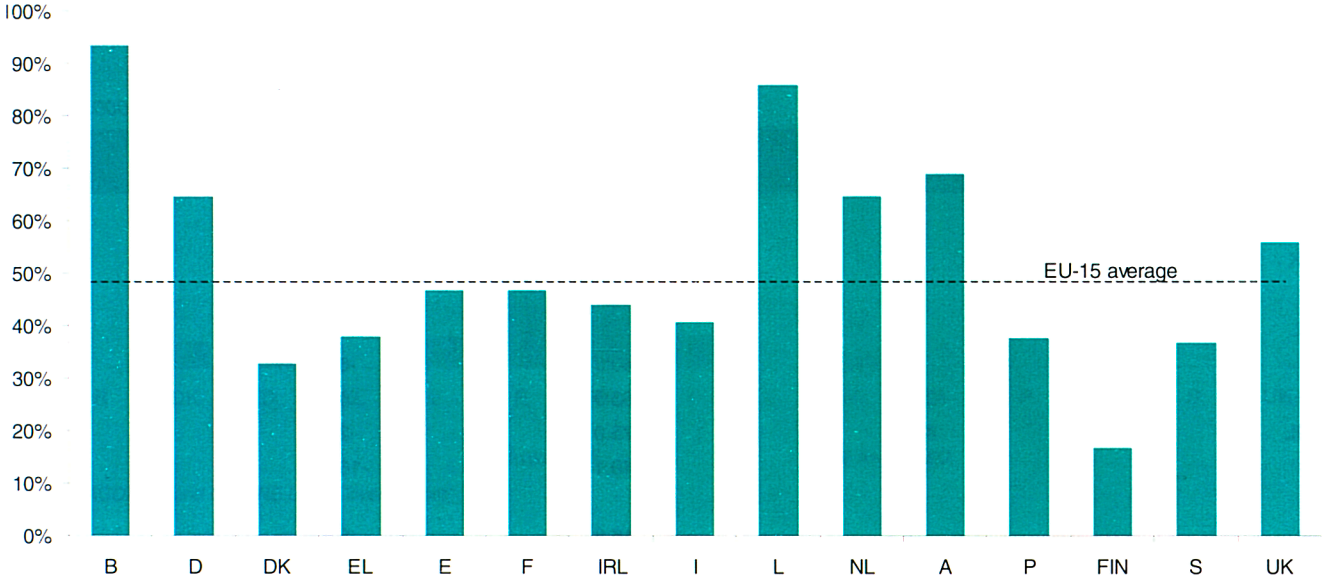
The indicator represents pressures on the integrity of biological systems, hence species and their habitats, within protected areas.

Protected areas have a high international profile (public and institutional) and therefore strong policy resonance. Protected areas do not fully reflect total biodiversity but normally do represent a significant part of it. Consequently most protected areas can be considered reservoirs of biodiversity and therefore, very sensitive areas for damage or loss from human activities.

The purpose of the indicator is to evaluate the trends observed in the loss of integrity of protected areas from those activities. The Trans European Transport Network is considered in this first exercise.

Nature conservation sites potentially impacted by the Trans-European Transport Network

% of sites impacted



Source: SEA of the TEN (preliminary data, adapted)

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Red	Comp.Space: Green

Comments

The density of the TEN is related to the population distribution and other mobility criteria in the EU. This density increases in a concentric manner towards central areas in the EU (principally Belgium, the Netherlands, Luxembourg, western Germany and northern France), where the relative accessibility of the TEN is highest. The accessibility levels are lower in the Scandinavian regions, the southern Mediterranean countries and northern Scotland.

The correlation between the number of impacted sites and the TEN density is obvious. The proposed development of the TEN by 2010 is expected to lead to a significant increase in the number of impacted sites (approximately 14 % according to estimations from the SEA of the TEN).

LB-2: Wetland loss through drainage

Definition

The indicator is defined as the loss of wetland area and is expressed as the percentage of wetland area lost with reference to an appropriate baseline year. According to the International Ramsar Convention for Wetlands Protection (1971), the term wetlands covers: '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.'

The only available data for two distinct points in time are data from the LACOAST project of the European Commission's Joint Research Centre (JRC) in Ispra, Italy. The LACOAST project is an analysis of land use changes within the coastal zone based on satellite images. These results are therefore *not* valid for non-coastal areas, although they constitute a useful sample of coastal wetlands.

Alternatively, data on the total extent of territorial wetlands are available for the majority of Member States (those with completed CORINE Land Cover (CLC) projects), but only for one point in time. Some data are also included in Europe's Environment: The Second Assessment.

Wetland loss in coastal zones [1)]

1 000 hectares

	Area 1975	Area 1990	% of Change 1975-1990	CLC
B				9.7
DK	34.9	34.5	-1.4%	600.9
D	52.4	50.0	-4.7%	195.2
EL	:	:	:	38.8
E	43.5	40.5	-6.8%	97.6
F	265.6	263.9	-0.6%	196.0
IRL	488.2	475.0	-2.7%	1 000.7
I	47.9	40.1	-16.3%	59.5
L	.	.	.	:
NL	18.4	16.8	-8.5%	34.0
A	.	.	.	15.1
P	:	:	:	13.2
FIN	:	:	:	:
S	:	:	:	:
UK	:	:	:	:

Source: LACOAST and CORINE Land Cover project

1) The last column, CLC, covers all wetlands (i.e. not only coastal zones); the actual year of the CLC data varies by country since some parts of the data base are older than others (1989-97).

Problems

Data to calculate this indicator completely are not available, because an inventory of European wetlands does not currently exist, and nor are there interpreted satellite images for the land area of the Member States of the EU that can provide complete data on wetland loss. The two data sets presented here have different methodologies and are not compatible. Problems with calculations of wetland loss 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 many wetlands have periods of retraction or even disappearance during naturally occurring dry climatic conditions. In addition, the use of satellite images can itself present problems such as concerns over resolution and accurate measurements of small wetlands (the CLC does not incorporate units of less than 25 hectares). The JRC in Ispra is developing the SHYLOC project (System for Hydrology using Land Observation for Model Calibration) under the Environment and Climate Programme. This project will develop a software package to determine the amount of surface water stored in designated sites, using satellite images and digitised stream positions. These types of models could be used to improve the indicator in the future, depending on their availability for particular areas.

LB-2: Wetland loss through drainage

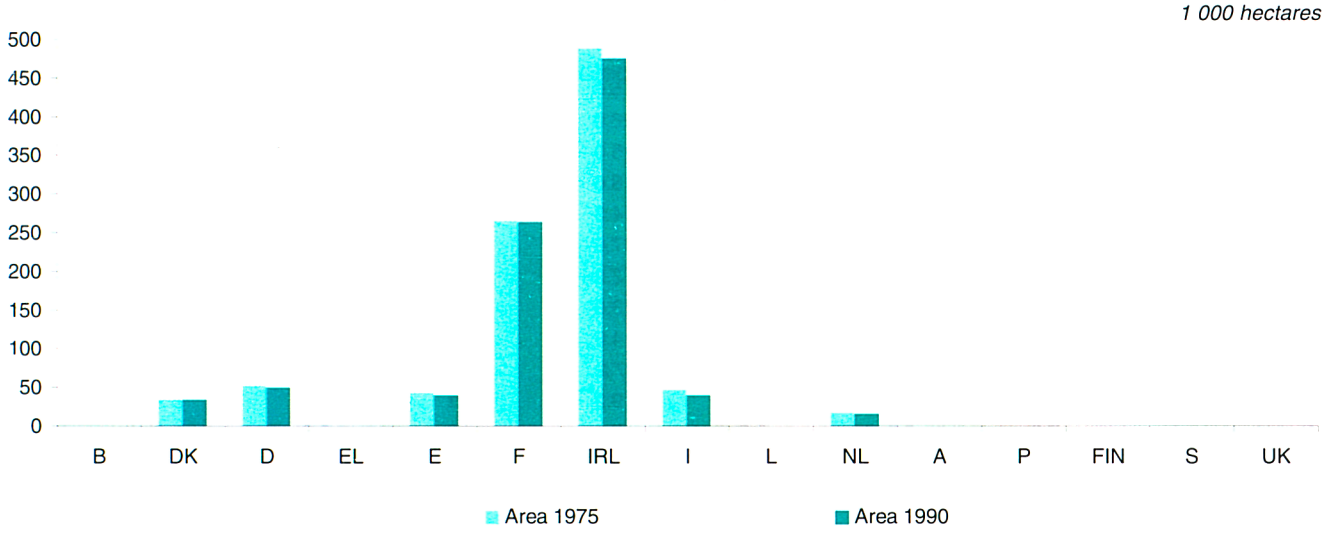
Purpose

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 is now recognised.

Targets

Sustainable use of resources (Agenda 21, 5EAP, Ramsar Convention 1971) and no further wetland loss or degradation and an improvement/restoration programme (key points in the 'wise use and conservation of wetlands' Communication, COM(95) 189 final).

Wetland loss in coastal areas



Source: LACOAST and CORINE Land Cover project

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: green

Comments

The concentration of great natural variety in existing wetlands makes these habitats priorities for protection, especially given the evidence of the progressive loss and degradation of many of them. The graph above shows a general loss in wetland areas in countries with available data. The interpretation of these losses must be carried out with caution because of the problems in the estimation of wetland area, mentioned under *Problems*.

There are cases of 'desk-based' estimates of losses, intended to be illustrative only; for example, a loss of 60-65 % has been estimated for Finland occurring primarily since the 1960s and a 57 % loss excluding marshes for Germany during the same period. Equally alarming estimates have been made for the Netherlands (55 % between 1950 and 1985) and France (annual losses rising from 9 000 hectares to over 120 000 by the early 1980s). The most common causes of these losses are drainage, agriculture, conversion to forestry, artificial regulation, severe pollution and over-exploitation of aquifers.

Wetland loss can be estimated as loss of surface and also loss of quality (for example, the recent ecological disaster in the Doñana wetlands of Spain). The lack of reliable, complete and systematic statistics for wetlands on a European scale limits the current and future possibilities for evaluating losses.

LB-3: Agriculture intensity: area used for intensive arable agriculture

Definition

The indicator is defined as the area used for intensive arable agriculture. The reference data for the indicator were extracted from agricultural production statistics. Some intensive crops have been selected: common wheat and spelt, barley, corn, rice, dry pea, potatoes, sugar-beet, forage-beet, colza, sunflower, soya, flax, forage corn and fresh vegetables. It is considered that not all the area devoted to these crops is exploited intensively and a correction factor has been introduced based on the data of the Community survey of agricultural holdings. The area of intensive agriculture is presented as a percentage of the total area of the country.

Area used for intensive arable agriculture [1)]

% of total area

	1990	1991	1992	1993	1994	1995	1996	1997
EU-15	12.0	11.8	11.7	10.8	10.7	10.8	11.0	11.1
B	16.1	16.2	16.5	15.6	15.5	16.1	16.5	*14.9*
DK	32.0	31.9	*30.3*	26.0	*24.4*	*24.0*	24.3	*23.6*
D	15.8	15.4	15.8	15.0	15.0	15.0	15.2	15.4
EL	9.6	9.6	9.2	8.6	8.5	8.2	8.5	8.6
E	14.5	14.4	14.6	14.3	13.1	12.9	13.0	12.8
F	19.7	19.6	19.1	17.0	17.3	17.8	18.1	18.6
IRL	3.1	3.1	3.1	2.9	2.9	2.8	3.0	3.1
I	15.0	14.4	13.7	13.0	13.5	13.8	14.3	14.2
L	4.9	5.3	5.2	4.8	5.0	5.7	5.7	5.8
NL	18.2	17.9	*18.2*	*17.2*	*17.8*	*17.8*	*18.1*	*18.1*
A	9.5	9.4	9.6	9.2	9.1	8.0	8.2	8.3
P	7.3	6.8	5.9	5.4	5.9	5.6	5.6	5.5
FIN	1.6	1.6	1.4	1.3	1.4	1.5	1.5	1.5
S	1.7	1.5	1.5	1.5	1.4	1.3	1.4	1.4
UK	14.9	14.9	15.1	13.3	13.3	13.6	14.1	14.7

Source: Eurostat

1) Data in italics exclude vegetables

Problems

As there is no specific definition of intensive agriculture, a selection of crops that are considered to be cultivated intensively has been made. This selection is always subject to discussion based on the diverse agronomic, economic and environmental criteria.

The Community survey on the structure of agricultural holdings is not carried out every year. The results of 1990 were applied to the 1990, 1991 and 1992 surfaces. The results of 1993 were applied to the 1993, 1994, 1995 surfaces, and because the results for 1995 were not available at the time of extraction, the 1993 results were also taken for 1996 and 1997. For fresh vegetables, some data are missing and estimations were carried out as far as possible. In other cases, calculations were carried out without taking fresh vegetables into account.

LB-3: Agriculture intensity: area used for intensive arable agriculture

Purpose

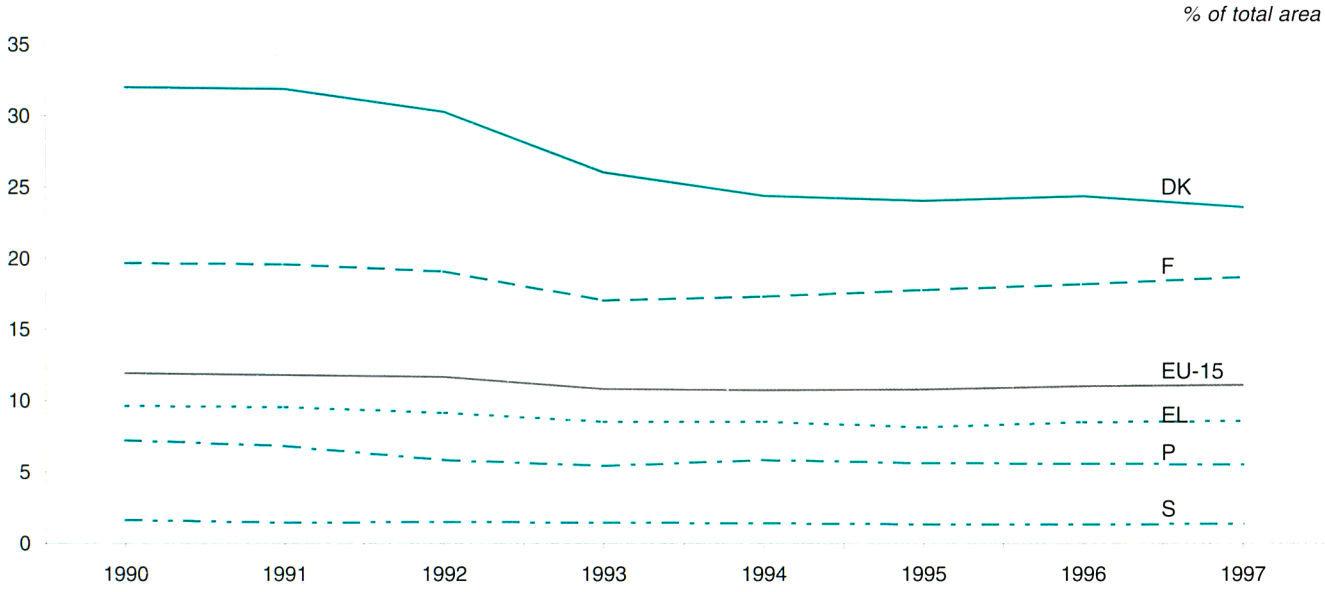
Agenda 21, Chapter 15 states that 'farmers' fields are of great importance as repositories of biological diversity'. Agricultural practices are recognised as having a direct impact on the maintenance or loss of biodiversity.

This indicator is a proxy for an aggregation of all pressures on biodiversity resulting from intensive agricultural practices, use of available genetic resources, use of pesticides, use of fertilisers, grazing intensity, loss of corridor landscape elements, etc.

Targets

The 5EAP aims at encouraging rural environmental management objectives permitting the maintenance of biodiversity and natural habitats (target 15 % of agricultural area under management contracts) and also promotes zonal programmes for the support of environmentally-friendly agricultural practices.

Area used for intensive arable agriculture - selected Member States



Source: Eurostat

Relevancy: Green	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Green

Comments

The effect of the 1992 CAP reform can be seen in the reduction in intensive agriculture which took place in many countries in 1993, mainly due to set-aside. However in some countries this effect appears to have been shortlived.

The situation in Sweden and Finland is identical: 3 % or less of the total land area is used for intensive agriculture. Denmark, Netherlands, Germany, Belgium, United Kingdom, Italy and Spain are above the EU average (11 %) for intensive agricultural area.

LB-4: Fragmentation of forests & landscapes by roads/intersections

Definition

This aggregated indicator includes forest and landscape fragmentation by roads, railways, communication networks, urbanisation and other development, etc. The available data limits the indicator calculation to the number of land units per Member State delineated by the (existing and planned) Trans European Transport Network (TEN) and larger than 1000 km^2. This corresponds to the concept of partitioning used in the Strategic Environmental Assessment (SEA) of the TEN conducted by IFEN.

A land unit is defined in the SEA as the 'contiguous part of land, completely enclosed by fenced transport infrastructure, water or frontiers of the EU.'

The impact of fragmentation on the biological integrity of any given forest or other ecosystem will depend on the size of the remaining blocks. A land unit as defined above takes this aspect fully into account.

Fragmentation reduces the size of these contiguous land units, while increasing the number of (smaller) units. The indicator therefore measures the area covered by blocks of land units, ranked according to size. For example, the 50 largest land units covered 55 % of the EU in 1996, and the 100 largest units covered 70 %. In the future the indicator should be disaggregated to measure the fragmentation caused by each sector (agriculture/forestry, transport etc.).

Total area covered by number of land units

% of total area

	Number of land units	50 [1)]	100	200	300	400	500	600
Present TEN (1996)	100 000 hectares covered	**1 788**	**2 287**	**2 556**	**2 723**	**2 843**	**2 913**	**:**
	percentage of EU land area	55	70	78	83	87	89	:
Planned TEN (2010)	100 000 hectares covered	**1 222**	**1 690**	**2 012**	**2 220**	**2 375**	**2 510**	**2 638**
	percentage of EU land area	37	52	61	68	72	76	80

Source: SEA of the TEN (preliminary data, adapted)

1) the 50 largest land units

Problems

There is currently no definition of the term 'landscape', which is necessary for considering ecological quality. The Strategic Environmental Assessment of the TEN has followed two approaches to this quality problem:

- based on the proportion of the land unit area designated by international conventions,
- based on the proportion of the land unit area covered by forest or semi-natural habitats.

The data shows how the current and future (planned) TEN affects the sizes of land units. Estimations available are only for the actual and proposed TEN and not for previous time series.

Only international European roads, railways and communication networks (excluding airports), and not urbanisation and other development have been taken into account.

LB-4: Fragmentation of forests & landscapes by roads/intersections

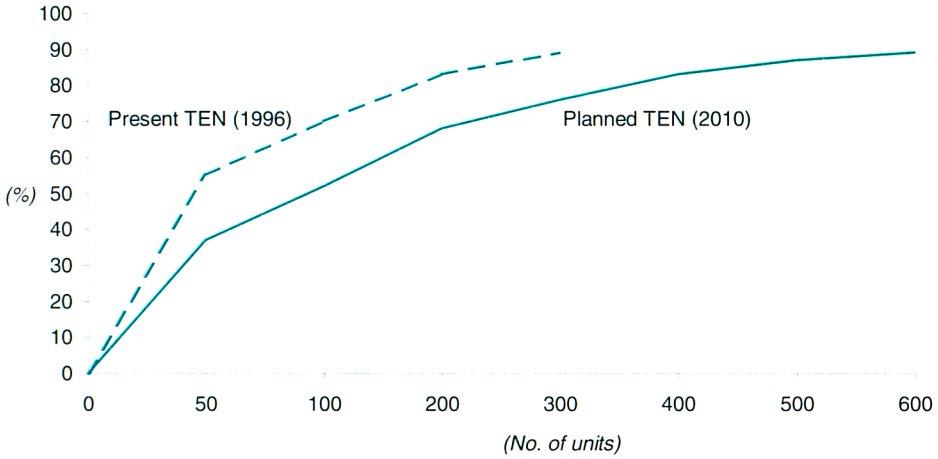
Purpose

Fragmentation of ecosystems can have various impacts on biodiversity, as a result of habitat loss. For example, forest areas will be particularly prone to changes in ecosystem components such as edges as a result of fragmentation.

Forest and landscape fragmentation can occur as a result of several human activities, among them clear-cutting and fragmentation through direct (infrastructure development) and indirect (fires, acid rain) human activities.

In this first step, the indicator purpose is to show the effects of partitioning on the size of the remaining land units as a result of infrastructure development. The increase in the number of land units reflects the pressure on biodiversity due to habitat loss.

Percentage of total area covered by number of land units [1)]



The figure opposite shows that a full implementation of the Trans European Transport Network would cut through existing landscapes in such a way that in future the same land area would contain approximately twice as many (but smaller) land units as today.

Source: SEA of the TEN (preliminary data, adapted)

1) Considering the largest units first

Relevancy: Yellow	Accuracy: Green	Comp.Time: Red	Comp.Space: Green

Comments

Fragmentation by roads is probably the most significant cause of landscape fragmentation. The effects of network partitioning on landscapes are estimated for two distinct points in time: current, with the existing TEN, and in the future, after full implementation of the proposed TEN. The expected result is a significant increase in the minimum number of land units required to cover a determined portion of land, which is a good approximation to the real landscape fragmentation increase. The existing TEN divides the EU surface area in such a way that the 100 largest land units cover an area of approximately 2.3 million km^2, corresponding to 70 % of the EU area. After full implementation of the proposed TEN, the existing land units will be further fragmented. The reduction in size of the land units will be such that it will then take some 300 land units to cover the same amount of land.

LB-5: Clearance of natural & semi-natural forested areas

Definition

The indicator is defined as 'the rate of loss of natural and semi-natural forested areas through clearance.' The unit of measurement is the percentage of existing natural/semi-natural forested area cleared per year. Three causes of clearance are included: clear-cutting, defoliation (through air pollution/acid rain), and fire.

When a substantial portion of existing natural or semi-natural forest is lost, the ecosystem is also lost. Fragmentation of forests (*see LB-4*) and degradation of forest resources are thought to have different impacts on biological diversity, although the reduction of overall area resulting from fragmentation and that resulting from the loss of a proportion of existing forest (clearance) may have similar effects. There is a lack of data on forest clearance for natural and semi-natural forested areas, therefore the indicator has been calculated for all forested areas.

Clearance of forest areas

% of total forest area

	EU-15	EU-12	B	DK	D	EL	E	F	IRL	I	L	N	A	P	FIN	S	UK
Annual Average (1987-1996)	0.64	0.47	1.27	0.86	0.24	0.71	0.49	0.16	0.78	0.29	0.01	0.72	1.18	1.50	0.90	0.82	0.74

Source: UNECE/FAO TBFRA 2000 (adapted)

Problems

Most available forestry statistics do not separate changes in land area of natural and semi-natural forest from changes in land area of other (non-natural) forests. The reliability of this indicator as an indicator of pressure on biodiversity is decreased by the incorporation within available statistical databases of forested areas that should not properly be considered. In addition, the concept of clearance can be more easily defined as a forestry concept rather than an ecological concept. Defoliation, included within this indicator, is generally not a cause of permanent clearance as defined in forestry statistics, but is a cause of forest damage. The indicator as determined here does not identify the causes of the losses in area. Therefore, the data obtained include causes of natural origin such as naturally occurring fires. In some cases (Spain, Portugal, Denmark and Greece), the only data available for all or part of the time series are data on fires, and therefore comparison with other Member States is limited. However, in some of these countries, especially the Mediterranean countries (Greece, Spain and Portugal), fires constitute the principal cause of annual loss of forested area.

LB-5: Clearance of natural & semi-natural forested areas

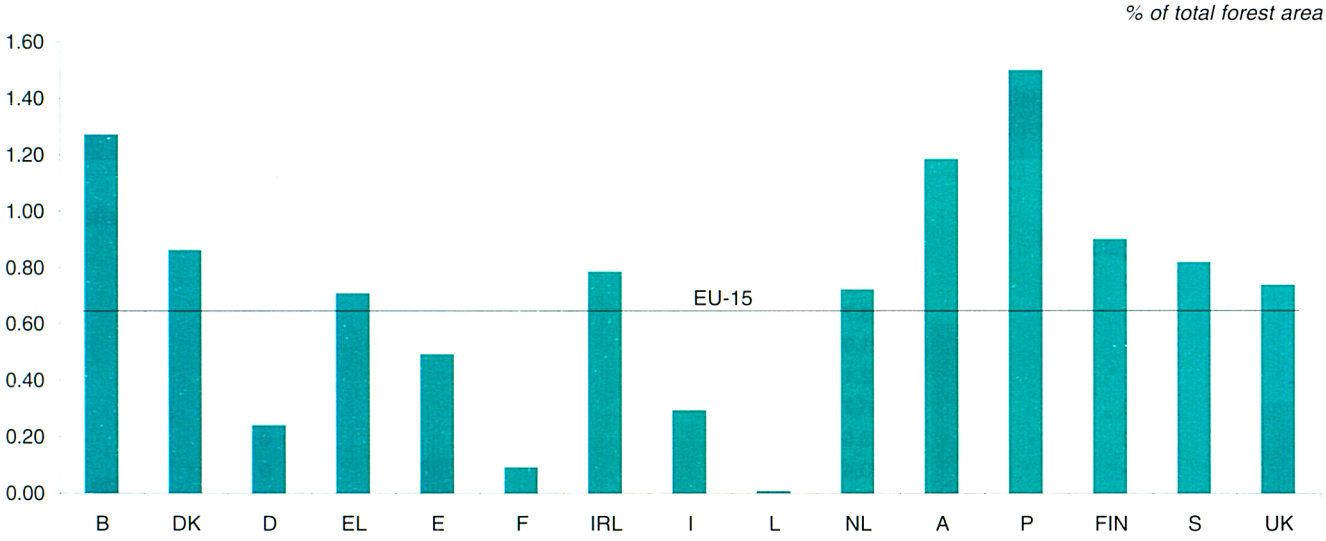
Purpose

The indicator represents the extent of loss of entire, contiguous forests as a result of clearcutting, defoliation (through air pollution/acid rain) and fire. The forests issue encompasses both biodiversity (habitats) conservation and the wider international issues of forests and timber production. In addition, 40 % of the total forest area in Europe is suffering from ill health from acidification, which can adversely affect biodiversity.

Targets

The 5EAP calls for no further deterioration.

Clearance of forest areas [1)]



Source: UNECE/FAO TBFRA 2000 (adapted)

1) The data presented is the annual average (1987-1996)

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Green

Comments

During the last ten years, the annual average loss in the EU-15 of forest surface has been estimated at around 0.64 % of the total forest surface. Most of the countries are above this average. Differences in the estimates for each Member State can be explained by the diversity of reasons for this loss and their unequal distribution between Member States (development of the industries responsible for clear-cutting, or forest fires, mainly in the Mediterranean area).

The indicator estimates the annual loss of forested area (a pressure indicator) and does not incorporate the recovery or colonisation of forested area, natural or artificial. A clear trend of net recovery of forested area in Europe is generally acknowledged, much of it due to direct human intervention through reforestation. However, the impact of this process on the recuperation of biodiversity is unequal and uncertain in many cases.

The indicator attempts to account for forest and subsequent biodiversity losses, which are assumed to be long-term or permanent. However, forested areas may be able to recover, for example after fires, which in some instances can even be beneficial to forest ecosystems. Actual 'clearance' can vary depending on the type of forest ecosystem (forests in southern climates have a more dispersed tree pattern). To account for these complexities further information on the extent of the contiguous loss of forest cover and the recuperative ability of the specific ecosystems would be necessary.

The concept of natural and semi-natural is ambiguous. In the recent UNECE/FAO survey, the majority of countries asked for a liberal interpretation of the concept, according to which forested area that could be considered within this category would include the majority of forested area not subject explicitly to cultivation. Between 70-100 % of forested area is considered natural and semi-natural in most of the countries. The existence of natural forest areas (undisturbed by humans) is, however, minimal or non-existent, although with a greater presence in the Nordic countries.

LB-6: Change in traditional land-use practice

Definition

Changes in traditional, high value farming practices resulting in homogenisation of land use and loss of habitat and species diversity.

The operational definition used for this indicator is the percentage of total agricultural land defined in the CORINE Land Cover project (CLC) as agriculturally heterogeneous. The class 'agricultural heterogeneous areas' from the CLC project includes the following categories: annual crops associated with permanent crops, complex cultivation patterns, land principally occupied by agriculture, with significant areas of natural vegetation, and agro-forestry areas. The CORINE Land Cover assessment has been carried out only once, therefore it is not possible at the moment to estimate the change in traditional land use practice.

Agricultural heterogeneous areas [1)]

% of total agricultural land use

	Annual crops associated with permanent crops	Complex cultivation patterns	Land principally occupied by agriculture, with significant areas of natural vegetation	Agro-forestry areas	Total
B	0.0	30.0	10.0	0.0	39.5
DK	-	9.0	11.0	0.0	19.6
D	0.0	9.5	3.5	0.0	12.9
EL	0.4	22.0	16.8	3.6	42.5
E	0.6	13.7	11.2	8.8	34.3
F	0.1	21.9	7.6	-	29.6
IRL	-	2.1	7.2	0.0	9.3
I	4.2	16.7	11.9	1.3	34.1
L	1.2	43.5	18.4	0.0	63.1
NL	-	20.4	4.0	0.0	24.4
A	-	27.9	2.2	0.0	30.1
P	11.8	9.2	17.4	12.8	51.1
FIN	:	:	:	:	:
S	:	:	:	:	:
UK	:	:	:	:	:

Source: CORINE Land Cover project (adapted)

1) Actual year of the data varies by country since some parts of the database are older than others (1989-97). The north west Italian coast is not included

Problems

An indicator to express the 'change' in traditional land-use practice requires a reading for two different points in time. CLC data is presently available for only one point, which differs from one country to another, as the CLC project was conducted between 1989 and 1997.

Since a strict definition of 'traditional high value farming practices' does not exist, a practical correspondence between the CORINE Land Cover classification and the concept of 'high value farming practices' has been developed to estimate the indicator. Further work is needed to assess whether each of the CORINE Land Cover categories truly implies the application of traditional high value farming practices.

In fact, the CLC classification does not permit a precise identification of traditional land uses. It is therefore necessary to use an approximation in which certain categories are excluded (pastures, natural grasslands) because they include land that does not meet the definition. This is because they may include more intensive land use (such as areas where forage is mechanically collected) or because they have little significant land use (such as high pastures). These criteria of exclusion may occasionally cause important distortions, as in the case of Ireland. In Ireland, pasture certainly includes a percentage of traditional land use. Therefore the real figure is greater than the 9.3 % in the table.

The surface covered by the CORINE Land Cover is 2.3 million km² of 12 countries of the EU. The minimum unit mapped is 25 hectares.

LB-6: Change in traditional land-use practice

Purpose

This indicator measures the potential maintenance of biodiversity by the use of traditional as opposed to intensive land management and use practices. It relates to pressures on wildlife as well as crop and livestock diversity.

Changes in high value farming systems and practices frequently result in homogenisation of land use and loss of corridors, landscape elements (trees, hedges, water bodies, etc.) and habitat diversity. The indicator provides a measure of the degree to which the agricultural landscape is redressing the balance in terms of impacts on biodiversity.

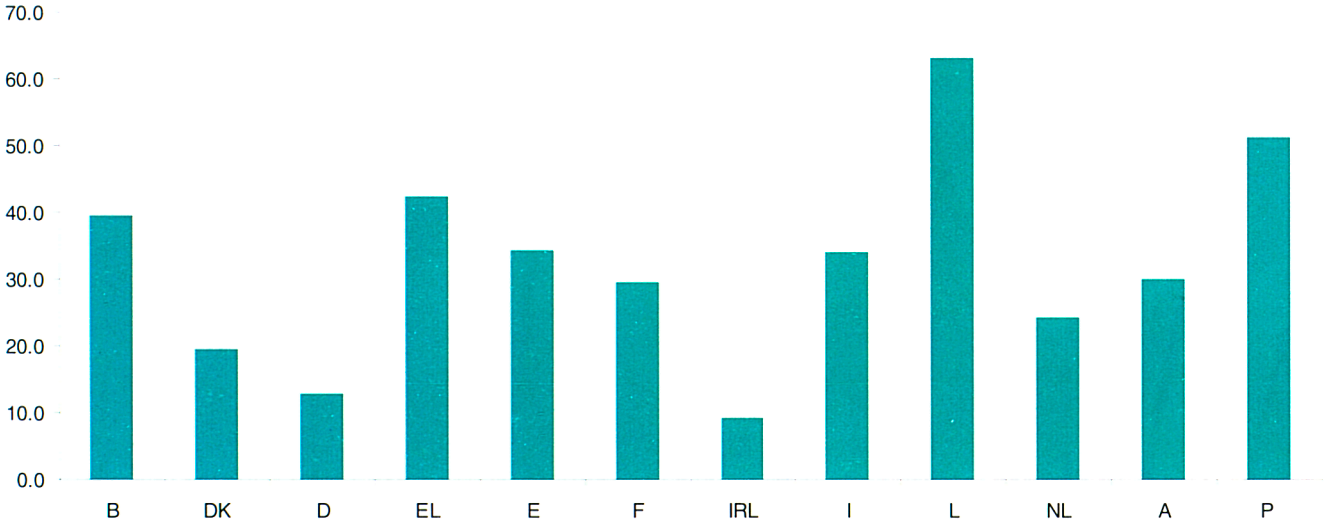
Agenda 21 promotes support for traditional patterns of sustainable land management through the formulation and implementation of integrated agricultural projects that include other natural resource activities such as management of range land, forests and wildlife. It advocates the conservation and sustainable use of plant and animal genetic resources and support for cottage industries and indigenous technologies.

Targets

The 5EAP promotes the establishment of rural environmental management plans and the protection of all endangered domestic animal species.

Agricultural heterogeneous areas

% of total agricultural land use



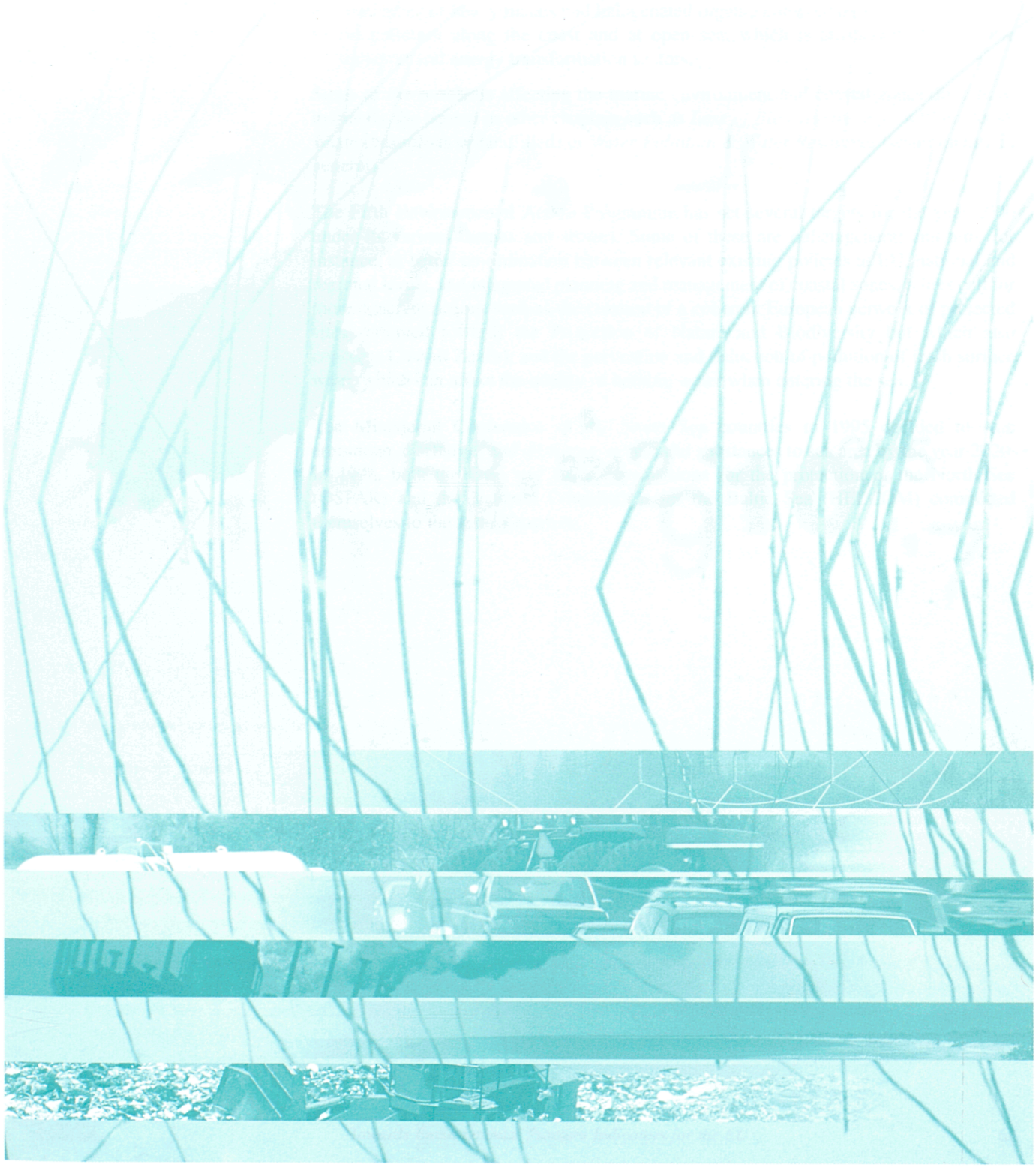
Source: CORINE Land Cover project (adapted)

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Red	Comp.Space: Yellow

Comments

The indicator shows that these heterogeneous agricultural areas cover more than 40 % of agricultural land in only four countries of the EU, reaching more than 60 % in Luxembourg (Belgium 40 %, Greece 43 %, Luxembourg 63 %, Portugal 51%). In the rest of the countries these zones represent only between 10 and 35 % of agricultural land.

MARINE ENVIRONMENT AND COASTAL ZONES



Introduction

Most pressures affecting the policy field *Marine Environment & Coastal Zones* are imposed by growing urbanisation and by all economic sectors, in particular tourism, transport, industry, energy, agriculture and fishing.

The indicators presented in this section aim to provide an overview of those pressures with a particularly harmful impact on the environment, as selected by the Scientific Advisory Groups:

- eutrophication,
- overfishing,
- development along shore, both linked to urbanisation and tourism,
- discharges of heavy metals and halogenated organic compounds and,
- oil pollution along the coast and at open sea, which is attributable to both the transport and energy transformation sectors.

Some of the problems affecting the marine environment and coastal zones directly or indirectly are treated in other chapters such as *Loss of Biodiversity* (e.g., wetland loss), *Waste* (hazardous or landfilled) or *Water Pollution & Water Resources* (water quality in general).

The Fifth Environmental Action Programme has set several targets for the year 2000 under its various themes and sectors. Some of these are rather general and aim, for instance, at better co-ordination between relevant existing policies at EU, national and regional levels, and integrated planning and management of coastal zones; others call for more concrete actions such as the creation of a coherent European network of protected sites (oriented towards the Protection of Nature and Biodiversity but which also concerns Coastal Zones), and the prevention and reduction of pollution of fresh surface water which can affect the quality of bathing water when entering the sea.

The Ministerial Conference of the North Sea countries in 1995 decided to stop emissions, discharges and all losses of harmful substances to sea area 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.

ME-1: Eutrophication

Definition

Eutrophication is the term used for the result of nutrient enrichment in a water body. This enrichment may be natural or anthropogenic and may be seen as the result of a pressure on the receiving environment, causing changes in the ecosystems and jeopardising beneficial uses of the resources. Anthropogenic eutrophication is caused by nitrogen and/or phosphate compounds either discharged through pipes or deposited to the water environment via the atmospheric fallout (nitrogen) or run-off from land.

The atmospheric deposition of nitrogen from a specific country to the marine environment is not commonly measured on a regular basis. The definition applied here is therefore limited to discharges of nutrients by riverine inputs and direct inputs from industries and settlements to the marine environment. Riverine inputs are the pollutants conveyed by a river at a point of entry to the marine area (upstream of tidal influence). The riverine inputs include the pressure from the catchment area so that the pressure from upstream countries is ascribed to the most downstream countries (e.g. the Rhine is ascribed to the Netherlands). Direct inputs are the pressures from point sources, e.g. waste water effluents directly discharged to the coastal zone.

The unit of measurement is annual input of total nitrogen and total phosphorus in tonnes. *Total nitrogen = oxidised nitrogen, ammonia, plus organically bound nitrogen.* Total phosphorus includes ortho-phosphate - commonly described as the available phosphate (i.e. usable directly by plants for growth) as well as suspended phosphate.

The most reliable aggregated data on eutrophication seem to be reported by OSPAR and by HELCOM. Therefore the indicator has been compiled on the basis of data reported from these commissions.

Riverine and direct inputs of nitrogen and phosphorus to the coastal and marine environment

1 000 tonnes

	Total-N						Total-P					
	1990	1991	1992	1993	1994	1995	1990	1991	1992	1993	1994	1995
EU-15	1 459	1 431	1 615	1 574	1 870	1 815	111	107	105	108	124	116
EU-12	1 263	1 227	1 397	1 369	1 660	1 617	102	98	95	99	115	107
B	49	54	59	48	51	57	5	6	5	4	3	6
DK (1)	109	93	101	88	101	81	7	6	6	5	5	3
D (2)	210	176	246	259	380	315	12	13	13	17	14	13
EL	:	:	:	:	:	:	:	:	:	:	:	:
E	:	:	:	:	:	:	:	:	:	:	:	:
F (3)	67	67	67	67	67	67	5	5	5	5	5	5
IRL	157	172	127	165	179	151	7	6	6	8	11	7
I	:	:	:	:	:	:	:	:	:	:	:	:
L	.	.	.	.	.	.	.	.	.	.	.	.
NL	345	326	396	366	491	577	23	20	20	22	29	34
A	.	.	.	.	.	.	.	.	.	.	.	.
P	18	18	17	17	16	10	3	3	3	6	14	3
FIN (1)	72	79	85	79	72	66	4	4	5	4	4	4
S (1)	124	125	133	127	137	132	5	5	5	5	5	5
UK	307	321	383	358	375	360	41	39	37	33	35	36

Source: VKI 1998, based on OSPAR and HELCOM data

1) Data from DK, D, S and FIN are obtained by interpolation of the direct inputs for the years 1991, 1993 and 1994
2) Includes former East Germany
3) Includes only riverine inputs to the Iberian Coast, the Atlantic Sea and the Channels

Problems

The OSPAR and HELCOM data refer only to the Atlantic, the Baltic and the North Sea.

Inclusion of atmospheric fallout of nitrogen into the marine environment should be considered in the indicator since this contribution can be of the same magnitude as the riverine input in several EU Member States. However, the available data on nitrogen deposition are very limited especially into the marine environment. Another problem is that the deposition is controlled by the frequency of rain fall and will vary during the year and from one year to another. Inclusion of atmospheric deposition would also disturb the identification of possible trends in the riverine and direct pressures.

ME-1: Eutrophication

Purpose

The indicator gives a measure of sewage, agricultural, forestry and industrial nutrient input to the marine environment. Measurement of nitrogen and phosphorus is simple and inexpensive.

A marked increase in nutrient input and hence a eutrophication problem has been noted in most regional seas. Some of the problems, such as increased algae blooms including toxic blooms, are of concern to the general public. The Dobris Assessment estimates that Baltic Sea nitrogen inputs have increased four-fold and phosphate eight-fold since the beginning of this century. Main contributors to the nutrient load are artificial fertilisers and animal manure, sewage and occasional point sources from the food industry.

It means that these sources comprise both the loss of fertiliser the farmer has paid for and would be eager to reduce, and the wilful disposal of waste.

Targets

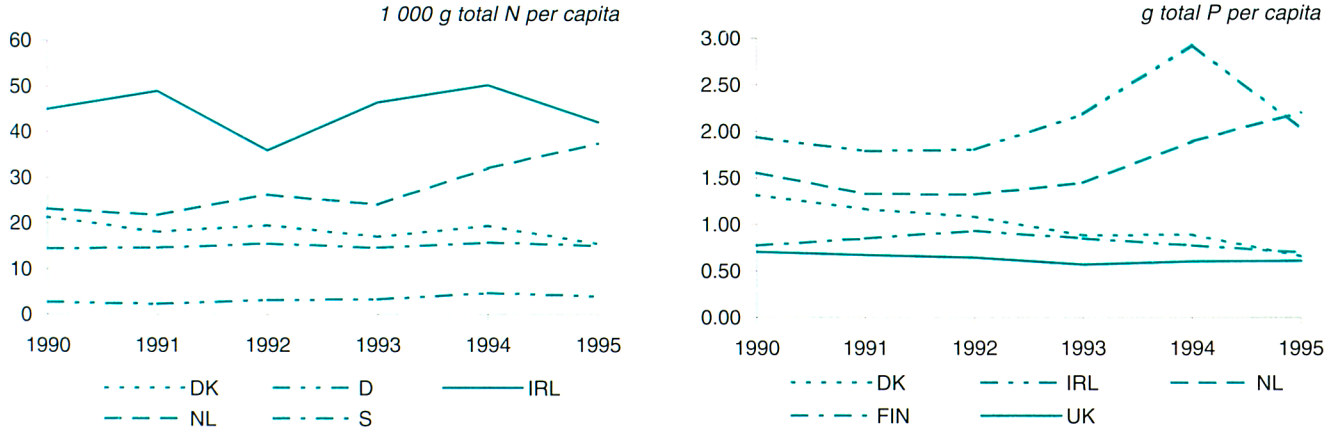
The EEC Nitrate Directive has three key targets:

- to ensure that the nitrate concentration in all ground water is below 50 mg/l and eutrophication is prevented,
- to identify vulnerable areas and prepare action programmes for them,
- to limit nitrogen input (animal manure only) to a maximum of 170 kg/ha in the first action programme 1995-1999.

Furthermore, the Directive on Urban Waste Water Treatment (91/271/EEC) sets deadlines for applying secondary treatment before discharge. These deadlines vary and depend on the population equivalents (p.e.) in the urban agglomeration. In addition, agglomerations of more than 10 000 p.e. situated in sensitive areas must have tertiary treatment facilities for all their discharges by the end of 1998.

At regional level, HELCOM set a target of halving the input of nutrients from the baseline year 1985 to 2005.

Riverine input of nitrate and phosphorus into marine environments - selected Member States [1)]



Source: VKI 1998

1) NL data should be interpreted with caution, as it includes pressure from upstream countries.

Relevancy: Yellow	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

For the sea areas covered by OSPAR and HELCOM, the distribution between direct inputs and riverine inputs of nitrogen is dominated by the riverine contribution and makes up more than 75 % of the total in several Member States. The distribution between riverine and direct inputs has been relatively constant over the years. Around 80 % of the total input of phosphorus can be ascribed to riverine inputs alone.

The riverine inputs of nitrogen and phosphorus vary a lot between Member States. In Denmark and in the United Kingdom, where the area is dominated by arable land, the riverine inputs are above 2 tonnes N per km² per year while the similar parameter in Sweden and Finland is around 0.25 tonnes N per km² per year. This is because the land area of the latter is dominated by forest.

The data situation with respect to inputs to the Mediterranean sea is very uncertain at present.

ME-2: Fishing pressure

Definition

The most appropriate information on which to base a pressure indicator is that of the effect of fishing on fish stocks.

The intensity of fishing activity is measured as a removal rate (fishing mortality rate -equivalent to the numerical proportion of the stock removed each year by fishing) in relation to the ability of the stocks to replenish themselves by reproductive activity thereby ensuring sustainability of the stocks and the associated yields from them.

Fishing mortality rates are scientifically evaluated each year for a large number of fish stocks within (and outside) EU waters. The information is available for the stocks which constitute the main catch and/or generate the main revenue from fishing. Fishing mortality rate is directly related to the total fishing effort (e.g. days' fishing) generated by the fleets and hence is an appropriate indicator of fishing pressure. The results of this evaluation have been used to present a picture of the current state of fish stocks for the main catch species.

The stocks (see above table) are classified as:

- **Under exploited** if long term gains in yield could be achieved at higher fishing mortality rate provided that, at these higher rates, the biomass of mature fish will remain above levels at which replenishment of the stocks is imperilled;
- **Fully exploited** (FE) if no substantial long-term gains or losses in yield will accrue if fishing mortality rate is moderately increased and the biomass of mature fish will remain above levels at which replenishment of the stocks is imperilled;
- **Over exploited** (OF) if moderate to substantial gains in long-term yield will accrue if fishing mortality rate is reduced, and if such a reduction will significantly reduce the probability that the biomass of mature fish will fall to levels at which replenishment of the stocks is imperilled;
- **Depleted** (DR) if fishing mortality rate is so high that the biomass of mature fish is already at levels, or is in the near future very likely to fall to levels, at which replenishment of the stocks is imperilled.

State of the main fish stocks by species

	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

Problems

The quantity and quality of information varies within European waters and there are still marine organisms exposed to fishing, either targeted or caught as by-catch, for which such information is limited or absent. These include a number of fish species, marine mammals, birds, reptiles and benthos. The pressure indicator will therefore not measure the total aggregated pressure on the marine biota as a whole. However the fishing pressure measured as removal rate is related to the total effort applied by fishing fleets and hence will be a surrogate of their pressure on the marine biota.

In the future, it could be envisaged that the analysis could be extended to cover more areas, such as the Mediterranean, and include information about, for example, sharks, tunas and deep sea species.

ME-2: Fishing pressure

Purpose

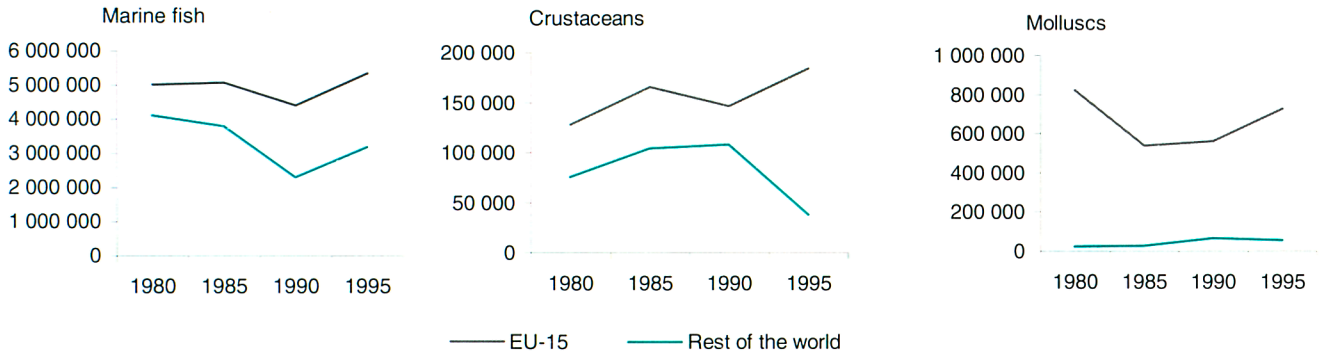
The aim is to use the best available information to derive an indicator of anthropogenic pressure on fish and shellfish resources. Quantitative knowledge about the overall effects of, for example, pollution, eutrophication and habitat destruction on fish stocks is currently limited. Moreover other environmental problems such as climate change, which will increase water temperatures, and ozone depletion which affects phytoplankton growth, are also expected to influence fish stocks.

Targets

There are currently very few agreed targets within Community legislation. However, ICES has recently proposed levels of fishing mortality rate and associated levels of biomass of mature fish (spawning stock biomass) in the context of a precautionary approach to the management of fish stocks. These proposals are to be evaluated by the Commission and Member States in the near future.

Fish catch by species (Marine fish, Crustaceans, Molluscs) in the North East Atlantic and the Mediterranean Sea

tonnes live weight equivalent



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

Fishing and aquaculture are important economic activities in the European Union. While the fishing sector's contribution to the gross national product of Member States is generally less than 0.5 %, its impact is highly significant as a source of employment in areas where there are often few alternatives.

In the last four decades world-wide catches of fish and shellfish have increased three-fold. It is widely acknowledged that as a consequence of expanded and more effective fishing, most of the major fish and shellfish stocks in the oceans are now fully or over-exploited. The situation is no different in EU waters.

ME-3: Development along shore

Definition

The indicator is to track increases in structural development in coastal zones. The unit of measurement is percentage increase in structural hard surface in the coastal zone. The indicator as presented below was calculated by interpretation of satellite images for the LACOAST project carried out by the JRC (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

	Area of Built-up Land (1975)	Area of Built-up Land (1990)	Area of Changes (1975-1990)	Change (%)	Change by Continous and Discontinous Urban Fabric (%)	Change by Industrial or Commercial Development (%)	Change by Transport (%)
B	8 064	11 202	3 138	38.90	0.180	0.075	0.134
DK	177 178	186 374	9 196	5.20	0.043	0.007	0.002
D	81 162	87 748	6 586	8.10	0.060	0.014	0.007
EL	:	:	:	:	:	:	:
E	144 980	167 744	22 764	15.70	0.122	0.018	0.017
F	255 311	291 416	36 105	14.10	0.108	0.024	0.009
IRL	57 421	61 288	3 867	6.70	0.054	0.009	0.003
I	257 767	323 569	65 802	25.50	0.188	0.060	0.007
L	.	.	.	.	.	.	.
NL	46 493	48 127	1 634	3.50	0.021	0.000	0.014
A	.	.	.	.	.	.	.
P	:	:	:	:	:	:	:
FIN	:	:	:	:	:	:	:
S	:	:	:	:	:	:	:
UK	:	:	:	:	:	:	:

Source: LACOAST project

Problems

The LACOAST project provides data corresponding to land use changes in a 10 kilometre coastal zone using the classifications of the CLC project of the EEA. The definition of coastal zone as equal to 10 kilometres may be adequate for gauging some environmental impacts, but perhaps inadequate for others. There is an inconsistency in the data relative to Greece in the area covered between 1975-90. The data on Greece has not been included as it is not comparable to the rest of the countries.

Roads and rail networks are only considered when the area is bigger than 25 hectares and the minimum width is 100 metres. These cases are rare in Europe.

LACOAST can only provide data for eight countries at present. Data for Portugal should be available shortly.

ME-3: Development along shore

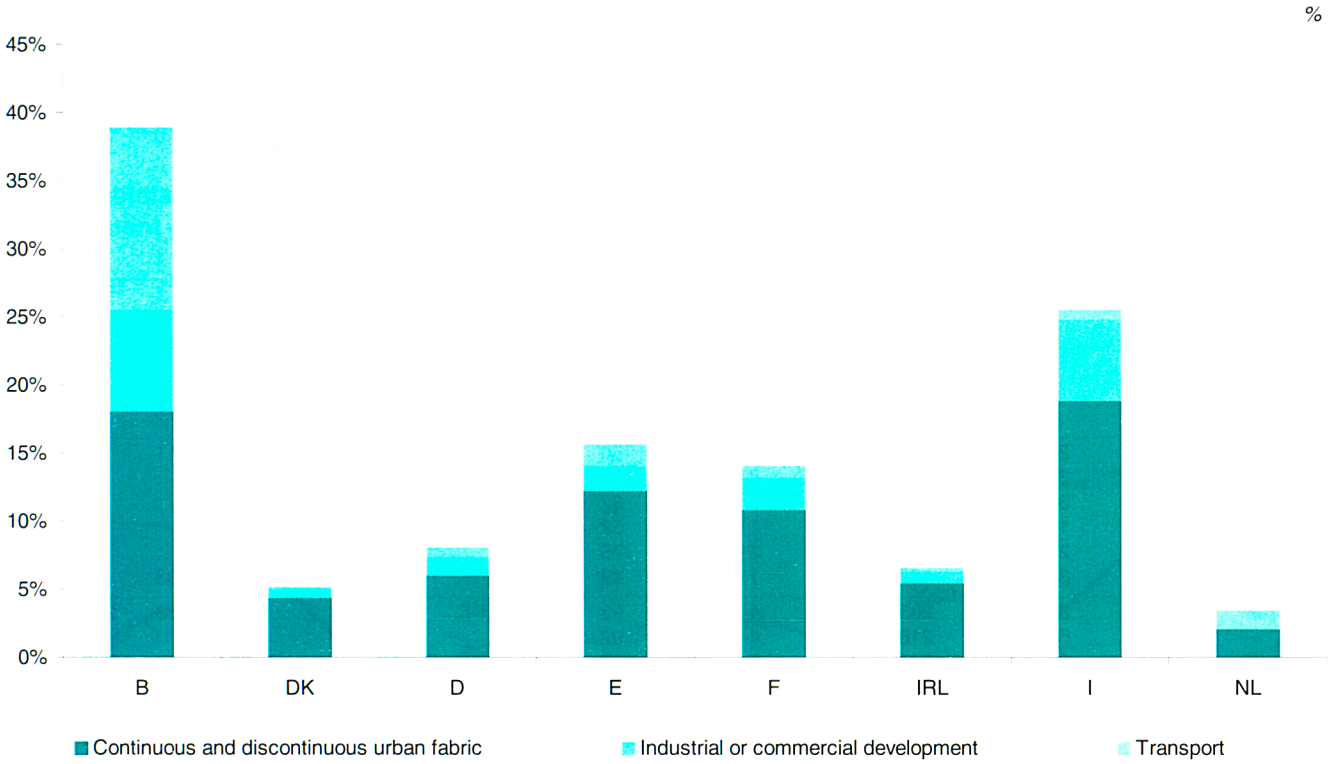
Purpose

The purpose of the indicator is to provide a picture of continuing encroachment of the built environment on our coast and consequent loss of flexibility and natural value in the coastal zone. The indicator does not evaluate the importance of the land converted (e.g. Natura2000 site or urban fringe) but simply considers any natural coastal land converted to hard or built surface as being inherently a pressure and a threat to the integrity of the marine and coastal zone.

Targets

In the 5EAPs reference to coastal zones, urbanisation is seen as a main threat to the coastal zone and targets include 'development of criteria for a better balance of land use and conservation and use of natural resources.'

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



Source: LACOAST project

Relevancy: Green	Accuracy: Green	Comp.Time: Yellow	Comp.Space: Green

Comments

The graph points out the relevance of the urban use in the development of the built up lands. However, it should be considered that the contribution of transport related activities in many countries is underestimated in reference to its real contribution (*see Problems*).

The chart shows two sets of clearly different countries. One consists mainly of Mediterranean countries that have had a large increase in the constructed surface in the coastal zone, with percentages between 15 and 25 % for the last fifteen years. The second group of countries has a slower rate of growth, substantially below 10 % for the same time period.

Close to a third of the European population is concentrated within a narrow stretch of coastal land of approximately 50 kilometres (Dobris Assessment). 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, whose impacts multiply seasonally (especially in Mediterranean areas) to support a concentrated tourist population during only a few months a year.

ME-4: Discharges of heavy metals

Definition

The most common heavy metals measured as significant in the coastal and marine environment are cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. In addition, arsenic, though not a metal, is often included in this group. The indicator is defined by the amount of heavy metals emitted directly or indirectly into the coastal zone and marine environment.

An analysis of the different international datasets revealed that time series are available for a small number of emission sources and toxic metals. At present, the indicator only includes direct and riverine inputs of mercury, cadmium, lead, copper and zinc into the marine environment.

The indicator has been developed using data from OSPAR and HELCOM which are the most reliable data available.

Riverine and direct inputs of heavy metals into the coastal and marine environment [1)]

tonnes per year

		B	DK	D	EL	E	F	IRL	I	L	NL	A	P	FIN	S	UK
Mercury	1990	4	0	10	:	:	4	0	:	.	3	.	5	0	0	6
	1991	1	:	10	:	:	:	0	:	.	3	.	2	:	:	5
	1992	1	:	11	:	:	0	0	:	.	3	.	0	:	0	4
	1993	0	:	10	:	:	:	0	:	.	3	.	0	:	:	4
	1994	0	:	6	:	:	:	0	:	.	6	.	1	:	:	2
	1995	0	0	5	:	:	:	0	:	.	8	.	0	1	1	2
Cadmium	1990	4	0	6	:	0	16	3	:	.	10	.	9	1	3	39
	1991	3	:	5	:	0	:	3	:	.	7	.	0	:	:	35
	1992	6	:	10	:	0	1	2	:	.	6	.	:	:	2	24
	1993	1	:	9	:	0	:	1	:	.	5	.	2	:	:	19
	1994	0	:	8	:	0	:	1	:	.	13	.	4	:	:	15
	1995	3	0	8	:	0	:	1	:	.	26	.	0	2	1	12
Lead	1990	24	5	215	:	8	242	50	:	.	347	.	:	11	64	515
	1991	32	:	297	:	8	:	50	:	.	250	.	:	:	:	505
	1992	30	:	315	:	3	40	82	:	.	222	.	:	:	45	468
	1993	16	:	378	:	1	:	52	:	.	392	.	7	:	:	596
	1994	26	:	247	:	2	:	75	:	.	702	.	6	:	:	497
	1995	39	0	187	:	1	:	49	:	.	872	.	3	33	31	360
Copper	1990	39	10	285	:	4	180	92	:	.	388	.	21	139	298	766
	1991	54	:	216	:	4	:	92	:	.	324	.	21	:	:	617
	1992	68	:	283	:	2	47	147	:	.	355	.	30	:	259	699
	1993	25	:	281	:	1	:	165	:	.	375	.	16	:	:	664
	1994	1	:	268	:	22	:	221	:	.	555	.	120	:	:	678
	1995	40	2	223	:	0	:	197	:	.	772	.	5	89	284	619
Zinc	1990	250	65	1 809	:	262	713	729	:	.	2 042	.	380	576	1 496	3 865
	1991	310	:	1 731	:	262	:	2 433	:	.	1 263	.	140	:	:	3 593
	1992	226	:	2 511	:	70	220	803	:	.	1 322	.	22	:	1 292	3 861
	1993	211	:	2 494	:	425	:	858	:	.	1 622	.	135	:	:	3 160
	1994	252	:	1 902	:	97	:	1 043	:	.	3 522	.	110	:	:	3 345
	1995	412	18	1 509	:	9	:	1 388	:	.	5 418	.	45	617	1 289	2 732

Source: VKI 1998 based on OSPAR and HELCOM data

Problems

There are many problems in presenting realistic estimations of the indicator. One of them is the limited data availability and the number of metals covered by the national monitoring programmes, used as a basis for the international commission reports. There is a particular lack of data concerning direct inputs from coastal industries and estimates from unmonitored rivers. No aggregated data have been found for direct and riverine inputs to the Mediterranean Sea.

The quantity of heavy metals entering the marine environment varies from year to year, and a variety of both natural and anthropogenic processes influence the input. Furthermore, there are also large variations in the frequency and the quality of reporting from the different Member States.

Besides direct and riverine inputs there are other sources of heavy metals in the marine environment which are important, such as deposition from the atmosphere, dumped industrial waste and dredged materials from harbour areas. The atmosphere deposition is estimated to be in the same order of magnitude as the riverine and the direct input.

ME-4: Discharges of heavy metals

Purpose

This indicator gives politicians and the public a picture of heavy metal losses to the coastal and marine environment from individual EU Member States due to riverine and direct inputs.

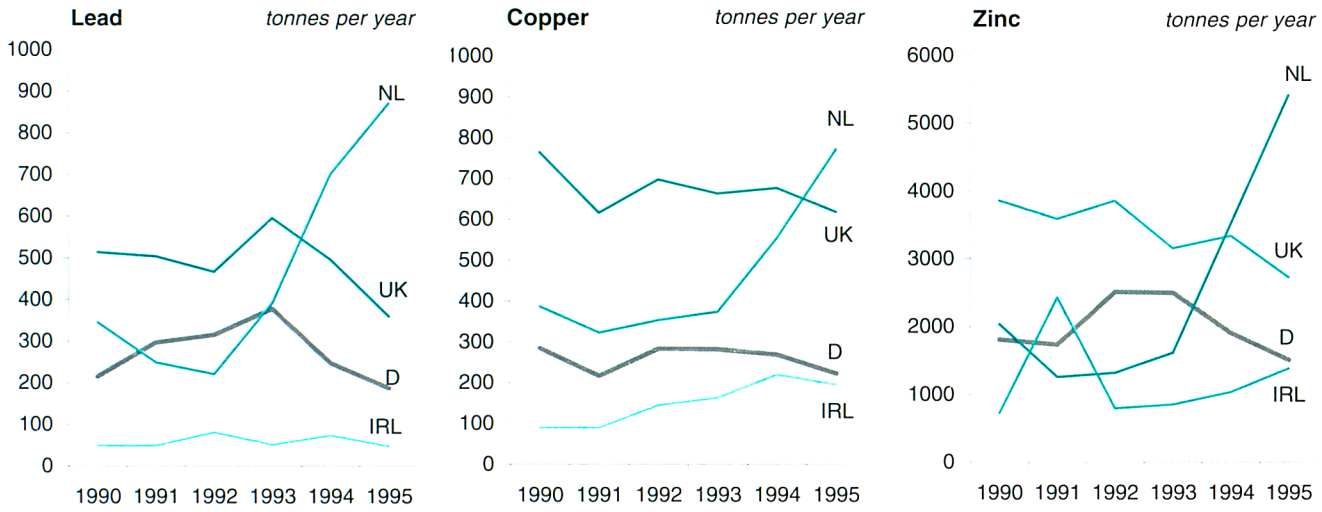
Many heavy metals are needed in trace amounts for normal function of animals and plants, but they become toxic in larger doses. Heavy metals are persistent and most of them can accumulate in organisms so that even small amounts in sea water or sediment may accumulate to significant exposure levels at 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 bioaccumulation and toxicity and thereby also different influences in the marine environment.

Targets

OSPAR and HELCOM set a target of gradually phasing-out and halving discharges of hazardous substances, including heavy metals, from the baseline year 1985 to 2005.

In EC Towards Sustainability 1997 there is a call for 'Reduction of discharges of all substances which due to their toxic persistence or accumulating impact could negatively affect the environment, to levels which are not harmful.'

Heavy metals (Lead, Zinc and Copper) discharged by riverine and direct inputs to the marine environment - selected Member States



Source: VKI 1998, based on OSPAR and HELCOM data

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

Breakdown of the riverine and the direct inputs shows that in nearly all cases the riverine inputs represent more than 90 % of the combined inputs for the heavy metals considered.

The riverine inputs result from the pressure in the whole catchment area whereby the pressure from upstream countries is ascribed to the most downstream countries (e.g. the Rhine is ascribed to Netherlands).

ME-5: Oil pollution at coast and at sea

Definition

The definition of the indicator is the total accidental, licensed and illegal disposal of mineral oil to the coastal and marine environment. The unit of measurement is tonnes per year.

The impact of the oil pollution depends on the type of oil and sensitivity of the area, as well as weather and how the pollution is tackled. As an example, salt marsh damage may be almost irreversible, while a rocky shore may be hosed down with relatively quick and satisfactory recovery. This variability makes oil as an indicator prone to argument and highlights the need for controlling the handling of oil and avoiding loss or illegal disposal.

Sources of oil pollution in coastal areas and marine environments are multiple and highly variable and include:

- Discharges from industries (e.g. petrochemical and oil refineries and factories for plastic, rubber, etc. and discharges from coastal iron and steel industries as well as engineering and other surface treatment industries);
- Direct discharges from urban activities via municipal wastewater treatment plants;
- Discharges and overflows of storm water, which often contain oil, soot, grease, etc.;
- Discharges from ships in operation including legal as well as illegal discharges;
- Shipping accidents at sea which release oil;
- Recurrent discharges entering the sea around oil platforms, from drilling muds and oil production water;
- Accidents in connection with oil and gas production, such as blow-outs, explosions, and fires;
- Spills during loading, unloading, and other port operations; and
- Atmospheric deposition.

There are many reports of specific incidents of oil pollution in marine areas, but reliable data sets of aggregated estimates over time cannot be found. Reliable data are collected on a regular basis at only a few point sources (e.g. refineries).

Due to this lack of data it is only possible to present three sets of aggregated estimates on pressure from oil pollution in different sea areas, and it is not possible at present to estimate total discharges from individual Member States. The applied data sets have been obtained from Status Reports of the North Sea and reports from UNEP and OSPAR/ITOPF.

Oil inputs to the North Sea, the Baltic Sea area, and the Mediterranean Sea (estimates)

1 000 tonnes oil per year

	North Sea						Baltic Sea Area						Mediterranean Sea	
	Input			% of total			Input			% of total			Input	% of total
Natural seeps		1		0	-	1								
Riverine and land run off	16	-	46	21	-	22	14	-	25	32	-	69		
Coastal sewage and municipal effluents	3	-	15	4	-	7	3	-	9	12	-	15	159	25
Storm water							1	-	5	5	-	6		
Sewage sludge disposed at sea	1	-	10	1	-	5								
Coastal refineries		4		2	-	5		0.2		0	-	1		
Offshore oil and gas production	20	-	30	14	-	26		0.01			0			
Oil terminals and reception facilities		1		0	-	1	0.1	-	2	0	-	3		
Other coastal industrial effluents	5	-	15	6	-	7	0.7	-	11	3	-	14		
Land-based industrial discharges													108	17
Dumped industrial waste	1	-	2		1									
Dredged spoils	2	-	10	3	-	5								
Operational ship discharges (legal)	1	-	2		1		0.2	-	7	1	-	9		
Accident or illegal discharges from ships	15	-	60	19	-	28	0.2	-	9	1	-	12		
Shipping													330	52
Atmospheric input	7	-	15	9	-	7	1	-	10	5	-	13	38	6
Total inputs	**77**	**-**	**211**				**20**	**-**	**78**					

Source: VKI, based on Quality Status Report of the North Sea 1987, the Nordic Council 1989 and Dobris Assessment, EEA, (original data from a report by UNEP and IMO in 1987).

Problems

Oil pollution at sea essentially takes place in two ways, either as large quantities during a short period owing to accidents or as small but continued amounts over a longer period.

Due to the limited amount of data, it is not possible to develop realistic estimates with time series to illustrate real trends in overall improvement or decline of oil pollution in the marine environment. Further, as can be seen from the table, the data obtained for the three seas do not contain the same kind of oil polluting sources. In comparing the three sets of data, it would appear that these data only include a fraction of the true oil inputs to the marine environment.

ME-5: Oil pollution at coast and at sea

Purpose

Oil lost or discharged at sea represents a pollution threat that can damage marine ecosystems, endanger marine life, and pollute beaches and coastlines. Its toxic effects can kill or damage marine organisms, and its physical effects, for example, on seabirds, can result in loss of water-repellent properties and reduced thermal insulation and buoyancy. Furthermore, oil can have a considerable impact on human activities that depend on clean sea water and clean shores, notably tourism, fishing and aquaculture.

Targets

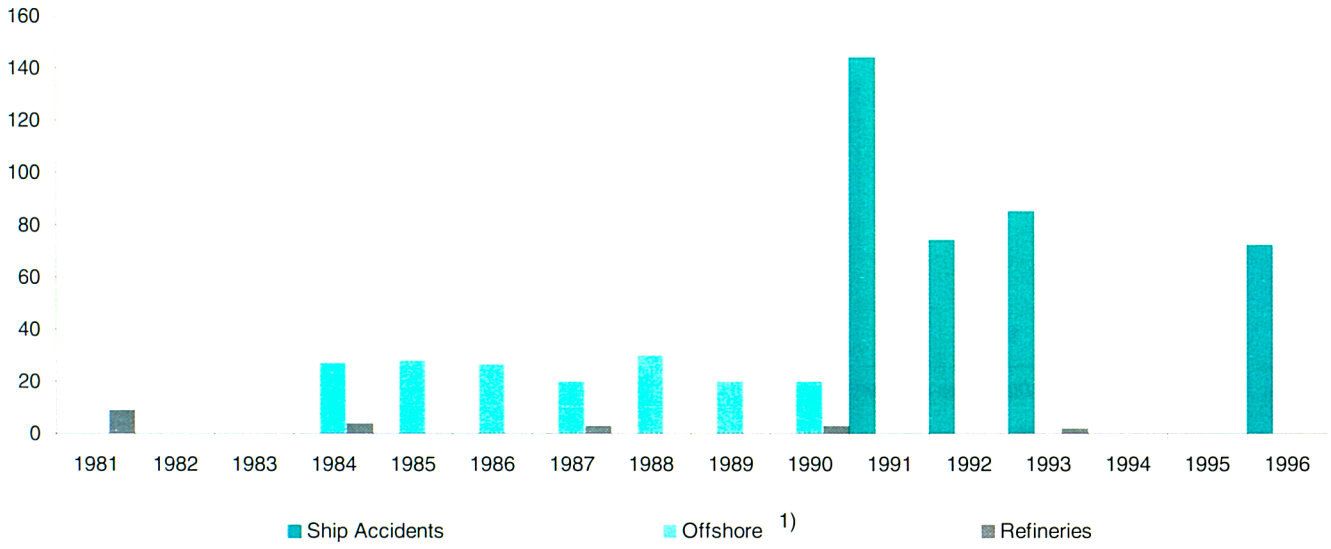
Targets on oil pollution are included in the Dangerous Substances Directive 76/464/EEC in two ways:

- persistent mineral oils are included in list I with a target of total elimination of pollution
- non-persistent oils are included in list II to be covered by specific quality objectives set by Member States.

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

Major oil spills and oil discharges in the European marine environment

1 000 tonnes oil per year



Source: VKI 1998, ITOPF 1998, OSPAR 1992, OSPAR 1997

1) Offshore: Oil production platforms in the North Sea

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Red	Comp.Space: Yellow

Comments

Compared with the total oil inputs to the North Sea, the Baltic Sea area, and the Mediterranean Sea, the major spills from shipping accidents make a considerable contribution in some years. In the case of the North Sea, oil discharges from offshore activities should also be considered as a major oil polluting source. The offshore activities in the Baltic Sea and in the Mediterranean Sea are negligible compared to activities in the North Sea.

The land based inputs of oil to the seas are very important. However, the available data are insufficient to be presented in this graph.

ME-6: Discharges of halogenated organic compounds

Definition

The indicator is defined as the amount of halogenated organic (or organohalogen) compounds emitted directly or indirectly (via rivers) into the coastal zone and marine environment. The unit of measurement proposed is tonnes or grams per year depending on the compound, in a specified area.

Since the actual data on such discharges is sparse, and can therefore be misleading or inaccurate, the indicator has been estimated using direct discharges and riverine inputs of hexachlorocyclohexane (γ-HCH, commercially known as Lindane) to the maritime area of the Paris Convention. The unit of measurement is the annual average of the lower and upper estimates in milligrams per capita.

γ-HCH discharges into the Paris convention maritime area [1]

(averaged lower and upper estimates) mg per capita

	1990	1995
B	5.16	3.46
DK	10.11	:
D	5.3	3.5
EL	:	:
E	:	:
F	:	:
IRL	:	:
I	:	:
L	:	:
NL	10	25.35 [2]
A	:	:
P	:	0.28
FIN	:	:
S	:	:
UK	13.50	13.30

Source: Riverine Inputs and Direct Discharges (RID 1995) Oslo and Paris Commissions 1997

1) γ-HCH or Lindane: Hexachlorocyclohexane
2) Data provided comprise approximately 90 % of the total loads into Convention waters

Problems

The data refer only to the basin within the OSPAR Commission. Nine EU Member States belong to OSPAR (Belgium, Denmark, France, Germany, Ireland, Netherlands, Portugal, Spain and the United Kingdom). Currently, γ-HCH is the only organohalogen that must be measured by mandate of the commission. However, not all of the contracting parties provide data for all of the obligatory parameters. Data on discharges for γ-HCH are available for five Member States.

In general, the measurement of these compounds, from diffuse sources, is far from easy given their low concentrations and the variations of flows. Lindane used as a contact insecticide is an organohalogen stable at high temperatures, which makes it highly dangerous.

ME-6: Discharges of halogenated organic compounds

Purpose

Halogenated organic compounds, though manufactured and used to fulfil specific functions such as to kill weeds, are always undesirable in the coastal and marine ecosystem. Many are carcinogenic, mutagenic, long lasting and can break down into daughter products, or undergo chemical changes, which pose new dangers to human and animal life. These compounds discharged to the coastal and marine environment are a significant danger to the receiving areas and to people who may ingest them in food from the marine environment.

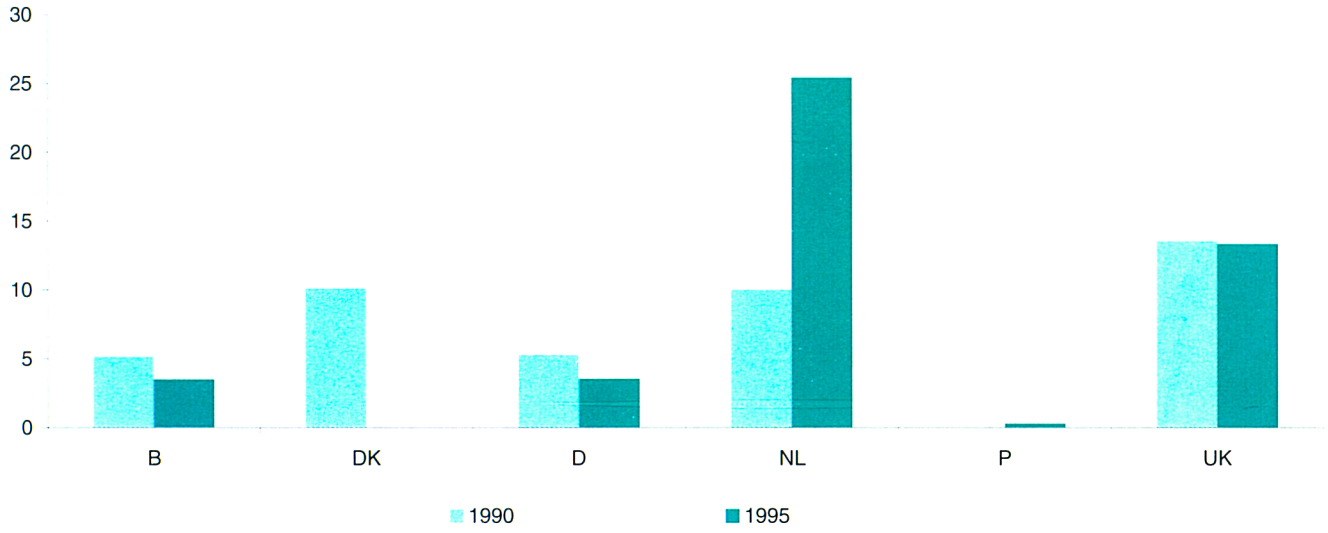
Targets

In EC Towards Sustainability 1997: reduction to levels that are not harmful of discharges of all substances which due to their toxic persistence or accumulating impact could negatively affect the environment. Fourth North Sea Conference Esbjerg Declaration (1995) to 'cease discharges, emissions and losses of hazardous substances to the North Sea by 2020' (Article 17).

OSPAR and HELCOM set a target of phasing-out and halving discharges of hazardous substances, including halogenated organic compounds, from the baseline year 1985 to 2005.

γ-HCH discharges into the maritime area of the Paris convention

(average of lower and upper estimates) mg per capita



Source: Riverine Inputs and Direct Discharges (RID 1995) Oslo and Paris Commissions 1997

Warning: given the comparability problems, this indicator should be interpreted with great care

Relevancy: Green	Accuracy: Green	Comp.Time: Yellow	Comp.Space: Red

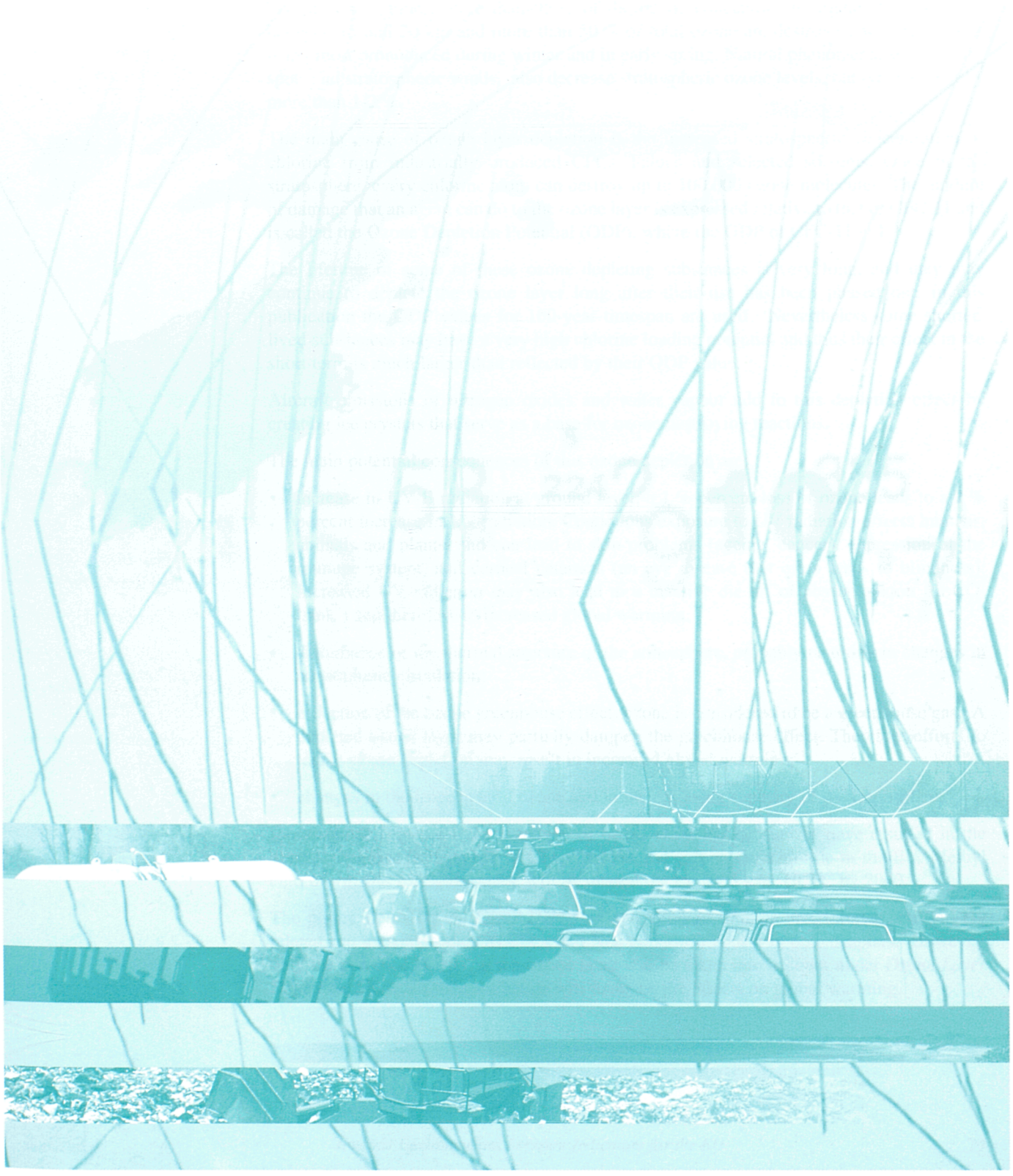
Comments

The chart shows the evolution of the discharges of lindane between 1990 and 1995. The high level of discharges of the United Kingdom have been stable during this period. The Netherlands shows a dramatic increase, which is partly due to changes in sampling and calculation methods for 1995.

The Directive 76/464/EEC on water contamination by specific substances specifies explicitly some organohalogens because of their high toxicity, persistence, or bioaccumulation, and establishes limit values for their emission. Lindane is included within List I of this Directive. Water quality objectives for lindane in estuaries and marine waters are in the order of 20 ng/l.

The Directive also requires countries to make inventories of such emissions. The first results of these inventories, which should constitute a good indicator of discharges of these substances to the marine environment from the industrial sector, are expected by the end of 1998.

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. Measurements carried out in the Antarctic have shown that at certain times, more than 95 % of the ozone concentrations found at altitudes of between 15 and 20 km and more than 50 % of total ozone are destroyed, with reductions being most pronounced during winter and in early spring. Natural phenomena, such as sun-spots and stratospheric winds, also decrease stratospheric ozone levels, but typically not by more than 1-2 %.

The main cause of ozone layer depletion is the increased stratospheric concentration of chlorine from industrially produced CFCs, halons and selected solvents. Once in the stratosphere, every chlorine atom can destroy up to 100 000 ozone molecules. The amount of damage that an agent can do to the ozone layer is expressed relative 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 is very long, and they may continue to deplete the ozone layer long after their use has been phased out. In this publication the ODP values for 100-year timespan are used. Nevertheless some shorter-lived substances may have a very high chlorine loading potential and thus their effect in the short term is much larger than reflected by their ODP value.

Aircraft emissions of nitrogen oxides and water vapour add to this depletion effect by creating ice crystals that serve as a base for ozone destroying reactions.

The main potential consequences of this ozone depletion are:

- increase in UV-B radiation at ground level: a 1 % percent loss of ozone leads to a 2 % 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 the tropospheric ozone and in the oxidising capacity of the troposphere.

International targets for the reduction of ozone depleting substances 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 HCFC by 2040.

The policy fields *Ozone Layer Depletion* and *Climate Change* are different, but closely related and indicators such as CFCs and NO_x emissions appear in both chapters. However, only the potential effects on the ozone layer will be taken into account under *Ozone Layer Depletion* whereas *Climate Change* will focus on the effects on global warming.

OD-1: Emissions of bromofluorocarbons (halons)

Definition

'Emissions of bromofluorocarbons' covers total emissions of halon-1211, halon-1301 and halon-2402 (Montreal Protocol Annex A, Group 1 substances). Ideally, emissions of individual halons should be multiplied by their Ozone Depletion Potentials[1], and summed.

Emissions of halons are extremely difficult to estimate, therefore apparent consumption is used as a proxy. Apparent consumption is calculated as *production + imports - exports ± stocks change*.

Statistics on production and consumption of halons for specific countries are not generally available for publication for reasons of commercial confidentiality, 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-15 only.

Apparent consumption of bromofluocarbons (Halons 1211, 1301, 2402)

g per capita

Halon 1211, 1301, 2402	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
	EU-12	EU-12	EU-12	EU-12	EU-12	EU-12 [1)]	EU-12 [1)]	EU-12 [1)]	EU-12 [1)]	EU-15	EU-15
Apparent consumption	20	25	26	25	22	16	12	6	-	-	-
EU production	41	46	50	41	34	31	20	10	-	-	-
EU imports	0	2	1	2	2	2	2	1	-	-	-
EU sales	22	24	27	24	22	18	13	8	0	0	-
EU exports	21	23	26	18	14	17	10	4	0	-	-

Source: European Commission, DG XI (Statistical factsheet-Ozone Depleting Substances)

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

Problems

In all cases, the data refer to halons produced and traded as such. They exclude halons incorporated in imported products.

In practice, since real emissions or releases of halons are very difficult to estimate, these apparent consumption figures are often quoted instead of emissions data. 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.

The available data group together the three halons and are given in metric units. Thus it has not been possible to convert these data into ODP-weighted units, as this requires the data to be available for the individual components. Due to the large differences in ODP value, no estimation for a group ODP factor can be made.

[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)

Purpose

Depletion of the stratospheric ozone layer will lead to increased ultraviolet (UV-B) solar radiation, which is harmful to human health, and ecosystems (both terrestrial and aquatic). Moreover, evidence exists that the climate system may also be affected by changes in the ozone layer.

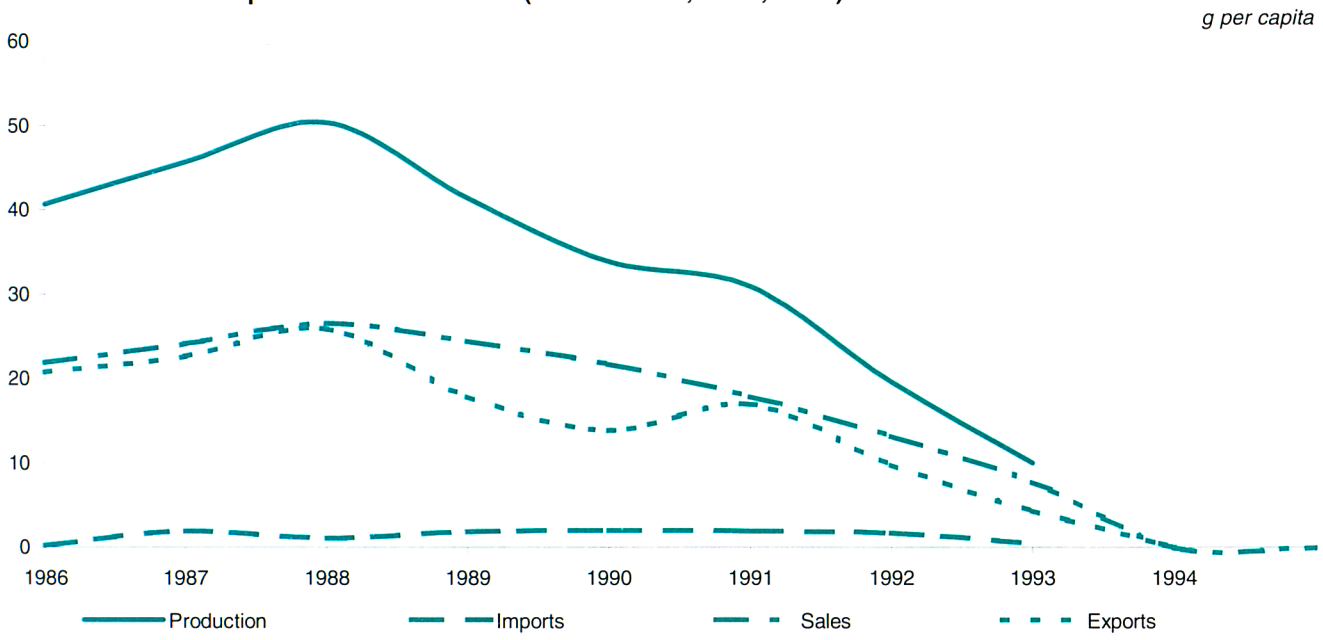
Halons are among the most important ozone-depleting substances. Therefore the main purpose of this indicator is to monitor the emissions of halons (bromofluorocarbons), which are almost exclusively used as fire extinguishing agents.

This indicator is linked to the other ozone-depletion indicators, and to those in the area of *Climate Change*.

Targets

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

Bromofluocarbons production and trade (Halons 1211, 1301, 2402) - EU-12



Source: European Commission, (DG XI)

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

Public awareness of 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 were stopped. This does not mean, however, that emissions are nil, as halons may still be released by older products when they reach the end of their life cycle.

OD-2: Emissions of chlorofluorocarbons (CFCs)

Definition

CFCs are man-made compounds and are used, for example, 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. Ideally, emissions of individual CFCs should be multiplied by their Ozone Depletion Potential[2], and summed. The unit of measurement is therefore ODP-tonnes (CFC-11 equivalents) per year.

Emissions of chlorofluorocarbons (CFC 11, 12, 113, 114, 115)

ODP tonnes

	1986 EU–12	1987 EU–12	1988 EU–12	1989 EU–12	1990 EU–12	1991 EU–12	1992 EU–12	1993 EU–12	1994 EU–12	1995 EU–15	1996 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
CFC 12	98 591	100 145	93 987	66 747	49 099	39 994	36 130	32 925	23 851	13 907	8 575
CFC 113	41 071	43 794	47 143	44 129	41 593	37 271	31 429	21 681	10 004	580	559
CFC 114	6 622	6 382	5 548	4 130	3 028	2 421	2 012	2 449	1 450	188	84
CFC 115	1 417	1 436	1 495	1 586	1 689	1 743	1 862	1 903	1 751	1 391	1 032

Source: McCulloch & Midgley

Problems

Normally in reports concerning Ozone Depleting Substances (ODS), apparent consumption is presented, rather than emissions, since real emissions or releases of CFCs are very difficult to estimate. Apparent consumption is calculated as *production + imports - exports ± stocks change*. However, presenting apparent consumption is misleading as releases from the 'stock' contained in equipment, such as refrigerators, or in products is not taken into consideration. The data presented here do incorporate such releases. The data have been calculated by McCulloch & Midgley[3]. The figures are derived by multiplying the quantities sold by category of end-use with release factors specific to the category of end-use. The precision is believed to be better than ± 20 % in most cases.

The figures cover only the five CFCs in Annex A, group I. There are no data on the 10 CFCs in Annex B, Group 1 of the Montreal Protocol.

[2] 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-211up to and including 217 = 1.0

[3] 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)

Purpose

The main purpose of this indicator is to monitor total emissions of all chlorofluorocarbons.

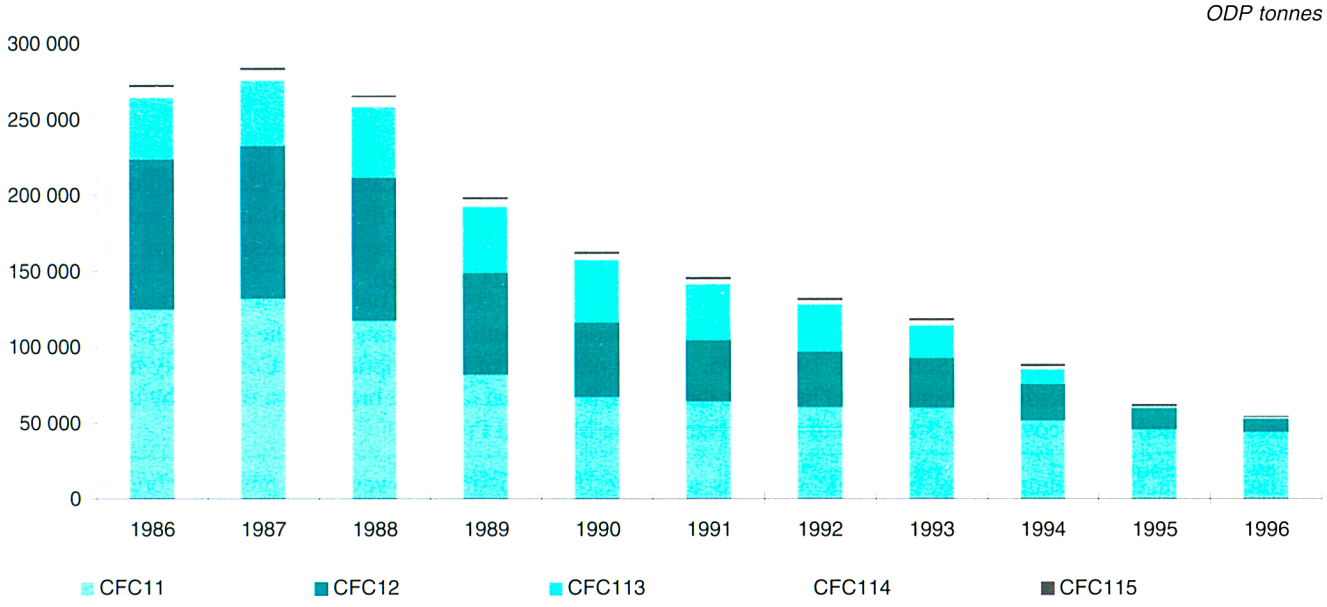
CFCs are among the most important ozone-depleting substances. The indicator is linked to the indicators of other ozone-depleting substances, as well as to those in the area of *Climate Change*. CFCs are greenhouse gases with a relatively high global warming potential. Furthermore, ozone is also a greenhouse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

Targets

In the EU, the production and supply of CFCs is regulated under EC Regulation 3093/94. This obliged Member States to phase out production and consumption of CFCs by January 1995, although limited production for essential uses is allowed.

Under the Montreal Protocol, developing countries may continue to produce up to 15 % of their 1986 level (Annex A substances)[4] or 1989 level (Annex B substances)[5], to satisfy their basic domestic needs. These countries must phase out CFCs by 2010.

Emissions of chlorofluorocarbons (CFC 11, 12, 113, 114, 115) - EU[1)]



Source: McCulloch & Midgley

1) 1986-1994 = EU-12, 1995-1996 = EU-15

Relevancy: Green	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Green

Comments

This figure shows that the EU has made significant progress towards its commitment to phase out CFC production and consumption. However, the figure includes releases of CFCs that are still in use in equipment, and which are not affected by this phase-out. These releases will continue for some time, even after the consumption has fully been reduced to zero. In several cases, however, the CFCs used in certain applications have been replaced by other substances that are believed to be less damaging to the ozone layer, at least on the longer term. This process is presented in *OD-3*.

[4] CFCs included in Annex A to the Montreal Protocol include CFC-11, 12, 113, 114 and 115.
[5] CFCs included in Annex B to the Montreal Protocol include CFC-13, 111, 112 and 211 up to and including 217.

OD-3: Emissions of hydrochlorofluorocarbons (HCFCs)

Definition

Included here are total emissions of HCFCs (Montreal Protocol Annex C, Group I). Emissions of individual HCFCs should be multiplied by their Ozone Depletion Potentials and summed. The unit of measurement is therefore ODP tonnes (tonnes of CFC-11 equivalent emissions) per year.

HCFCs sales - EU-15

tonnes

	HCFC 22	HCFC 141b	HCFC 142b	HCFC 123	HCFC 124	Total
1986	24 659	0	0	0	0	24 659
1987	25 872	0	0	0	0	25 872
1988	30 396	0	0	0	0	30 396
1989	32 300	0	0	0	0	32 300
1990	35 326	0	0	0	0	35 326
1991	37 210	2 400	2 740	450	100	42 900
1992	41 529	4 790	5 480	900	200	52 899
1993	43 660	7 860	8 990	1 500	300	62 310
1994	46 881	14 600	16 700	2 800	600	81 581
1995	52 980	23 600	27 000	4 500	900	108 980
1996	51 741	23 800	25 400	4 350	900	106 191

*Source: E*M*A*I*L*

HCFCs emissions - EU-15

ODP tonnes

	HCFC 22	HCFC 141b	HCFC 142b	HCFC 123	HCFC 124	Total
1986	1 012.5	0.0	0.0	0.0	0.0	1 012.5
1987	1 062.4	0.0	0.0	0.0	0.0	1 062.4
1988	1 166.1	0.0	0.0	0.0	0.0	1 166.1
1989	1 294.3	0.0	0.0	0.0	0.0	1 294.3
1990	1 443.5	0.0	0.0	0.0	0.0	1 443.5
1991	1 542.3	110.0	39.0	2.0	2.2	1 695.5
1992	1 613.4	220.0	84.5	6.0	2.2	1 926.1
1993	1 644.3	352.0	136.5	12.0	4.4	2 149.2
1994	1 731.7	671.0	247.0	22.0	6.6	2 678.3
1995	1 826.3	1 078.0	403.0	38.0	13.2	3 358.5
1996	1 922.6	990.0	331.5	52.0	15.0	3 311.1

*Source: E*M*A*I*L*

Problems

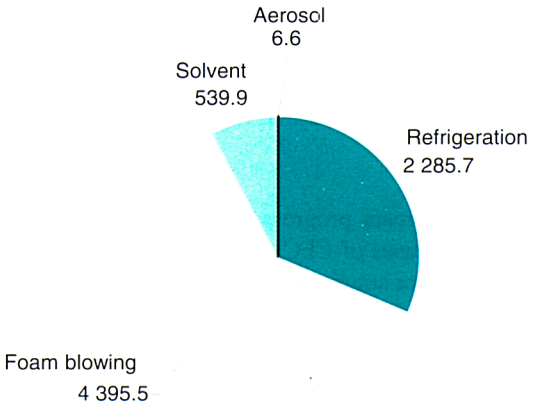
The emissions figures presented here were weighted using standard long term steady state Ozone Depletion Potentials[6], as is usual in calculations of Ozone Depleting Substances. However, HCFCs have shorter lifetimes than CFCs and some have a higher chlorine loading potential. Their contribution to the depletion of the ozone layer in the short term[7] is therefore underestimated by a factor of 4 for HCFC 22 and a factor of 2 for HCFCs 124 and 142b.

The UNEP Ozone Secretariat provides data on consumption of Ozone Depleting Substances in the report 'Production and Consumption of Ozone Depleting Substances 1986-1995.' As the reduction of consumption is a Community matter under the Montreal Protocol, neither the source used here, nor the Ozone Secretariat allows a breakdown of data by country. The figures presented above cover only 5 HCFCs of the 40 listed in the Montreal Protocol.

No breakdown of consumption by economic sector is available. It is possible, however, to present a breakdown by application of the HCFCs. The breakdown is presented in ODP tonnes

HCFC use by application - EU-15 (1996)

ODP tonnes



[6] Long Term Ozone Depletion Potentials of HCFCs vary between 0.001 to 0.1 relative to CFC11 (1.0)
[7] Short Term ODPs of HCFCs vary from 0.1-0.5

OD-3: Emissions of hydrochlorofluorocarbons (HCFCs)

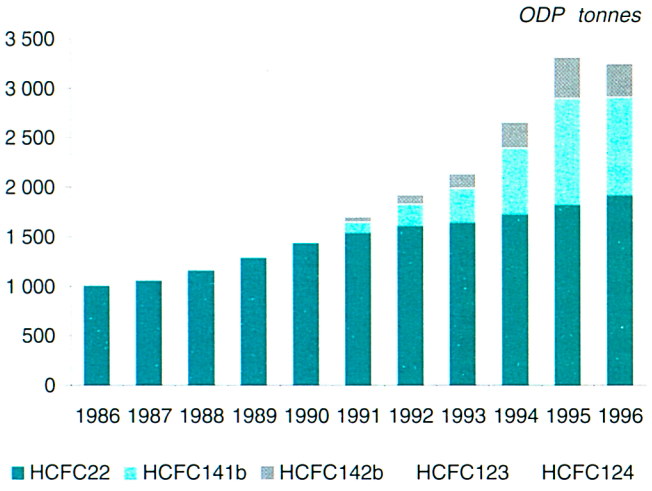
Purpose

The main purpose of this indicator is to monitor total 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 depends on whether one weights by Ozone Depletion Potentials or Chlorine Loading Potentials. HCFCs are viewed as transitional alternatives to CFCs as chlorine-free alternatives are sought and introduced. Until now only sales, use or apparent consumption data were available as a proxy for emissions. However, estimates of emissions are now available. The difference between the two approaches is striking.

Targets

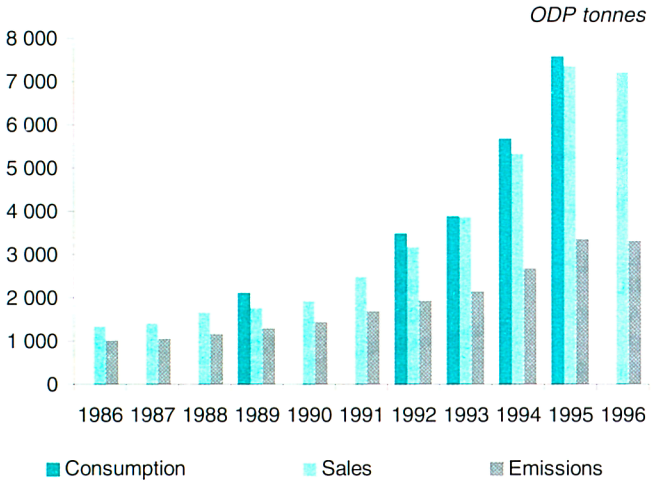
A gradual phasing out of HCFC consumption, starting with a freeze in 1996 at a level 2.8 % above the 1989 level, 35 % reduction in 2004, 65 % reduction in 2010 and phase out in EU-15 in 2015.

HCFC emissions - EU-15



*Source: E*M*A*I*L; Ozone Secretariat*

HCFC consumption, sales & emissions



*Source: E*M*A*I*L; Ozone Secretariat*

Relevancy: Green	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Green

Comments

The historic emissions of HCFCs presented here were calculated by McCulloch & Midgley[8] and adapted by E*M*A*I*L. Figures used for HCFC-22 were obtained from the European Commission, except for small differences for 1995 and 1996. The figure 'HCFCs consumption, sales & emissions' reflects the relationship between sales and emissions. The terms 'consumption' and 'sales' are often perceived to be more or less synonymous with emissions. Due to the introduction of new HCFCs, requiring new and less emitting technologies, the emission of HCFCs is now calculated to be less than half the sales amount.

Since there are almost no stocks of HCFCs, consumption is more or less synonymous with sales. The graph shows little difference between consumption[9] of all 40 HCFCs and sales of the group of 5 HCFCs. From these figures it can be deduced that the remaining 35 HCFCs add relatively little to the problem of Ozone Depletion.

The target of a sales freeze by 1996 at the level of 1989 + 2.8 % is clearly not being met. This line was already crossed in 1991. Growth of emissions of HCFCs 141b and 142b has been particularly strong, and HCFC22 sales continue to grow. Therefore extra commitment will be necessary to bring the phase-out schedule back into line.

[8] Estimated Historic Emissions of Fluorocarbons from the European Union. Atm. Environ. Vol 32, No 9.
[9] 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 nitrogen oxides (NO_x) by aircraft

Definition

Total NO_x emissions from subsonic and supersonic aviation in the upper troposphere or lower stratosphere in tonnes, i.e. emitted during the cruise phase of civil aircraft, flying under Instrument Flight Rules (IFR), at a flight altitude of more than 5 km, coinciding with the 500 hPa level. Half of the emissions should be attributed to the country of departure and half to the country of destination; each stage of a journey is considered as a separate journey. The NO_x emission is a function of distance travelled (as the specific emission coefficient is expressed in kg/km). Therefore, in the absence of data on emissions of NO_x by aircraft, data on aircraft mileage is used as a proxy.

NO_x emissions are also dependant on flight altitude, which affects combustion temperature. The cruising phase has been chosen as being most significant, as the climb and descend phases partially take place below the altitude limit of 5 km.

Total aircraft mileage attributed

mio km

	1990	1991	1992	1993	1994	1995	1996	1997
B	119	116	118	125	133	147	163	177
DK	49	48	54	56	49	62	63	68
D	631	685	720	760	786	832	876	893
EL	88	86	107	112	118	114	104	105
E	485	508	469	477	523	544	566	606
F	408	411	469	489	515	535	569	600
IRL	38	38	40	44	45	48	52	55
I	192	205	221	229	237	262	289	317
L	16	15	15	17	20	22	22	25
NL	160	174	207	233	249	275	300	325
A	60	66	75	77	82	91	99	105
P	118	128	137	130	132	143	146	151
FIN	28	30	27	23	22	29	31	33
S	57	56	63	65	57	64	67	67
UK	727	734	800	832	899	951	986	1 071

*Source: Eurocontrol, E*M*A*I*L*

Problems

A new Eurostat project will calculate aircraft emissions using the emission coefficients calculated for the Cost 319 project (Estimation of Pollutant Emissions from Transport) and using detailed Eurocontrol data for IFR aircraft movements. Flight information will include type of aircraft, enabling the calculation of real emissions. As this project will not deliver data in time for this publication, an alternative estimate based on simplified Eurocontrol data was made.

All flights between an EU Member State and any given destination are multiplied with the associated flight distance. For each destination half of the derived total aircraft mileage is attributed to the Member State, and the other half to the country of destination. Scandinavian countries were reported as one group in the Eurocontrol data before 1994. Data had to be attributed to the individual countries, which accounts for the distinct 'dip' in the data for these countries for 1994.

The methodology used is rather crude. Flights within the greater European airspace are calculated with a fair degree of reliability, but intercontinental flights are attributed a single flight distance for each continent. Therefore the sensitivity and the 'closeness' to real emissions is not very high. The results given by this first estimation are therefore only indicative. This approach is equivalent to assuming that the emission coefficients for all aircraft types are the same. In spite of this, it is felt that this method will give similar trends to the full calculations (see graph).

No estimation for the actual NO_x emissions can be made in this approach, but a rough calculation suggests that in 1997 the total NO_x emissions for EU-15 would amount to approximately 455.6 kilotonnes, assuming all flights were made by Boeing 747.

OD-4: Emissions of nitrogen oxides (NO_x) by aircraft

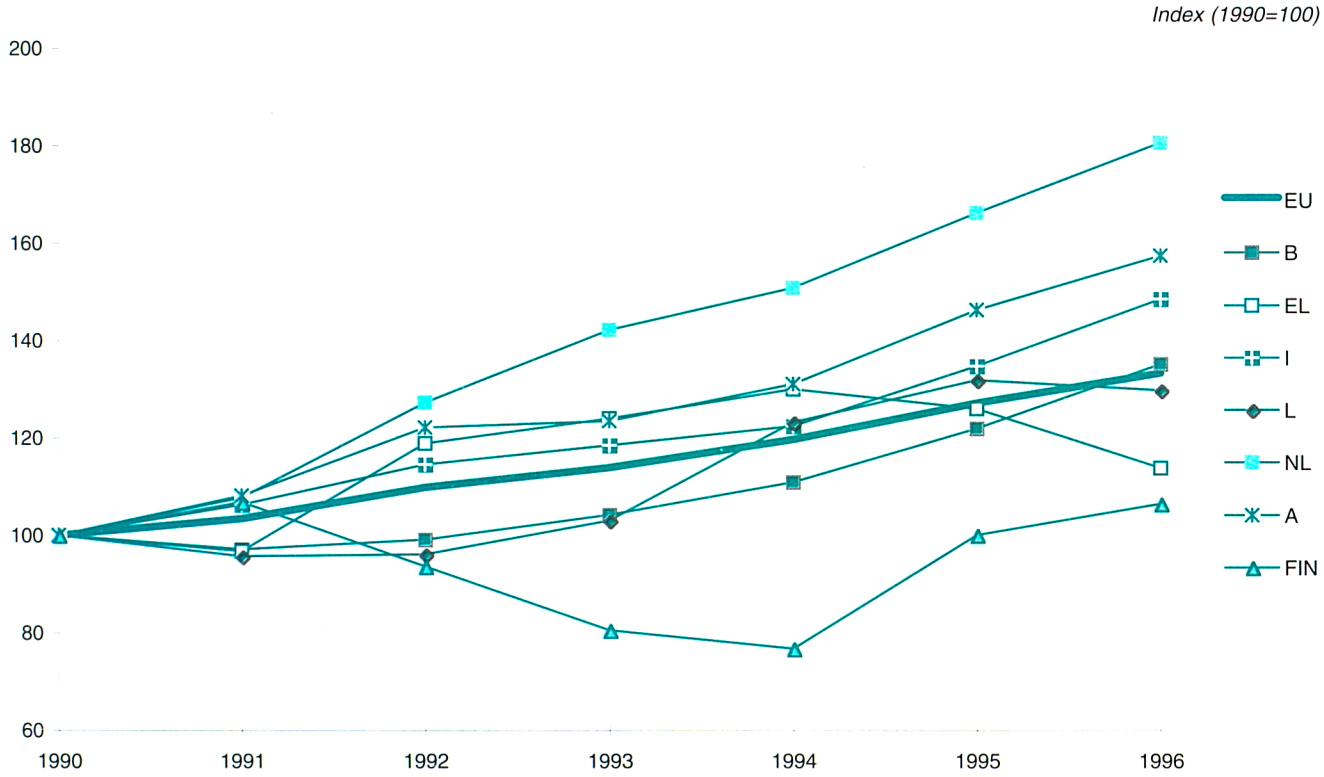
Purpose

The purpose of the indicator is to measure anthropogenic NO_x emissions from subsonic or supersonic aviation in the upper troposphere and lower stratosphere. Due to its short life time, NO_x emitted in the lower troposphere will not reach the stratosphere. Therefore NO_x emitted at lower altitudes should not affect the ozone layer. High altitude NO_x emissions are believed to affect the ozone layer due to the catalytic destruction of ozone by icecrystals arising from water vapor and NO_x emissions in high altitude aircraft. Since air travel is increasing and an increase in supersonic flights, which take place closer to the ozone layer, is planned, this indicator will become more important over time.

Targets

No targets exist for NO_x emissions from aviation.

Attributed flight length per capita - selected Member States



*Source: Eurocontrol (adapted by E*M*A*I*L)*

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Green

Comments

The exact impact of NO_x in the upper troposphere and lower stratosphere is not very well understood. Several studies are currently underway to improve understanding of this mechanism.

In the absolute flight length per country, United Kingdom and Germany take the pole position, followed at a distance by France and Spain, followed again at a distance by the other countries, of which the Netherlands and Italy score highest. The Netherlands has the fastest growth (air traffic has doubled since 1990).

The indicator is presented per capita for reasons of comparability. The steep increase for the Netherlands can be explained by the high number of flights to and from Schiphol International Airport, relative to the number of Dutch inhabitants. It is followed by Austria, Italy and Belgium, which have steep growth curves. The attributed flight length for Greece has been diminishing since 1994. The decrease for Luxembourg in 1996 is caused by an increase in population, rather than a decrease in flight km.

OD-5: Emissions of chlorinated carbons

Definition

The total anthropogenic emissions of carbon tetrachloride (CCl_4) and methyl chloroform (1,1,1-trichloroethane; CH_3CCl_3), Montreal Protocol Annex B, Group II and III substances. The emissions of the two individual compounds should be multiplied by their Ozone Depletion potential[10], and summed. The unit of measurement is therefore ODP-tonnes (tonnes of CFC-11 equivalent emissions) per year.

Chlorinated carbons sales - EU

ODP tonnes

	Carbon Tetrachloride			Methyl Chloroform		
	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	:	1 905	8 360	3 789	5 637
1995	4 706	:	:	:	3 509	4 425
1996	463	:	:	:	:	:

Source: EEA

Problems

Emission figures are not available for chlorinated carbons. The real emissions due to the use of chlorinated carbons have not been researched. However, there are two data sources that provide important information: the Ozone Secretariat and the European Environment Agency. The definitions of 'production' and 'consumption' used by the Ozone Secretariat are confusing and do not add to the estimation of emissions. We therefore present the sales data as the closest estimation of emissions in the EU.

Unfortunately no breakdown into the contributing economic sectors can be made.

[10] Ozone Depletion Potentials:
CFC-11 = 1.0 (Reference)
CCl4 = 1.1; CH4CCl3 = 0.1

OD-5: Emissions of chlorinated carbons

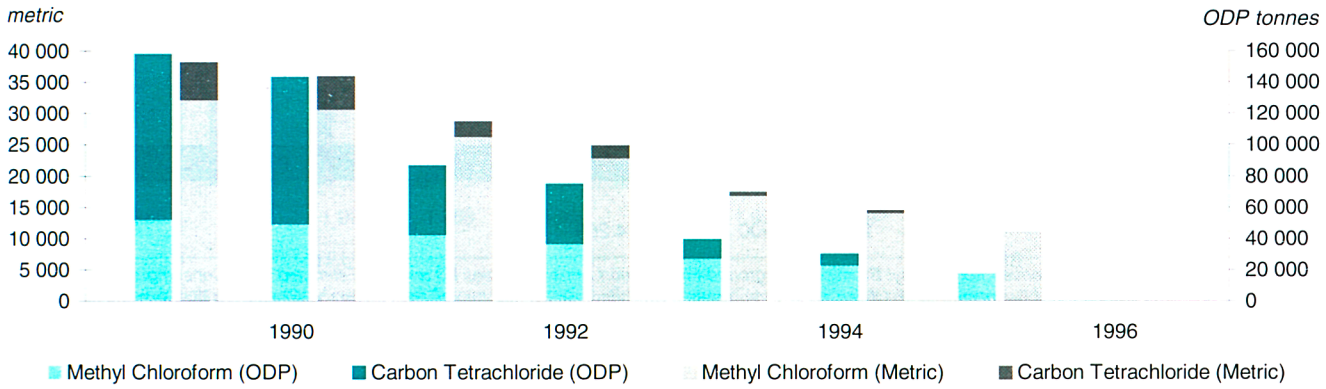
Purpose

The main purpose of this indicator is to monitor anthropogenic sources of emissions of chlorinated carbons. Carbon tetrachloride and methyl chloroform are major anthropogenic source gases for stratospheric chlorine, and hence stratospheric ozone destruction. Carbon tetrachloride and methyl chloroform are man-made compounds. Carbon tetrachloride is used as a fire extinguishing agent, and in pesticides and dry cleaning agents. Methyl chloroform is used for cleaning metal.

Targets

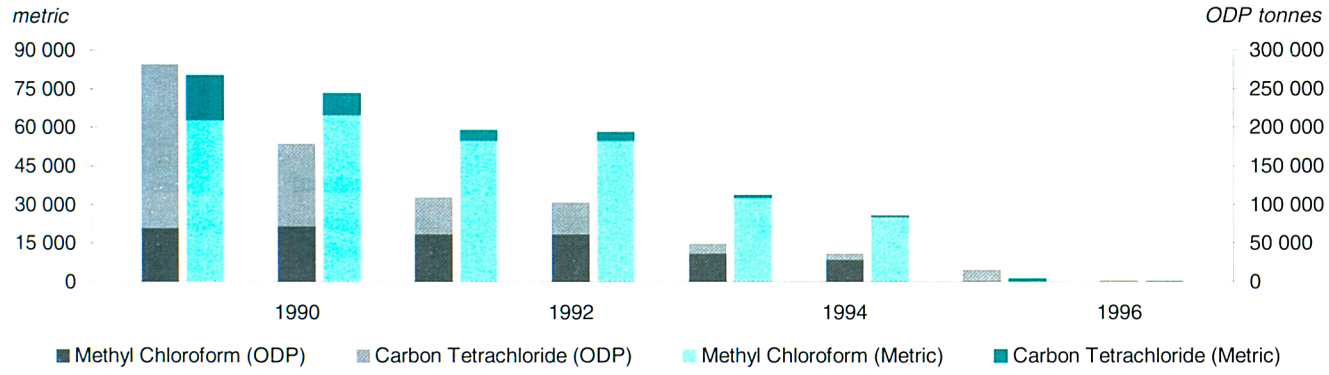
EU-15 countries have been obliged to completely phase out carbon tetrachloride by 1995 and methyl chloroform by January 1, 1996 (zero production and consumption; with possible exemption for essential uses). In order to satisfy the basic domestic needs of developing countries, the production may amount to 15 % of its 1989 level.

Chlorinated carbons sales - EU



Source: EEA

Chlorinated carbons production - EU



Source: EEA

Relevancy: Yellow	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

The phasing out of production and consumption (and thus of emissions) of chlorinated carbons has been successful over the past years, and although some data are lacking for 1995 and 1996, it can be concluded that the production of chlorinated carbons has been almost phased out. This is true for carbon tetrachloride sales. The sales of methyl chloroform have not been entirely phased out. As no level of sales has been defined for 'essential use,' no evaluation can be made as to the acceptability of the remaining methyl chloroform sales.

Since 1992 more chlorinated carbons have been sold and exported than produced in the EU. As no import takes place, stocks must be decreasing.

OD-6: Emissions of methyl bromide (CH_3Br)

Definition

Total emissions of methyl bromide (CH_3Br), Montreal Protocol Annex E, Group I, multiplied with its Ozone Depletion Potential[11]. The unit of measurement is therefore ODP tonnes (tonnes of CFC-11-equivalent emissions) per year.

Three potentially major anthropogenic sources of methyl bromide have been identified: agricultural use (mainly fumigation), biomass burning, and exhausts of cars using leaded gasoline. Agricultural emissions are presumed to equal the agricultural use of methyl bromide.

Methyl bromide use - EU-12

ODP tonnes

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
EU-12 [1)]	7 490	8 294	9 438	9 154	10 324	9 463	9 578	18 329	:	:	11 030	11 484

1) 1993, 1996 and 1997 figures refer to EU-15

Methyl bromide use - EU-15 (1993)

ODP tonnes

	B	DK	D	EL	E	F	IRL	I	L	NL	A	P	FIN	S	UK
1993	174	14	:	570	2 400	900	:	4 200	:	:	:	61	:	:	312

Source: EU-12 data 1986-1992 derived from Methyl Bromide Background-Final Report Annex F Tables F3 and F4 (Estimated Total Consumption) ; 1993 data: Methyl Bromide Background-Final Report Annex F-1 (Use for soil treatment) ; 1996 data: DGXI use for soil fumigation.; 1997 data: DGXI Consumption figures (Production+Import-Export)

Problems

The tables above refer to industrially produced methyl bromide. No adequate data and/or emission coefficients have been found for biomass burning and emissions of cars running on leaded fuel. The latter is currently of less importance as the use of leaded fuel is diminishing rapidly. For biomass burning, some studies have been conducted for Africa and South America but no relevant sources have been found for Europe. It is not known whether emission coefficients for these areas are applicable for Europe.

[11] The long-term Ozone Depletion Potential for methyl bromide is 0.6, as opposed to its short-term ODP, which exceeds 10! Therefore the data presented here show a serious underestimation of damage to the Ozone Layer in the short term.

OD-6: Emissions of methyl bromide (CH_3Br)

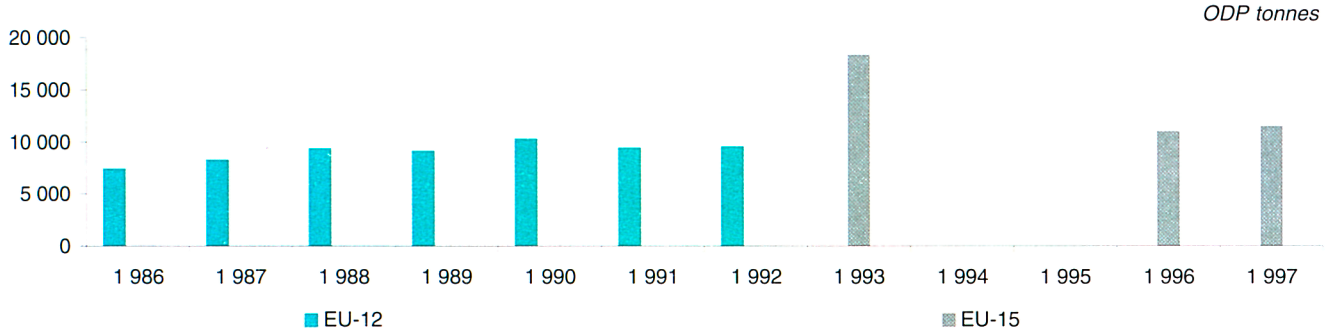
Purpose

Methyl bromide, a major anthropogenic source for stratospheric bromine, is viewed as a significant ozone-depleting compound. The main purpose of this indicator is to monitor the total anthropogenic emissions of methyl bromide (CH_3Br).

Targets

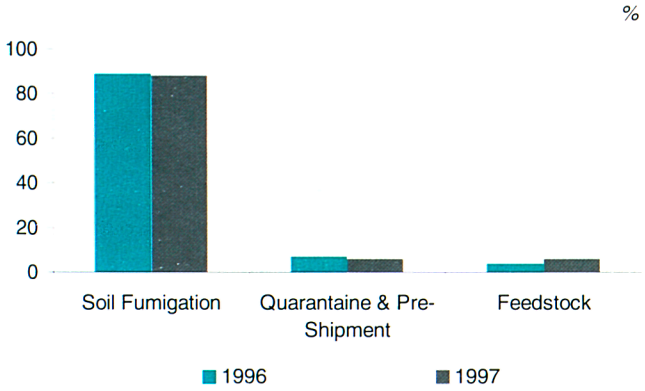
Since 1 January 1995, industrialised countries have been obliged to limit their consumption of methyl bromide to the calculated level of consumption in 1991. In order to satisfy the basic domestic needs of developing countries, production may exceed the production level of 1991 by up to 10 %. In addition, a gradual phasing out of methyl bromide is required, to be finalised in 2005 with possible exemptions for critical agricultural use.

Methyl bromide use - EU



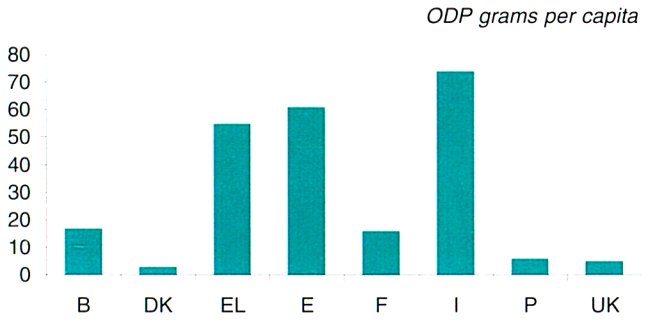
Source: Methyl Bromide Background-Final Report Tables F1-F4; DGXI (Pers. Comm.); EU-15 (1993) estimated based on soil fumigation data and share of soil fumigation in total Methyl Bromide use (1996); 1993 soil fumigation: data for 8 Member States

Methyl bromide use by application - EU (1996)



Source: European Commission (DG XI)

Soil fumigation by country (1993)



Source: Methyl Bromide background-Final report tables F1- F2

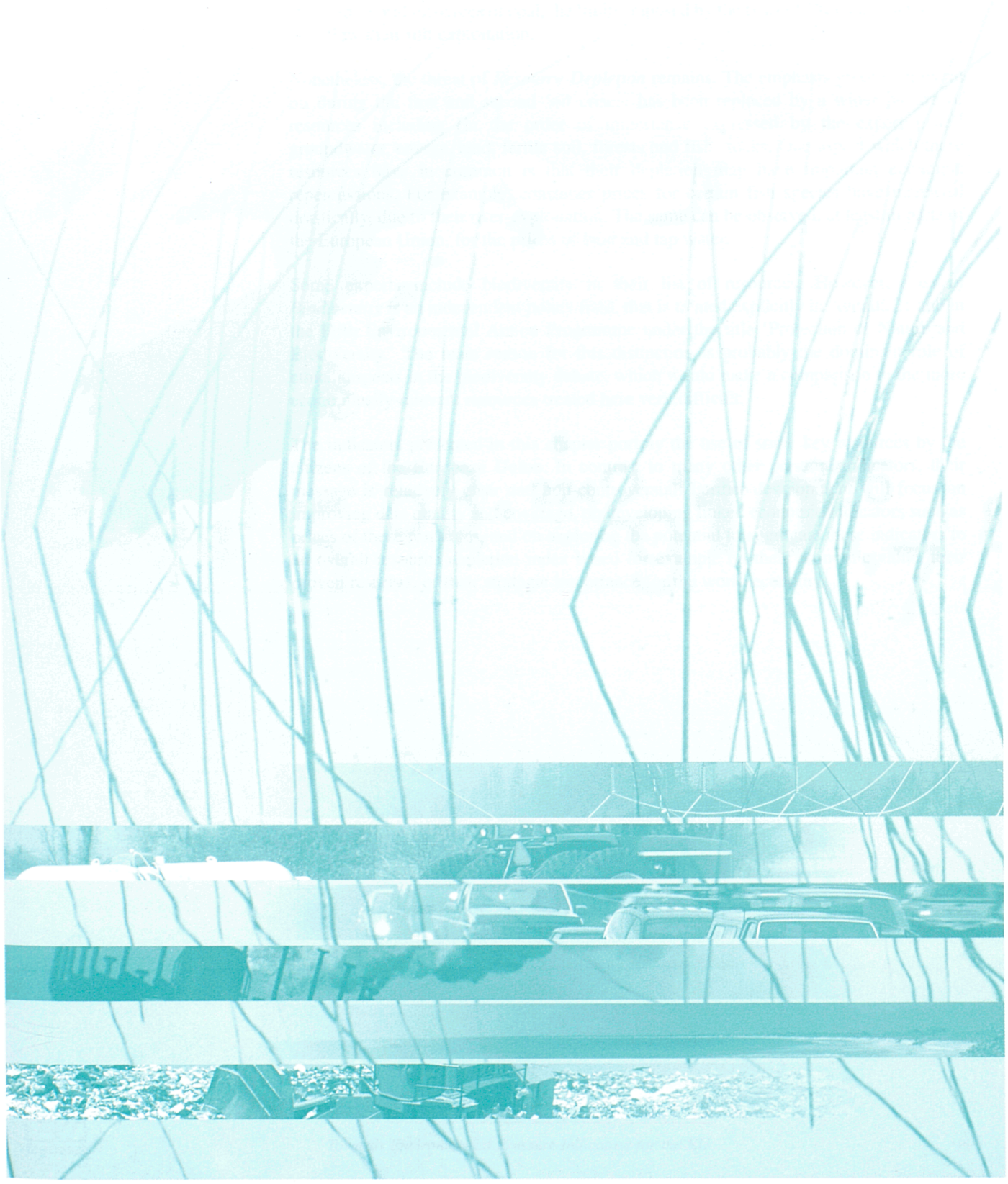
Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

The EU has not yet succeeded in limiting its consumption of methyl bromide to the 1991 level. The target level is exceeded by 4 %. There is no sign yet of a gradual phasing out of use of methyl bromide. Large differences exist between EU Member States.

The differences in the totals used in the different countries reflect both the types of horticulture in the different areas, and the prevailing legislation. The system of maximising yields and monoculture results in pest and disease infection of soil, which is most easily treated by methyl bromide. Ninety percent of all methyl bromide use is for soil fumigation; other uses are quarantine and pre-shipment treatment of exports of foodstuffs and timber. CH_3Br is used largely in southern European countries, especially Italy on open-field tomatoes and in Spain on open-field strawberries. In the Netherlands, Sweden, Finland, Austria, Germany, Luxembourg, and Denmark its use is severely restricted or banned.

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*. Many of the resources that drive our economies are limited and will therefore one day be exhausted, if we continue to use them at current rates.

Twenty-five years after 'Limits to Growth,' the focus of environmental policy has shifted to other policy fields. For example, we have realised that, in spite of fairly abundant world resources of coal, the limits imposed by the risks of Climate Change will not allow their full exploitation.

Nonetheless, the threat of *Resource Depletion* remains. The emphasis given to mineral oil 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. One aspect which these resources have in common is that their depletion may have important economic repercussions. For example, consumer prices for certain fish species have increased drastically, due to their over-exploitation. The same can be observed, at least in parts of the European Union, for the prices of land and tap water.

Some experts include biodiversity in their list of resources. However, *Loss of Biodiversity* is an independent policy field, that is treated explicitly in Agenda 21 and in the Fifth Environmental Action Programme under the title 'Protection of Nature and Biodiversity.' The main reason for this distinction is probably the dominant role of ethical aspects in the biodiversity debate, which would make a comparison to the more economically relevant resources treated here very difficult.

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. Further development will focus on improving data quality and coverage, on developing linked economic indicators such as prices of these resources, and on exploring the potential to aggregate these indicators to an overall resource depletion index based for example on their economic value, their proven reserves, or their strategic importance for the world economy.

RD-1: Water consumption

Definition

Total annual demand for drinking water, process water and irrigation water by all economic sectors, expressed in cubic metres per year per capita. The quantity of fresh water 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. The demand can be quantified based on figures on supply to users. If required, abstraction figures can also be used. Water abstracted from surface water to be used as cooling water is returned and does not contribute to depletion. This fraction should not be included in the indicator, but the statistical data available do not always allow such a precision.

The indicator is measured in units per capita to enable direct comparison between countries.

Fresh ground and surface water consumption

m^3 per capita

	1980	1985	1990	1991	1992	1993	1994	1995
B	917	:	:	:	:	:	:	:
DK	:	333	233	:	:	:	:	:
D	:	:	742	579	:	:	:	:
EL	523	:	:	:	:	:	:	:
E	1 068	1 204	857	948	:	:	:	849
F	698	631	:	:	:	615	:	:
IRL	315	:	:	:	:	:	:	:
I	996	919	:	:	:	:	:	:
L	109	:	124	:	:	:	:	139
NL	650	645	522	517	:	:	:	:
A	290	280	326	:	298	282	:	:
P	1 075	:	736	:	:	:	:	:
FIN	774	816	471	534	439	460	478	:
S	494	356	347	345	343	339	337	309
UK	:	:	:	:	:	:	:	:

Source: Eurostat

Problems

Even though water use is very simple to aggregate, the quality of the data sets does not allow reasonable time series to be drawn up. Therefore data sets are not comparable between Member States and only trends can be observed.

Water resources are renewable, therefore to properly assess depletion it is necessary to compare consumption to rates of replenishing, especially groundwater. However there is a lack of appropriate data for this comparison.

The per capita figures for Mediterranean countries are calculated using the normal population, and do not include the massive influx of tourists each summer, which temporarily, but regularly inflates the population and adds extra pressure to water resources. The result is that the figures for countries with a large tourist industry are well above the EU average.

RD-1: Water consumption

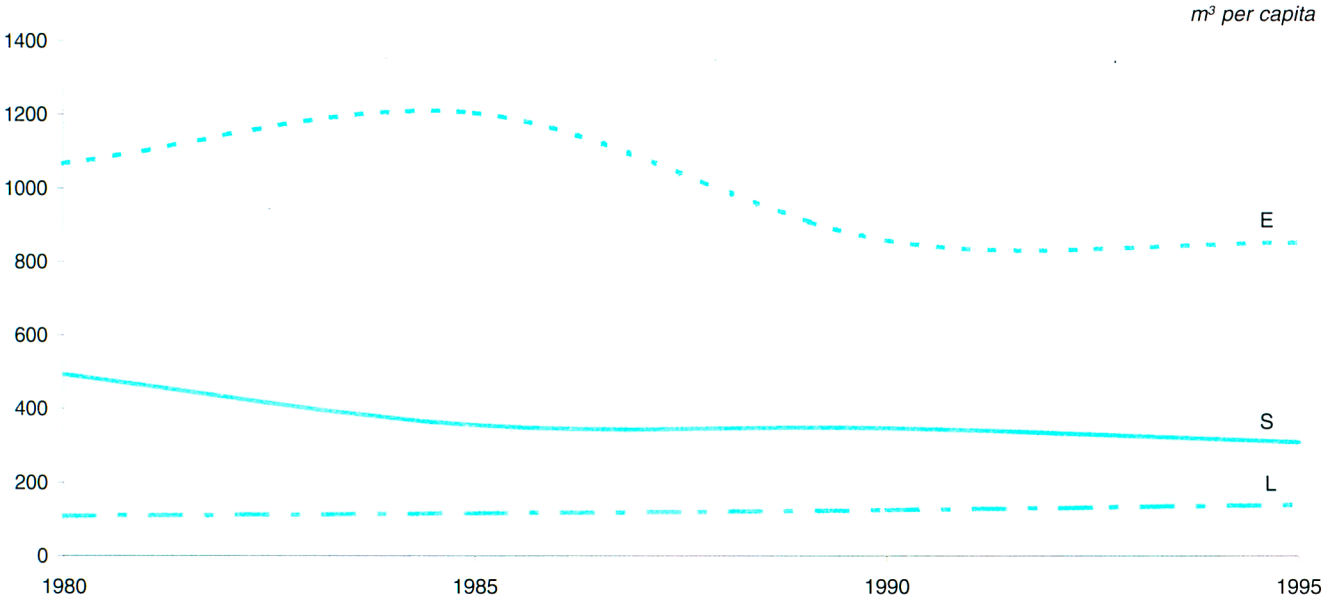
Purpose

The purpose of this indicator is to present the pressure exerted on water resources by demand for fresh water of a certain quality, demand which comes from all economic sectors. However pressure is related also to availability and to renewal rates, and therefore is not significant in sparsely populated northern countries.

Targets

No targets exist for this indicator.

Water consumption evolution - selected Member States



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Yellow	Comp.Space: Yellow

Comments

It is difficult to compare water abstraction data between countries. Data are not yet homogeneous and the uses by sector may vary widely.

The amount of fresh water used for cooling in electricity generation varies from 8 to 74 % depending on the country. In Mediterranean countries irrigation and tourism are important users of water whereas abstraction for public water supply is generally 10 % to 20 % of total abstractions. In countries where self-supply is free, industry abstracts most of the water directly. This practice is becoming less common as governments try to manage better available water resources and require permits for water abstraction.

RD-2: Energy use

Definition

The indicator covers the gross inland consumption of energy per capita. The use of energy is a measure of the energy intensity of society. The quantity of energy used per capita is directly related to individual and industrial energy consumption patterns.

Statistics on gross inland consumption show the gross inputs for Member States, which can be broken down by type of fuel source. It is a key aggregate in the energy balances. It represents the quantity of energy necessary to satisfy energy demand for a given country, calculated as follows:

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

Gross inland energy consumption

toe per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
EU-15	3.4	3.4	3.5	3.5	3.5	3.6	3.7	3.6	3.6	3.6	3.7	3.8
B	4.4	4.6	4.6	4.6	4.7	4.7	4.9	5.0	4.8	4.9	4.9	5.3
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
D	4.4	4.4	4.4	4.4	4.3	4.4	4.3	4.2	4.1	4.1	4.1	4.3
EL	1.9	1.9	1.9	2.1	2.2	2.2	2.2	2.3	2.2	2.3	2.4	2.4
E	1.9	1.9	2.0	2.2	2.2	2.3	2.4	2.4	2.3	2.5	2.6	2.6
F	3.7	3.7	3.8	3.7	3.9	3.9	4.1	4.0	4.1	3.9	4.0	4.3
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
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
L	8.5	8.4	8.2	8.5	9.0	9.3	9.7	9.7	9.7	9.3	8.1	8.2
NL	4.2	4.4	4.5	4.4	4.4	4.5	4.6	4.6	4.6	4.6	4.7	4.9
A	3.1	3.2	3.3	3.2	3.2	3.3	3.5	3.2	3.2	3.2	3.3	3.4
P	1.2	1.3	1.4	1.5	1.7	1.7	1.8	1.9	1.9	1.9	2.0	2.0
FIN	5.5	5.7	6.1	5.7	5.9	5.7	5.8	5.6	5.8	6.0	5.7	6.0
S	5.6	5.9	5.8	5.8	5.6	5.5	5.6	5.3	5.3	5.6	5.6	5.8
UK	3.6	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.8	3.8	4.0

Source: Eurostat

Problems

No problems were encountered for this indicator.

RD-2: Energy use

Purpose

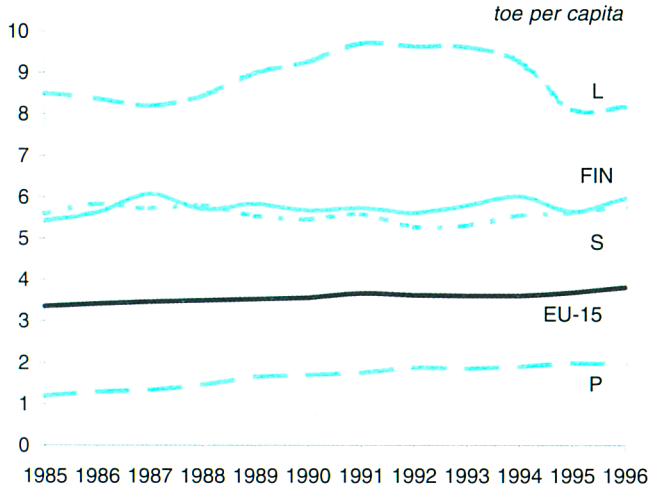
The indicator represents the overall pressure on energy resources.

Energy consumption requires the use of non-renewa-ble resources such as coal, oil, (natural) gas, uranium, semi-renewable resources such as biogas, wood and waste, and of renewable resources such as water, wind and solar energy. Only a very small percentage of the resources presently used are fully renewable. Therefore an increase in overall energy use will directly increase the use of non-renewable resources. In addition to this, the use of energy also puts pressure on the use of space. Note that this indicator includes nuclear energy use, as recommended by the Scientific Advisory Group. Although resources of uranium are fairly high compared to fossil fuels, they are not unlimited, and often found only in regions where political instability may pose a threat to supply security. Furthermore, the nuclear fuel cycle also requires a considerable amount of non-nuclear resources.

Targets

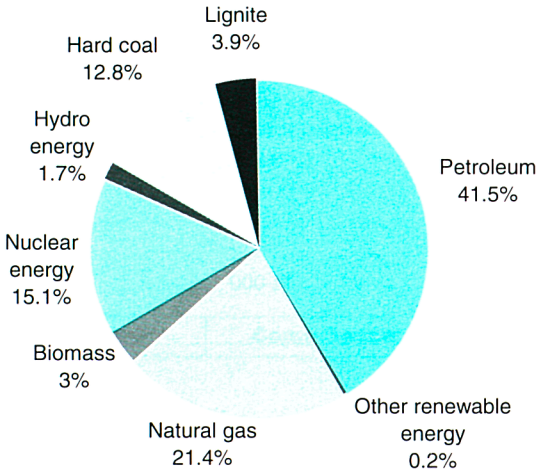
There are no precise targets for energy use. Existing texts refer to use of energy in general terms: for example, the European Energy Charter aims to advance energy efficiency, Article 130 of the Treaty on the European Union calls for prudent and rational utilisation of natural resources, and the Energy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

Gross inland energy consumption - EU-15



Source: Eurostat

Gross inland energy consumption, by resource EU-15 (1996)



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

Gross inland consumption in EU-15 increased by 14 % between 1985 and 1996. The largest increase was for natural gas (+ 54 %), which represeented 16 % of gross inland consumption in 1985 and 21.4 % in 1996. Nuclear energy increased by 45 % over the same period, to account for 15.1 % of gross inland consumption in 1996, compared to 11.9 % in 1985. The biggest fall (- 46 %) was for lignite, due to the move away from this fuel in the new German Länder.

RD-3: Increase in territory permanently occupied by urbanisation

Definition

This indicator represents the total annual increase in land which is permanently occupied by urbanisation, infrastructure, waste-tips and quarries expressed in square kilometres.

The annual increase in the urbanisation of land is related to economic growth. Unlike indicator UP-6 (see *Urban Problems*), this indicator includes only the use of territory by infrastructure and urbanisation and not the use for recreation as the latter is not considered irreversible. Also this indicator is depicted in km^2, whereas UP-6 is depicted in m^2 per capita for reasons of comparability. Urbanisation includes areas in use for living and small societal activity but excludes other uses such as industrial areas. Infrastructure includes roads, railways, ports and airports. Because the distinction between different uses is not always clear cut, this indicator will never be very exact. It is expected however to give a good indication of the trend in the pressure on land resources.

Area with built-up land

km^2

	1970	1980	1990	1991	1992	Change 80-90
B	:	4 870	5 605	:	:	15%
DK	:	:	:	:	:	:
D	25 226	30 004	33 722	:	:	12%
EL	4 661	4 893	:	:	:	:
E	18 768	18 518	19 292	:	:	4%
F	:	25 370	29 149	:	:	15%
IRL	:	:	:	:	:	:
I	:	:	38 870	:	:	:
L	:	:	:	:	183	:
NL	3 215	5 085	5 484	:	:	8%
A	:	:	2 740	2 740	2 740	:
P	:	:	14 140	:	:	:
FIN	:	:	:	:	:	:
S	11 000	11 550	11 720	:	:	1%
UK	:	17 500	:	:	:	:

Source: EEA

Problems

The main problem is the lack of suitable data to compile this indicator. Moreover, it can be difficult to distinguish urban areas from, for instance, industrial areas.

RD-3: Increase in territory permanently occupied by urbanisation

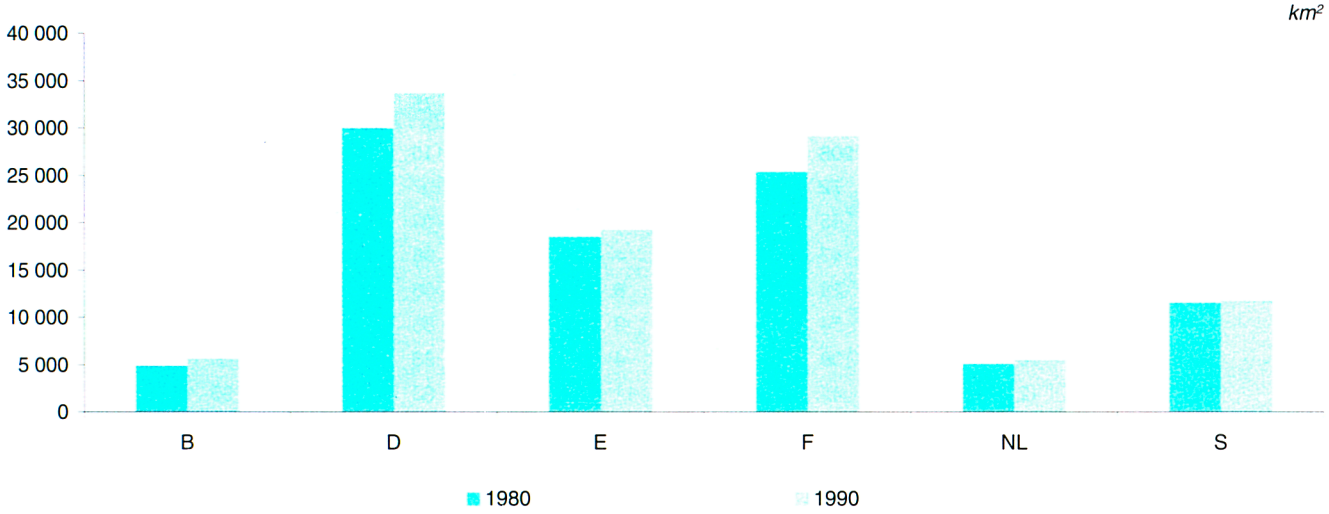
Purpose

Land which can still be used multifunctionally is considered to be a natural resource. Irreversible occupation of territory is considered as a depletion of this resource. The indicator represents the increase in use which reflects the overall pressure on the use of land for urbanisation and infrastructure. Urbanisation and infrastructure are considered the major causes of pressure on land resources.

Targets

Reference levels for this indicator can be derived from existing policy targets in the field of urban and infrastructural planning.

Area with built-up land - selected Member States



Source: EEA

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

Between 1980 and 1990, built up area increased by over 10 % in Belgium, Germany and France.

RD-4: Nutrient balance of the soil

Definition

This indicator corresponds to the average balance of input and output of nitrogen and phosphorus per hectare of agricultural area per year. At this stage only nitrogen is considered.

The difference between input and output gives the figure for this indicator. The input includes organic and mineral fertilisers, as well as input from biological nitrogen fixation and atmospheric deposition. The output includes the nitrogen removed from the soil by harvesting and grazing, the latter being estimated on grass consumed based on fodder requirements.

Soil surface nutrient balance (1995)

kg per hectare

	Nitrogen inputs (kg/ha[1])				Nitrogen output (kg/ha[1])	Nitrogen balance (kg/ha[1])
	Atmospheric deposition	Livestock Manure	Biological nitrogen fixation	Mineral fertiliser		
EU-15	16	57	7	75	95	60
B	33	206	5	110	251	103
DK	18	72	11	107	136	72
D	32	65	7	103	106	102
EL	7	47	4	96	96	58
E	6	28	8	36	40	37
F	20	54	9	85	110	57
IRL	10	109	4	98	159	62
I	12	45	11	63	55	76
L	27	114	5	143	168	121
NL	31	282	2	195	297	213
A	20	48	5	37	94	16
P	4	39	5	35	60	22
FIN	5	32	4	84	74	51
S	5	39	5	70	80	38
UK	18	65	6	81	129	40

Source: Eurostat

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

Problems

The main problem is that national data can hide large regional differences, particularly in larger countries. In this publication it is not possible to produce regional results, however these are published by Eurostat in 'Nutrients in Agriculture', Eurostat 1999. The soil surface phosphorus balance will be also available in the near future.

RD-4: Nutrient balance of the soil

Purpose

The indicator represents the overall pressure on the main quality aspect of the soil.

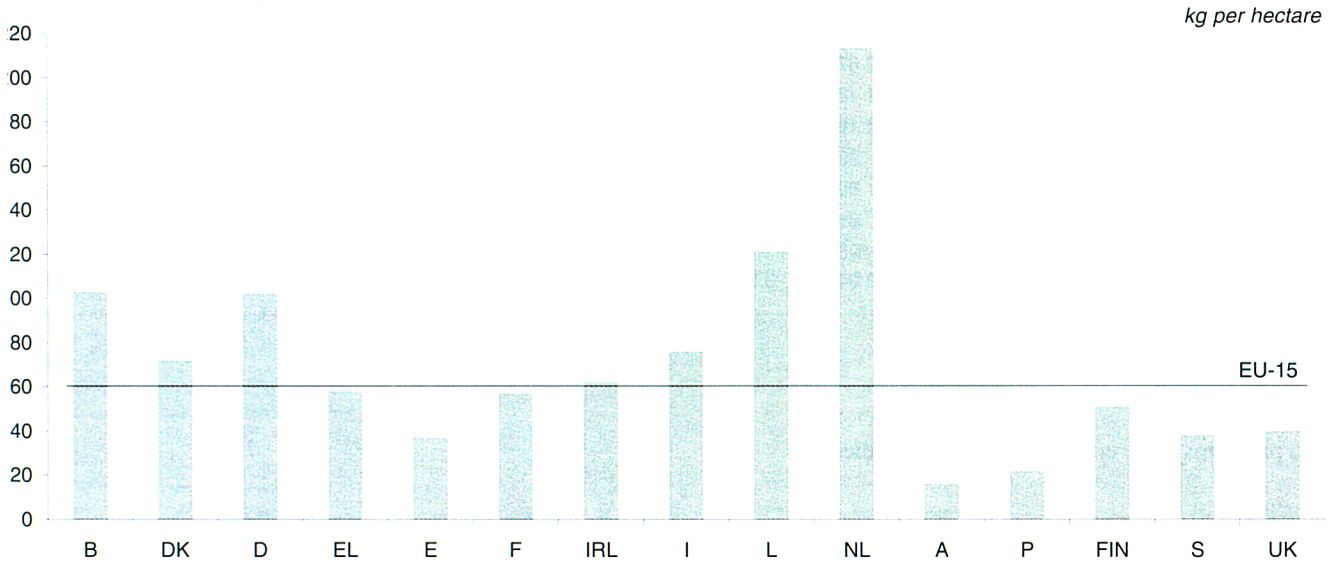
Nutrients need to be applied to most agricultural soils to maintain high crop yield. Crops and plants take up nutrients - primarily nitrogen (N), phosphate (P_2O_5) and potassium (K_2O) from the soil as they grow. Other nutrients are required in smaller amounts. The excessive use of manure and chemical fertilisers by agriculture is considered to be one of the most important threats to soil quality.

Improving nutrient management to reduce losses to the environment is essential, and requires assessing nutrient need, timing nutrient application and placing nutrients close to crop roots.

Targets

The Nitrates Directive (91/676/EEC) requires countries to identify vulnerable zones and to take steps to reduce inputs, particularly of manure, to more sustainable levels.

Soil surface nitrogen balance (1995)



Source: Eurostat

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

Because the regional differences in nitrogen surpluses are so great even within one country, it is difficult to comment usefully on these figures.

For the purposes of the Nitrates Directive, the Netherlands, Luxembourg, Germany, Denmark and Austria have declared their whole territory to be vulnerable zones.

It is interesting to note that atmospheric deposition of nitrogen, usually as ammonia and nitrogen oxides, can account for a significant proportion of the surplus in some countries. Therefore measures to tackle air pollution should also have beneficial effects on the soil surface nitrogen balance.

RD-5: Electricity production from fossil fuels

Definition

Electricity generation from fossil fuels corresponds to the total amount of electricity produced from fossil resources (oil, coal, lignite and gas, including blast furnace gas). The indicator represents the overall pressure on non-renewable resources for the production of electricity.

Net electricity production from fossil fuels

kWh per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
EU-15	2 435	2 446	2 507	2 457	2 620	2 699	2 980	2 899	2 803	2 878	2 976	3 071
B	1 790	1 440	1 635	1 698	2 140	2 295	2 361	2 320	2 349	2 570	2 680	2 902
DK	5 325	5 614	5 358	5 053	4 171	4 565	6 472	5 389	5 878	6 955	6 301	9 201
D	3 142	3 204	3 171	3 096	3 149	3 247	4 337	4 104	4 015	4 020	4 035	4 066
EL	2 504	2 489	2 727	3 068	3 202	3 248	3 184	3 368	3 439	3 612	3 598	3 322
E	1 615	1 560	1 544	1 267	1 728	1 715	1 727	1 972	1 789	1 848	2 060	1 813
F	869	649	580	530	830	728	958	780	507	498	592	694
IRL	3 080	3 184	3 272	3 308	3 543	3 752	3 918	4 089	4 186	4 319	4 570	4 716
I	2 228	2 307	2 655	2 671	2 894	3 031	2 941	3 012	2 966	3 066	3 325	3 164
L	1 032	1 136	1 129	1 185	1 280	1 281	1 407	1 337	1 334	1 050	841	860
NL	3 846	4 086	4 183	4 182	4 356	4 276	4 407	4 512	4 430	4 551	4 587	4 857
A	1 054	1 096	1 054	924	1 041	1 230	1 326	1 193	1 556	1 736	1 879	2 109
P	720	1 049	967	894	1 809	1 763	1 910	2 321	2 073	1 891	2 274	1 807
FIN	565	624	732	859	1 023	1 271	1 201	1 303	3 982	5 124	4 588	5 967
S	377	349	305	256	197	187	301	378	703	849	760	1 301
UK	3 860	3 928	4 003	3 945	3 868	4 025	4 025	3 850	3 740	3 772	3 914	4 033

Source: Eurostat

Problems

No problems were encountered for this indicator.

RD-5: Electricity production from fossil fuels

Purpose

Non-renewable resources such as coal, lignite, oil, (natural) gas and uranium are by far the most important resources for electricity production.

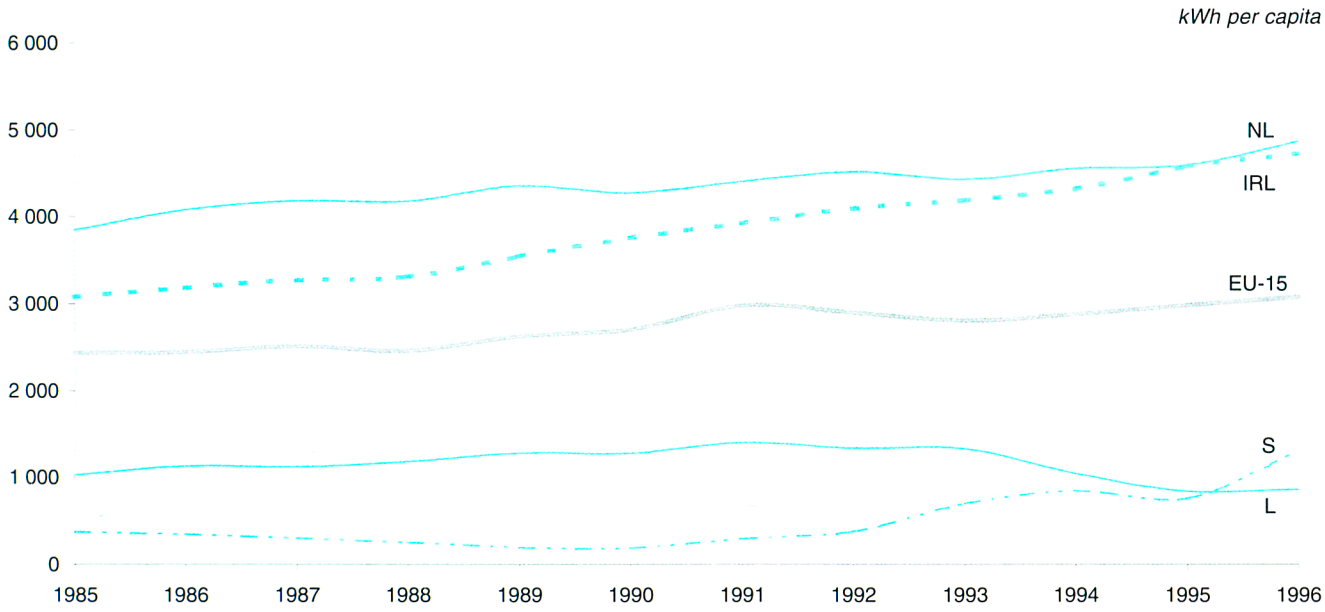
In contrast to the previous indicator on energy use, nuclear energy is not included here. The role of nuclear energy continues to be controversial, but irrespective of the trends of this societal debate, there are technical and economic reasons why the use of nuclear energy will remain limited to electricity generation. The vote of the *Resource Depletion SAG* to exclude nuclear energy here, but to include it in general energy use, reflects the logic 'If society decides to use nuclear energy, it will be limited to electricity generation; in any case, the use of fossil fuels unnecessary for electricity production should be avoided when they could be used directly, thus avoiding the conversion losses'.

From an environmental point of view, there is an urgent need to substitute renewable energy sources for fossil fuels in electricity generation and to reduce electricity use.

Targets

No targets have been established for this subject.

Electricity production from fossil fuels



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

The total production of electricity is steadily growing, in line with economic trends. The share of fossil fuels is almost constant at 51 %, and renewable resources still play a minor role in most Member States. Hydroelectric power plays an important role in some Member States (especially in Sweden, Finland and Austria). The share of wind energy is rapidly growing in Member States with favourable conditions (Denmark), and is expected to increase as the cost of producing electricity from wind falls.

RD-6: Timber balance

Definition

Timber balance here 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 data are extracted from the updating of the UNECE Forest Resource Assessment 1990 (FRA-1990). The updating refers to 1995. The concepts are defined as follows: *Net annual increment* is gross increment less 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.

Timber balance (1995)

	1000m^3 fellings	1000 m^3 net annual increment (NAI)	% fellings/NAI
EU-15	130 874	258 756	51
EU-12	277 330	462 630	60
B	3 326	4 457	75
DK	2 000	3 200	63
D	37 190	79 000	47
EL	3 376	3 813	89
E	15 014	28 891	52
F	36 045	76 753	47
IRL	2 250	3 330	68
I	6 997	33 942	21
L	345	132	261
NL	1 568	2 258	69
A	19 846	31 416	63
P	13 738	11 818	116
FIN	58 410	74 858	78
S	68 200	97 600	70
UK	9 025	11 162	81
IS	:	:	:
NO	11 635	24 240	48
CH	5 760	6 670	86

Source: Eurostat

Problems

The figures refer to the situation in the middle of the 90s only, so no conclusions on the development of the ratio fellings/NAI can be drawn. No distinction is made between production forests and natural forests.

RD-6: Timber balance

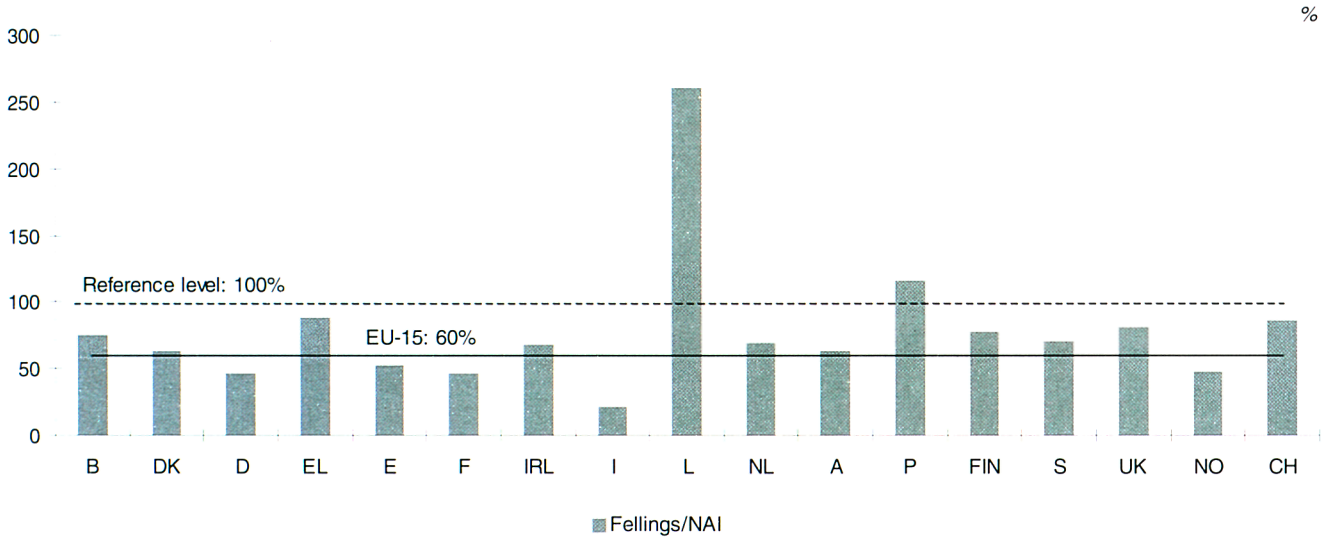
Purpose

The indicator reflects the demand for timber, which is the main pressure on the cutting of wood from natural and production forests. If the new growth of wood in production forests is not high enough to cover the demand for timber, it puts pressure on both natural and production forests. However, demand for timber and timber products is also met by imports, and to be complete this indicator should also include information on imports.

Targets

Reference levels for this indicator should be the 100 % mark. Values on that level or below represent a sustainable management of renewable resources. This means that the NAI itself is the reference level of the volume of felled timber. The 5EAP calls for an optimisation of forest areas as to fulfill all their functions through an increase in afforestation, including on agricultural land (new afforestation and regeneration of existing forest, favouring the most adequate means for the environment - slow growing trees, mixed afforestation).

Fellings divided by net annual increment



Source: Eurostat

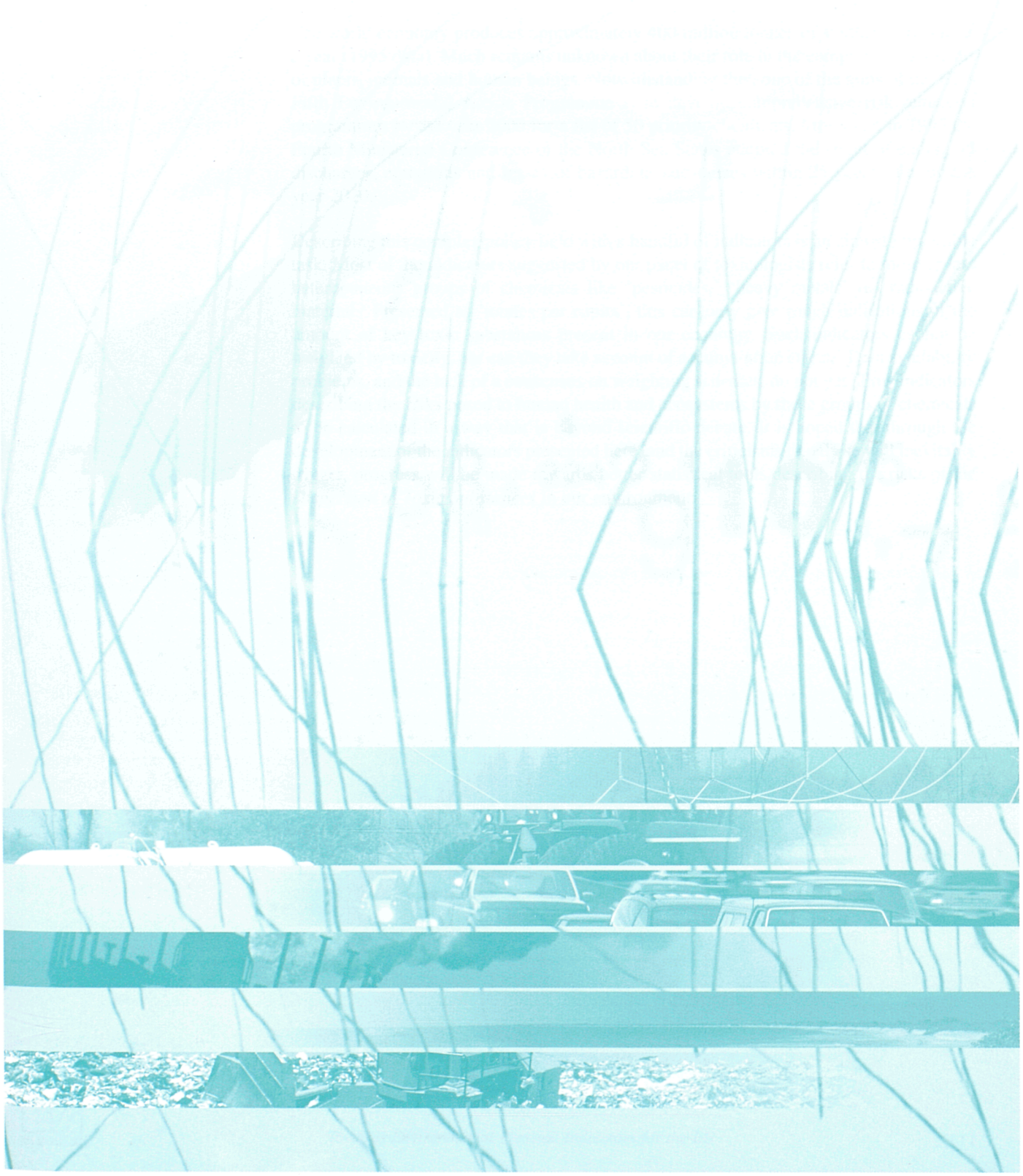
Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

For several decades now, EU forest resources have been expanding slightly, and this trend is expected to continue. Fellings have remained well below increment, and losses through transport and other development are counterbalanced by expansion elsewhere into agricultural and other land. In the middle of the 90s, the total NAI in EU forests was 463 million m³, while total fellings amounted to 278 million m³, 60 % of the net annual increment. Fellings were higher than the NAI in Luxembourg and Portugal.

The total volume of the growing stock in Community forests is estimated at around 13 300 mio 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 %.

DISPERSION OF TOXIC SUBSTANCES



Introduction

Among the ten policy fields, *Dispersion of Toxic Substances* is probably the one that raises the emotion of fear most frequently: the fear of being killed by an accident releasing toxic substances (as in Seveso or Bhopal), or the fear of being poisoned slowly through chemicals in our food, drinking water and in our living environment.

The term 'toxic' refers to chemical elements or substances that are harmful to biological systems. 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. Notwithstanding this, one of the aims of the EU's Fifth Environmental Action Programme is to develop comprehensive risk reduction programmes by the year 2000 for a list of 50 priority chemicals. Moreover, in 1995 the Fourth Ministerial Conference of the North Sea States adopted the target of ending all discharges, emissions and losses of hazardous substances within 25 years - i.e. by the year 2020.

Describing this complex policy field with a handful of indicators is an almost impossible task. Most of the indicators suggested by our panel of toxicologists refer to more or less heterogeneous groups of chemicals like 'pesticides,' 'heavy metals' or 'radioactive material.' Presented as 'tonnes per capita', this can only give rough indications of the amount of key toxic substances present in our economy. Such indicators cannot be weighted by toxicity, nor can they take account of accumulation effects. Data availability problems, 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.

TX-1: Consumption of pesticides by agriculture

Definition

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 use on farm land.

The quantities below refer to active ingredients. The active ingredients in a pesticide are those which have the desired effect on the fungi, weeds or insects targeted. Pesticides refer to herbicides, fungicides, insecticides and other pesticides. The 'other pesticides' category covers a wide range of products such as growth regulators, soil disinfectants, rodenticides, and varies from one country to another.

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.

Agricultural pesticide sales [1]

kg of active ingredient per hectare of agricultural area [2]

	1980	1985	1990	1991	1992	1993	1994	1995	1996
B [3]	5.06	6.42	7.54	7.36	7.81	7.69	7.30	8.06	7.62
DK	:	2.42	2.03	1.67	1.66	1.51	1.45	1.77	1.33
D [4]	2.69	2.51	2.80	/ 2.16	1.98	1.69	1.72	1.99	2.03
EL	:	:	:	1.52	1.62	1.80	1.93	1.65	1.91
E	:	:	1.29	1.30	1.06	0.99	1.06	0.93	1.10
F [3]	2.44	3.14	3.22	3.42	2.82	3.07	3.00	2.82	3.10
IRL	0.26	:	0.40	0.45	0.53	0.49	0.63	0.60	0.58
I	:	:	:	3.38	3.42	3.20	2.76	2.90	2.89
L	:	:	:	2.02	:	:	:	:	:
NL	:	10.38	9.39	8.81	8.13	6.00	5.75	5.56	5.09
A	:	1.50	1.21	1.28	1.11	1.14	1.04	0.99	1.04
P [3]	:	:	:	2.31	1.54	2.27	2.41	/ 3.00	3.19
FIN	:	0.81	0.80	0.68	0.56	0.55	0.56	0.49	0.44
S	1.05	0.69	0.55	0.45	0.44	0.58	0.40	0.49	0.49
UK	:	2.19	1.60	1.63	1.79	1.88	2.14	2.13	2.24

Source: Eurostat / ECPA (European Crop Protection Association, Brussels, Belgium)

1) : Data not available ; / Break in time series
2) Agricultural area = arable crops + permanent crops + grassland
3) Pesticide data for B, F and P include non-agricultural pesticides
4) D: Figures for 1980 to 1990 refer to former Federal Republic of Germany

Problems

Statistical problems: Disaggregated data on active ingredients are not readily available. Also sales data are not identical to usage. Moreover, it is not possible to separate out the mineral pesticides from the data supplied by countries. Stocks held by consumers should strictly speaking also be taken into account but will probably only affect statistics over a short time span due to the costs related to keeping a large stock of expensive chemicals on the farm.

Analytical problems: The amounts of active ingredients per hectare give only a very vague indication of the environmental risks associated with the use of pesticides. The real risks depend on many factors such as type of product, toxicity, persistence, climate and soil conditions, type of cultivation, farmer knowledge and application practices. Ideally, a proper *pesticide risk index* would take into account all these factors. The OECD Pesticide Forum is currently examining this problem, with a view to producing an international methodology for calculating pesticide risk.

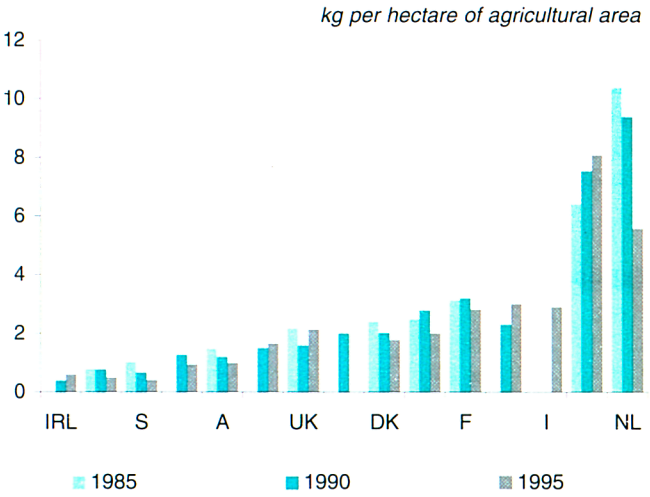
TX-1: Consumption of pesticides by agriculture

Purpose

This indicator represents the total annual amount of pesticides used by agriculture. Persistent pesticides may cause adverse environmental effects on human health as well as on ecosystems. Within the policy field *Dispersion of Toxic Substances*, the focus is on risks to human health and the ecosystem, e.g. through the content of pesticides and their residuals in food and water. A better knowledge of amounts used would help to focus on activities which encourage a reduction of consumption to a level strictly adjusted to the actual needs of the crop.

Pesticides are a diverse group of chemical substances. Some older types in use were persistent and could accumulate in farm land and crops. Over-dosage and accumulation in crops and farm land are viewed as being non-sustainable practices.

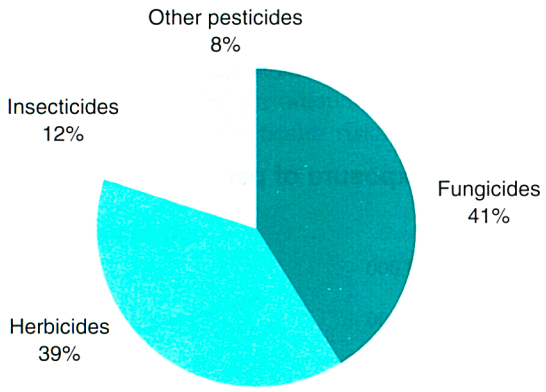
Agricultural pesticide use [1)]



Source: Eurostat

1) EL, L, P: data for year 1990 refer to 1991; D refers to former Federal Republic of Germany

Sales of pesticides by type - EU (1996)



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

The reason for the increasing use of pesticides seen in the past is the same as for fertilisers: the intensification of agriculture caused by the Common Agricultural Policy (CAP) since 1958. However, this trend 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 proposed Agenda 2000 reform of the CAP is also expected to encourage a more reasoned use of inputs. But in the end, pesticide use is largely governed by outbreaks of plant diseases, plagues of insects, etc, which cannot be controlled by legislation. 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, the decrease in pesticide use (in kg/ha) in the EU is the result of newer products, active at lower application rates (grams instead of kilograms) and of policies developed for example in Denmark, the Netherlands and Sweden in order to decrease pesticides use.

TX-1: Consumption of pesticides by agriculture[1] (continued)

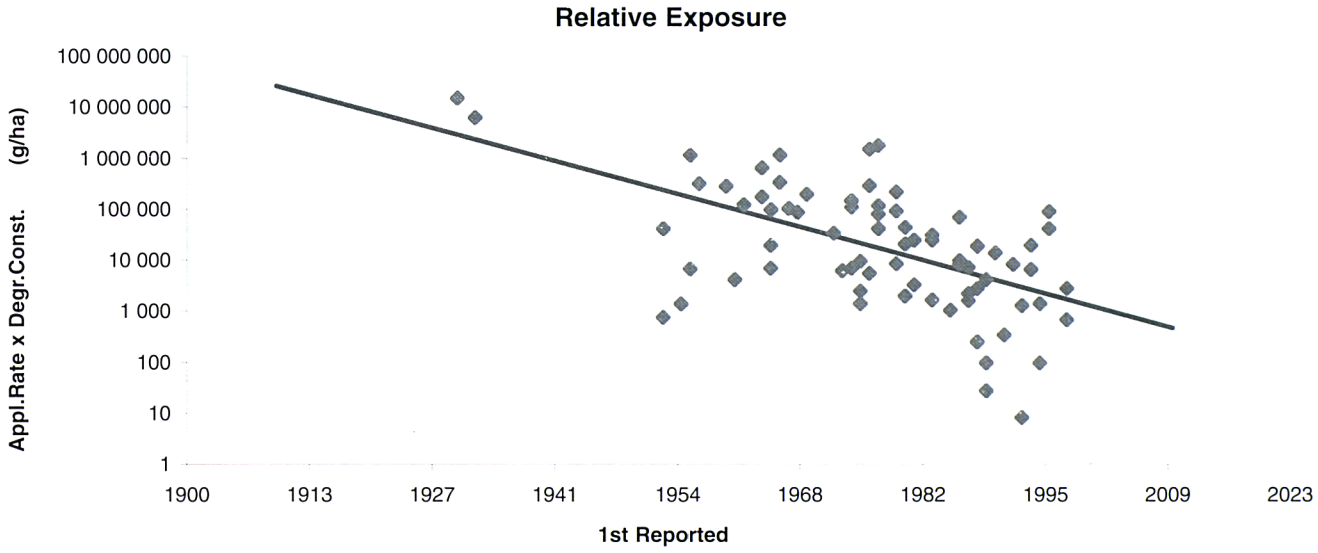
After World War II, some pesticides introduced to the market were highly persistent; they accumulated in biotic systems and were harmful to human health and the environment. DDT is one example. Even years after being banned in the EU, it is still present in the environment.

The pesticides which are on the market in the EU today cannot be compared with these older types. Their chemical and environmental properties have changed considerably. Sales figures just give a first hint. Additional information is needed to evaluate the sales figures in order to create a meaningful pressure indicator. At present there is no universally accepted method of aggregating or combining data on use of individual active ingredients to give an indication of the risk they pose to health and the environment. However several different methods, each with their strengths and weaknesses, are being developed. Two such approaches are given below: the first has been developed by ECPA, the second by the Swedish Chemicals Inspectorate.

The ECPA approach

The first approach estimates the development of newly introduced pesticides concerning their behaviour in the environment (soil, water, air). Without considering the market share or other weighting schemes between pesticides, a time series of various indicators can be set up. These indicators give a trend of the development of the environmental behaviour of pesticides.

Relative exposure of pesticides over the years



Source: ECPA

In the above figure the relative exposure is shown. The relative exposure is the product of the amount of pesticide applied times the degradation constant (half-life value of the respective pesticide in the environment). It represents the maximum load of the soil compartment with a pesticide. A high relative exposure is not desired and there is a clear tendency for modern pesticides to have lower application rates and the ability for faster degradation.

Other indicators, illustrating the effect of pesticides on human health, their toxicity to soil organisms and the aquatic environment show no (aquatic environment), a slow (human health) or a steep reduction (soil organisms) in the past 20 years. Lower application rates are therefore not counterbalanced by higher toxicity levels.

[1] figures and methodology by ECPA, 1998

TX-1: Consumption of pesticides by agriculture (continued)

The Swedish approach

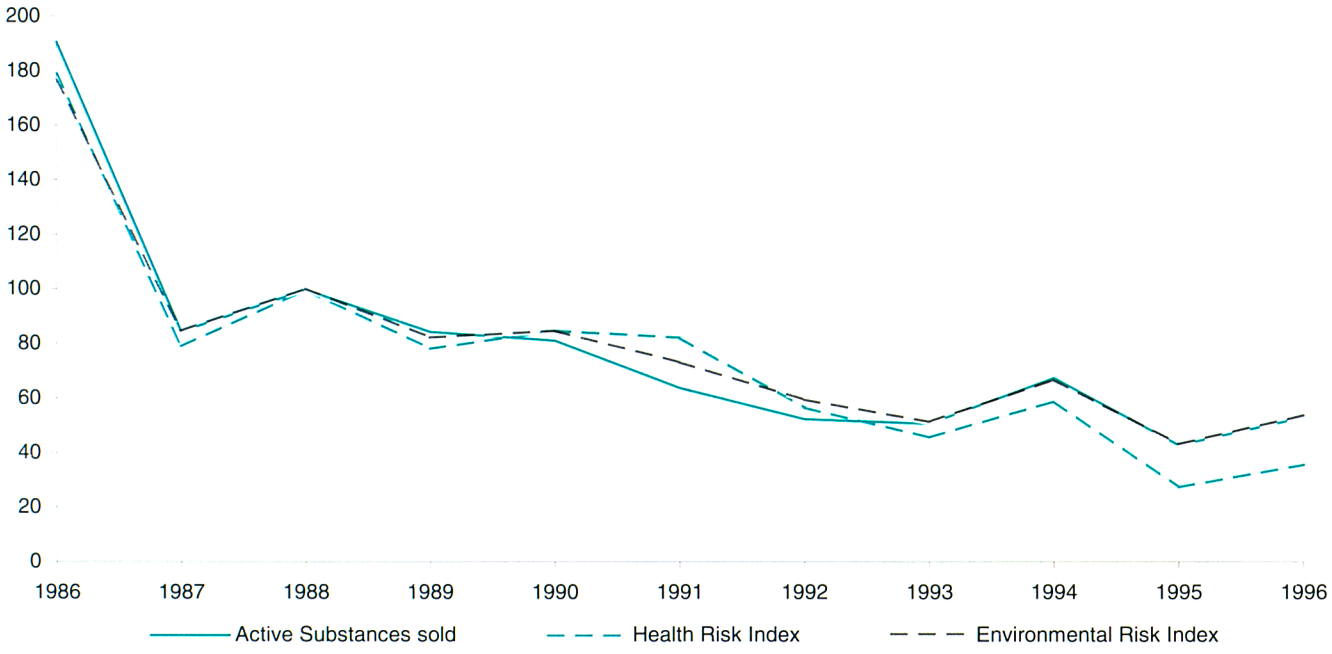
The second approach is based on market volumes. Sweden[2] has created two indicators, one for human health risks, the other for the environmental risk posed by the pesticides used in Sweden over the past 10 years. The Health Risk Index is calculated by multiplying the pesticides sold with a human health index score, ranking the categories of danger from moderately harmful (rank 1) to very toxic, carcinogenic (rank 10). The Environmental Risk Index is performed in the same way. The environmental index score includes bioaccumulation, mobility, soil degradability and toxicity to organisms. The theoretical maximum environmental index score per active substance is 12.

The results are shown in the next figure. The quantities sold, the Health Risk Index and the Environmental Index are indexed for the year 1988, because for the year 1988 the quantities of pesticides sold and used are assumed to be in balance. For 1986 the sold quantities are higher than the average as a result of stockpiling activities by farmers.

From 1988 to 1996 the amount of pesticides sold in Sweden was halved due to the national reduction programme introduced. The slope of the Health Risk Index as well as the Environmental Risk Index follows the Index of sold quantities of pesticides. Within the uncertainty of the methodological approach used here it sounds reasonable that with the reduction of the sold quantities a reduction in risk has taken place. There is no indication that the reduction in the use of pesticides is counterbalanced by the use of 'high risk' pesticides. On the other hand, one can assume that the amount of pesticides sold (as active ingredients) is an easily accessible indicator that reflects to a certain extent the health risks as well as the environmental risk.

Pesticides sold, their human health risk index and environmental risk index

index 1988 = 100



Source: P. Berquist, National Chemicals Inspectorate, Sweden

From the ECPA data there is strong evidence that new pesticides have less or even no impact on human health and on the environment. The Swedish data give a strong indication that the human risk as well as the environmental risk of pesticides are strongly correlated to the amount of active ingredients. Even when the amount of pesticides are reduced there is no counterbalanced effect. Therefore it appears that sales statistics give a good approximation of the environmental performance of pesticides.

[2] P. Berquist, National Chemicals Inspectorate, Sweden.

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

Definition

Persistent Organic Pollutants (POPs) are organic chemical substances which are toxic, degrade slowly, and in many cases accumulate in biological systems. This indicator concentrates on POPs which are toxic to humans. For this first step, only emissions into the air are taken into account.

The different POPs, which are monitored under several conventions (e.g. UNECE) can be divided into (1) pesticides, (2) (hydro-)chlorocarbons such as solvents and (3) POPs emitted from various processes. Pesticides and (hydro-) chlorocarbons are covered by their own indicators.

The indicator describes the emission of POPs into the air. The indicator was developed considering (1) toxicity to humans and (2) the amount of emitted toxic substances. The toxicological weighting scheme takes into account the toxicological effects of the substances and the lifetime of the substances in the biosphere. The lifetime is measured by the half-life of the estimated degradation of the chemicals.

In order to reduce the number of POPs, a list set up by international committees (UNECE) has been adopted. For the first approach, the 1990 TNO/UBA database was used for emission figures for the EU Member States. The calculation shows that the most relevant POPs for human exposure via air were polychloro-dibenzodioxins and -furans (dioxin). This indicator will therefore focus on the main dioxin emissions as a representative POP. For this indicator the modelling approach of the 'European Dioxin Inventory' has been adopted. The same emission coefficients have been applied to technical processes with similar techniques.

Emissions of dioxin into the air

µg I-TEQ[1] per capita

	1985	1990	1995
EU-15	29.0	16.4	13.2
B	52.4	44.0	45.2
DK	26.9	11.6	8.3
D	24.4	11.1	7.0
EL	20.8	12.7	10.9
E	18.2	9.7	7.4
F	35.8	22.5	18.2
IRL	17.5	10.2	8.5
I	26.9	18.0	16.8
L	187.9	182.9	75.2
NL	31.3	11.1	6.5
A	35.1	20.6	15.1
P	21.2	13.7	12.2
FIN	27.5	18.8	16.5
S	48.1	16.0	8.4
UK	32.8	17.4	14.8

Source: OEKO-Institut

1) I-TEQ = International Toxic Equivalent

Problems

The Dioxin Inventory is 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.

Furthermore, interest should not be restricted to air emissions. Emissions to water and soil should be included, although their toxicological relevance may differ in magnitude. A more sophisticated toxicological weighting scheme should be developed which would include the different types of emissions and would reflect the different economic activities through which humans are exposed to POPs.

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

Purpose

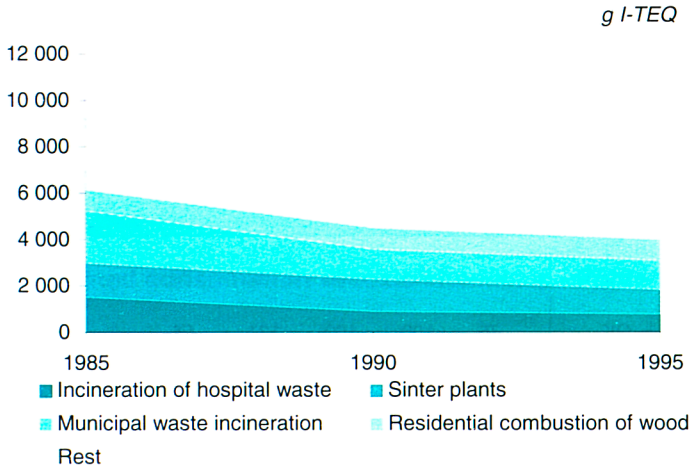
The purpose of this indicator is to represent the emissions of POPs over a period of time. POPs are emitted locally but transferred over long distances or distributed into the food chain. Due to the persistence of the substances, the relevant toxicological intake by humans through the food chain results from past economic activity. The nature of POPs creates methodological problems. POPs are present in the environment and their presence can be described as a state indicator. When plants take up the POPs and are traded as products (e.g. food), the presence of POPs changes into an impact indicator. The pressure indicator discussed here only reflects the primary sources of air emissions.

Different activities lead to different types of emissions. Better knowledge of emitted amounts helps to identify activities aimed at decreasing emissions. POPs arise from different economic activities, and emissions take place during production and use, as well as waste disposal. Neither an increase in POP emissions, nor keeping POP emissions at today's levels should be considered sustainable.

Targets

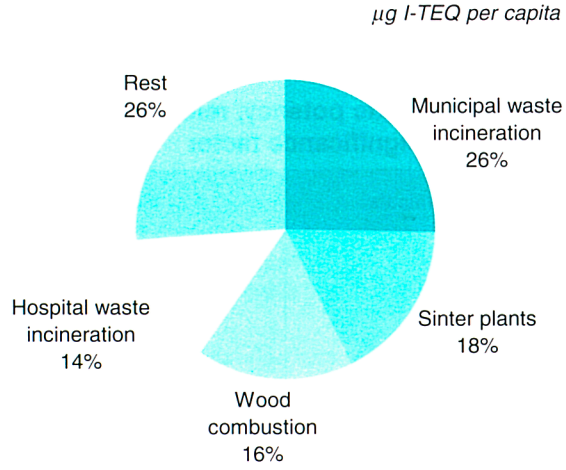
The 5EAP sets targets for more environment-friendly agricultural/industrial practices (e.g. significant reduction of pesticide use per unit of land). However, the 4th Ministerial Conference of the North Sea States committed itself in 1995 to end all discharges, emissions and losses of hazardous substances by the year 2020; this target was adopted in 1998 by OSPAR and HELCOM. The 1998 LRTAP Protocol on POPs and heavy metals asks for a 'reduction of emissions' with final targets being established in future negotiations.

Air emissions of dioxin from core processes - EU-15



Source: OEKO-Institut

Share of emission sources (1995) - EU-15



Source: The European Dioxin Inventory (1996)

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Yellow

Comments

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. open sea burning, cable/PVC burning) but is not possible to calculate emissions for these processes. The amounts for the past may be therefore underestimated.

For the year 1994, total EU emissions have been calculated at 5 750 g I-TEQ per year, the possible deviations are given from a minimum of 1.3 kg I-TEQ per year to maximum of 20 kg I-TEQ per year (European Dioxin Inventory).

At EU level, dioxin emissions from hazardous waste incineration are regulated. Some countries (Austria, Germany, Sweden, the Netherlands) have also regulated municipal waste incineration. For the iron ore sintering process, the feasibility of reducing dioxin process emissions has been demonstrated (Austria, Germany).

Many of the older POPs are covered by existing monitoring programs and remarkable reductions in production or emissions have been achieved, for example as a result of the Montreal Protocol. Programs for newer POPs, such as chlorinated aliphates or musk derivatives, are currently under discussion.

TX-3: Consumption of toxic chemicals

Definition

This indicator covers the consumption of toxic chemicals as defined in Directive 67/548/EEC. Within Directive 67/548/Annex VI-Part II, toxic chemicals are defined as substances which are very toxic, toxic, harmful, can cause other serious damage to health, are corrosive, irritant or have other toxicological properties or are carcinogenic, mutagenic or teratogenic.

Directive 67/548/EEC deals with dangerous chemicals. It does not apply to medicinal products, radioactive substances, explosives, pesticides and fertilisers or other chemicals, which are regulated by other Directives. The chemicals are classified by R-phrases reflecting their physical-chemical properties (explosive, inflammable, etc.), toxicological properties to humans (acute and long-term toxicity, carcinogenic substances, etc.) and environmental effects.

In this indicator only the toxicological properties concerning humans are taken into consideration. According to the Directive the main issue is the use of chemicals in industry (i.e. workers).

The large number of chemicals has to be aggregated to form one indicator. Therefore the following weighting scheme has been applied:

$$Toxic\ Chemicals = \Sigma\ C * P_{tox} * P_{rel} * F_{si}$$

where C is the amount of chemical consumed (C), P_{tox} is the toxic potency (with score from 1 to 10), P_{rel} is the release potential (with score from 1 to 4) and F_{si} is a significance factor which reflects the main conditions of chemical use as intermediates within the chemical industry. This formula has been applied to toxic chemicals with a production volume of over one million tonnes in the EU. These 15 chemicals with their toxic potency, release potential and significance factor are listed below. The results of this calculation are presented as an index in the table.

Product of toxic potency, release potential score and significance factor

Chemicals	P_{tox}*P_{rel}	F_{si}
formaldehyde	16	1
acetic acid	12	1
methanol	12	1
benzene	30	0.1
chloroethylene	40	0.1
ethylbenzene	3	0.1
styrene	3	0.5
1,2-dichloroethane	30	0.1
sodium carbonate	2	1
sodium hydroxide	4	1
ammonia, anhydrous	16	1
sulphuric acid	4	1
sodium hypochlorite	6	1
nitric acid	12	0.1
chlorine	16	0.1

Source: OEKO-Institut

Weighted consumption [1] of toxic chemicals

index: 1995=100

	1993	1994	1995	1996	1997	% of EU-15 total in 1995
EU-15	102	101	100	102	102	100
DK	75	100	100	121	95	0.1
D	83	93	100	105	114	31
E	82	111	100	101	109	6.5
F	126	95	100	107	102	19
IRL	105	100	100	94	99	0.9
NL	90	96	100	96	91	13.3
A	86	102	100	98	105	0.3
P	53	81	100	96	96	2.8
UK	79	117	100	96	89	9.3

Source: Eurostat according to the methodology of OEKO-Institut

1) based on production data including Eurostat estimations

Problems

Consumption is traditionally defined as *Production + Imports - Exports*. However it has only been possible to work with production figures as the confidential import and export data were not yet available.

Directive 67/548/EEC covers more than one thousand chemicals so a pre-selection was necessary. This pre-selection was based on the IUCLID Database[3] on production volume and toxic potency. Chemicals with a production volume of more than 0.5 and less than 1 million tonnes would add less than 25 % to the toxic equivalents.

[3] Published by the Chemical Bureau at ISPRA

TX-3: Consumption of toxic chemicals

Purpose

Toxic chemicals are consumed by various economic activities, and subsequent emissions will take place during their whole life cycle, from production and use up to waste treatment and disposal. Knowledge of the processes and the subsequent emissions is needed to support activities aimed at reducing consumption and thereby decreasing emissions.

Targets

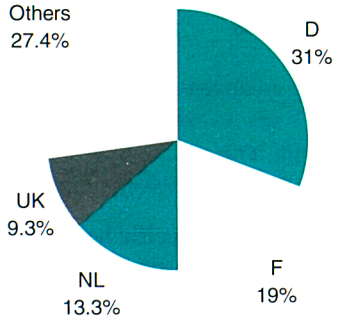
Comprehensive risk reduction programmes before the year 2000 for a list of 50 priority chemicals (5EAP p. 61). Moreover, the Fourth Ministerial Conference of the North Sea States committed Members to ending all discharges, emissions and losses of hazardous substances by the year 2020. This target was implemented by OSPAR and HELCOM in 1998.

Weighted consumption of toxic chemicals in selected Member States



Source: Eurostat

Weighted consumption of toxic chemicals - Percentage of EU-15 total (1995)



Source: Eurostat

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Green

Comments

Further discussion is needed on the choice of chemicals to be included in this indicator, and all contributions to this discussion would be welcome. The indicator should be improved by further development of the weighting scheme and the introduction of consumption by different economic sectors. The sectoral breakdown may become the most important development for this indicator. For some chemicals it is known that they are widely used in all kinds of industries and sometimes are partly distributed via household products. A first hint is given by the significance factor. However, this factor currently gives only a rough estimate of the specific emissions situation in different industries.

TX-4: Index of heavy metal emissions to water

Definition

The environmental focus is on seven heavy metals: mercury (Hg), lead (Pb), cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni) and zinc (Zn). In addition, arsenic (As), which is a non-metal, is often discussed as if it were a member of the group of heavy metals. However in this first approach, only mercury, lead and cadmium have been considered.

Emissions of heavy metals from households to water have been estimated using emission coefficients in 5 EU Member States and a pooled average estimate for the others. Where relevant, household emissions after treatment in waste water treatment plants have also been estimated.

These emissions have been weighted according to their ecotoxicity in water and sediment, expressed as Arsenic Equivalents, and aggregated to give an index of heavy metal emissions to water. The weighting factors are based on the OSPAR reference values for ecotoxicity in water and sediment and are calculated as follows:

$$WF_i = 2(RV_{wat,i}/RV_{wat,As} + RV_{sed,i}/RV_{sed,As})^{-1}$$

where $RV_{wat,As}$ is the reference value for arsenic and $RV_{wat,i}$ for the metal i in water and $RV_{sed,As}$ is the reference value for arsenic and $RV_{sed,i}$ for the metal i in sediment.

Ecotoxicology reference values and weighting factors

Reference value	Arsenic	Mercury	Lead	Cadmium
Water (µg/l)	1 – 10	0.001 – 0.01	0.1 – 1	0.1 – 1
Sediment (mg/kg dry weight)	1 – 10	0.05 – 0.5	5 – 50	0.5 – 5
Weighting Factor	**1**	**39.2**	**0.4**	**3.3**

Source: VKI

Index of heavy metal emissions (Hg, Pb, Cd) from households (1990 - estimates)

thousands As-EEQ

	EU-15	B	DK	D	EL	E	F	IRL	I	L	NL	A	P	FIN	S	UK
Before	2 362	63	47	540	69	264	386	24	280	3	65	53	67	37	74	391
After	654	:	10	152	63	181	:	:	:	1	14	22	57	12	13	130

Source: VKI

Problems

Only a very limited amount of reliable data are available on specific heavy metal emission factors to water from different sources. Further, the emission factors obtained are found to be specific for the individual Member States and even within one Member State significant variations in terms of place and time are expected. Due to lack of data, it was not possible to create time series reflecting improvement due to phasing out and/or regulatory limitations of heavy metals in products.

The estimates for emissions after treatment are based on data on population connected to treatment plants, the type of plants (primary, secondary and advanced) and an average removal efficiency for the individual metals concerned. The removal efficiency is based on international experience obtained at different individual treatment plants because only very limited statistical aggregated data are available in most Member States.

Therefore the overall quality of the emission estimates is not good. To develop this indicator further there is a serious need for reliable emission coefficients for important sources of heavy metal discharges in the individual Member States.

TX-4: Index of heavy metal emissions to water

Purpose

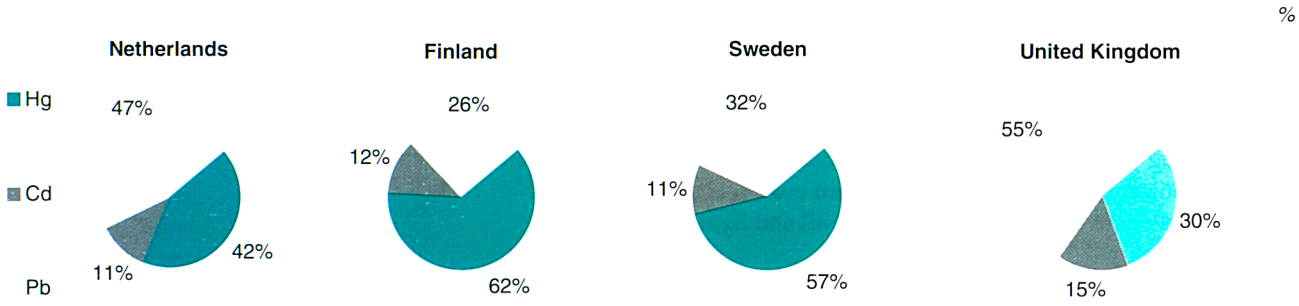
Heavy metals are toxic in large doses, but are necessary in trace amounts for the function of animals and plants. Heavy metals are chemical elements and therefore completely persistent; they can accumulate e.g. in sediments and sewage treatment sludge. Most heavy metals can also accumulate in organisms in such a manner that even small amounts in water or sediment layers may become significant threats to species at the end of the food chain. Further, some heavy metals with limited toxicity can form complexes with organic materials to produce highly toxic compounds. The main purpose of the indicator is to represent the ecotoxicity weighted amounts of heavy metals emitted from different sources into water.

Targets

The 5EAP calls for actions in two areas that are important with respect to emission of heavy metals to water:

- surface water quality improvement towards a better ecological quality and safeguard of high quality where it exists;
- marine water objectives and actions as expressed by the OSPAR and HELCOM reduction targets which aim at ending all discharges, emissions and losses of hazardous substances by the year 2020.

Heavy metal riverine and direct emissions to coastal zones: relative composition - selected Member States (1995)



Source: VKI

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Green

Comments

In some countries the distribution between the three heavy metals by the riverine and the direct inputs to the coastal zones are quite similar as shown for Finland and Sweden. However, the Netherlands and the United Kingdom show a very different trend. It should be noted that around 80-90 % of the total input for the Netherlands, Finland and Sweden can be ascribed to riverine contributions. In the United Kingdom only about 50 % of the input can be ascribed to the riverine contribution.

To develop this indicator further there is a serious need for reliable emission coefficients for important sources of heavy metal discharges in the individual Member States.

TX-5: Index of heavy metal emissions to air

Definition

The indicator describes the emissions of heavy metals into the air. Traditionally arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium and zinc are considered when emitted during 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 amount of emitted metal.

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 in this indicator 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 oral reference dose (RfD) of a substance has been chosen as a way of measuring the chronic toxicity of a substance.

The heavy metal arsenic was used as a reference substance (1 g As = 1 g As-TEQ). The As equivalence factor for lead is increased by a factor of 10 in the case of motor vehicle emissions because of the resulting of high ambient air concentration. The toxicological weighting scheme also takes into account the lifetime of the substances in the biosphere. Chromium (in its highly carcinogenic oxidation state +VI) quickly reacts in the biosphere to become chromium with a non-relevant carcinogenic potential. For this reason its As equivalence factor was reduced by 10.

The TNO/UBA database was used to determine the processes most relevant for the heavy metal indicator. 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 by hard coal, fuel oil and lignite
- industrial combustion of hard coal, fuel oil and lignite
- road transport
- iron and steel industry.

As-TEQ weighted emissions of heavy metals to air

index:1995 = 100

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1995
EU-15	272	233	223	214	197	189	167	151	130	117	100	100.0%
B	299	211	197	204	198	186	178	172	150	134	100	2.4%
DK	400	343	292	263	191	172	183	147	133	127	100	1.0%
D	681	638	579	519	461	411	357	293	228	160	100	13.0%
EL	167	116	116	113	116	116	117	112	105	99	100	3.0%
E	150	142	146	150	154	165	135	116	103	109	100	13.6%
F	333	315	321	322	251	227	173	154	128	114	100	10.3%
IRL	157	144	133	114	113	123	124	114	108	107	100	1.2%
I	140	106	109	110	114	113	110	113	105	103	100	27.4%
L	138	142	115	107	104	92	89	82	64	74	100	0.6%
NL	590	512	322	298	249	269	226	194	181	128	100	1.0%
A	753	723	689	625	463	398	353	303	205	130	100	0.4%
P	111	94	89	86	128	125	121	131	111	98	100	3.0%
FIN	351	323	306	267	215	176	160	139	115	103	100	1.1%
S	565	480	421	366	261	204	181	176	144	107	100	1.1%
UK	236	168	166	169	159	168	151	140	124	119	100	20.9%

Source: OEKO-Institut

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, and 1995, 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.

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 emission data for the year 1985. To enhance data quality, other information sources related to heavy metal emissions were used.

TX-5: Index of heavy metal emissions to air

Purpose

The main purpose of this indicator is to represent the total amounts of heavy metal emissions to air from the core sources in EU-15 in the period 1985-1995. A better understanding of the amounts of heavy metal emissions helps identify the action needed to decrease emissions.

Heavy metals are chemical elements and therefore do not decay. All metals emitted into the air will eventually be deposited on land or water. Thereafter they will accumulate in soil, water and sediments. Such an accumulation of toxic metals is not sustainable.

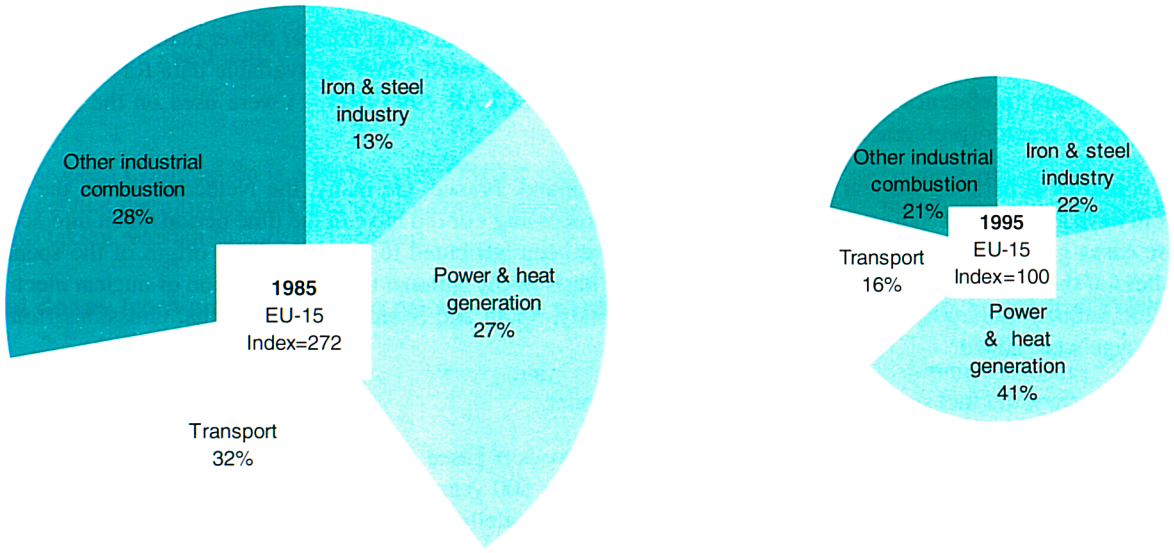
Targets

The 5EAP calls for a reduction of at least 70 % of emissions from all sources of Cd, Hg and Pb in 1995.

The 4th 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 OSPAR and HELCOM. The 1998 LRTAP Protocol on heavy metals asks for a 'reduction of emissions' with the final targets to be set in future negotiations.

AS-TEQ weighted emissions of heavy metals by process - EU-15 (1985 and 1995)

% [1]



Source: OEKO-Institut

1) The pie areas are proportional to the total emissions (see table)

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

The heavy metal index shows a significant reduction from 1985 to 1995 (see table). Noteworthy reduction has taken place in the transport sector where weighted heavy metal emissions are less than one-fifth of the 1985 value. In 1985 road transport made up about one third of the index, but only 16 % in 1995 due to the use of unleaded fuel.

The reduction in emissions from power plants 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 to remove particles, including heavy metals, from exhaust gases.

Within the iron & steel sector, weighted heavy metal emissions were reduced by 40 % from 1985 to 1995, while the total production of steel increased slightly during the same period, as a result of changes in technologies. 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. Here also the switch away from lignite in the former East Germany played an important role.

TX-6 : Emissions of radioactive material

Definition

The indicator corresponds to the Committed Collective Effective Doses to the world population, summed over time, resulting from any one year of emissions of radioactive material from the nuclear industry attributed to individual countries and divided by the number of inhabitants of the country in each case. It is expressed in man.sievert (man.Sv) per inhabitant per year of emission.

Ionising radiation from radioactive nuclides affects organisms by interacting with chemical bonds within the living cells, which may cause biological effects. The use of Committed Collective Effective Doses provides a measure of these potential effects irrespective of the specific types and energies of radiation from the individual nuclides.

Calculation of the indicator

Some radionuclides decay relatively rapidly into stable non-radioactive forms and thus affect essentially only the local and regional environments and then only in the relatively short term; others remain radioactive for very long time periods and are dispersed on a global scale with long-term effects. The local/regional and global doses are therefore calculated separately using different models and allowing a comparison of these two components before they are summated to give what will be termed, for the purposes of the indicator, the total dose.

The following data and assumptions were used:

- Nuclide specific emission data in Becquerel per year (Bq/a) from each individual nuclear power plant were used, if data was available and reliable (preference 1). Otherwise estimates were based either on available data for the same plant during other years (preference 2) or generic estimates from UNSCEAR 1993 (Ref. 1) were used on the basis of the specific type of reactor (preference 3).

- Of the countries generating nuclear electricity, Belgium, Finland, France, Germany, the Netherlands and the United Kingdom have a policy of sending spent nuclear fuel for reprocessing - or did have in the time period taken into account. In these cases generic reprocessing emissions (Ref. 1) have been attributed to the country of origin of the spent fuel (regardless of the time and location of reprocessing) on the basis of the national annual production of nuclear electricity. Where the national policy is not to reprocess spent fuel (Italy, Spain and Sweden), no additional emissions from this process stage were added.

- No emissions from the fuel supply side were taken into account.

- Modelling of local/regional Committed Collective Effective Doses is based on the generic industrial model site defined by UNSCEAR (Ref. 1) which serves to integrate the doses over 500 years following the year of emission. This model site is typical for sites in more populated areas. No site specific modelling was performed.

- Modelling of global doses was based on the work of UNSCEAR (Ref. 1) or, for certain nuclides, on the more recent and more detailed models developed by NRPB (Ref. 2). Total global doses were added in totality to the country of origin of the emissions, no matter where the global dose effects might occur (in neighbouring countries, EU-15-wide, or worldwide). Global long-term doses integrated over the relevant timespan were attributed to the year of release of the emissions. No dose threshold values were applied.

Problems

For carbon-14, a globally dispersed radio-nuclide with the most influence on the Committed Collective Effective Doses, only a few countries report measured data from their plants. Most of the data had to be estimated on a plant-type-specific basis. The error in the estimates could be relatively high, because world-wide data shows considerable variations even among reactors of the same type *(see also following pages)*.

It should also be noted that only the emissions of radioactive material from nuclear power stations and nuclear fuel reprocessing plants are included. Discharges of radioactivity from non-nuclear industries may be of comparable importance for the risk to man. To give a fully realistic view of the state of the environment with respect to discharges of radioactivity from industry, these sources would have to be included. Both of these aspects will require further consideration and methodological development.

Given the ongoing controversial scientific and political debate on radioactive emissions and the role of nuclear energy, it should be noted that the indicator definition given here was developed by Öko-Institut Darmstadt. It does not necessarily reflect the standpoint of the European Commission.

TX-6: Emissions of radioactive material

Purpose

This indicator is a measure for the following political pressure issues:

- Is a reduction of releases and the resulting doses to the public based on an application of the best available technology possible and appropriate, and which measures on which relevant pathways provide the most effective ways for reductions?
- Do short-term local/regional effects cover the main risks from operational releases, or do global long-term risks add substantially to the total risk from these releases?
- Regulation of operational releases of material has been orientated in the past towards limiting individual doses for the most exposed persons in the vicinity of the respective plant. Is this orientation appropriate, or should limitations be added to cover also the global risks?
- Do other stages of nuclear fuel production and use add substantially to the releases of radioactive material, in such a way that they should be included into a process-orientated indicator?
- Does reprocessing of spent fuel and reuse of that material, compared to the use of additional natural uranium, add to a reduction of total operational releases?

To enable comparison of the indicator with other natural and man-made sources of radiation, the most significant sources for exposures are listed with their bandwidth.

Targets

The European Commission is a Party to the OSPAR statement of July, 1998, following the Sintra meeting of Ministers to the effect that the ultimate aim is to reduce environmental concentrations of artificial radioactive substances to levels close to zero taking relevant factors into account.

Total doses from emissions from nuclear power plants and from reprocessing spent fuel (1990)



Source: OEKO-Institut

The separate calculations of the Committed Collective Effective Doses for short-term local/regional effects and long-term global effects show that the global dispersion of the long-lived radionuclide carbon-14 (half-life 5 736 years), emitted to air and to liquid pathways by nuclear power plants and reprocessing plants, dominate total doses by about 98% out of a total of some 20 000 man.Sv per year of emissions. Shorter lived nuclides contribute very little to the overall effects.

This suggests that more efforts should be made to include this exposure pathway in monitoring (currently few data sources provide physically measured information on this nuclide) and regulation (globally dispersed and long-lived nuclides and their effects are little recognised in the regulation of emissions).

The results for total doses have been broken down by the country to which the emissions are attributed and normalised by dividing by the number of inhabitants in each case as shown below.

Comments

It should be emphasised that the present indicator was defined to calculate the total effects of the dispersion of radioactive substances, no matter where and when these effects occur. The more common calculation of maximum individual doses from a given site targets an individual's risk limitation for the most exposed person. Incompatibility of the results is therefore unavoidable.

TX-6: Emissions of radioactive material (continued)

Modelling of the doses from reprocessing in this indicator is policy-orientated. If a country, or plant owner, generally decides to reprocess its spent fuel, doses are attributed to that country for the year when the fuel is in use, not to the country where the subsequent reprocessing takes place. A single fuel bundle is used during several years of operation and, once unloaded, the spent fuel is usually reprocessed several years later to allow for an extended cooling period (4 to 10 years); the plant-specific information available does not allow this time element to be taken into account but, bearing in mind the timescales over which the doses are estimated for the purposes of the present indicator and the long half-life of carbon-14, the difference will be of little or no significance.

Total doses from annual emissions of nuclear reactors and from reprocessing spent fuel, by reactor location [1]

man. µSv

	1985	1986	1987	1988	1989	1990	1991
B	105	135	144	147	140	152	152
DK [2]	-	-	-	-	-	-	-
D	60	58	61	67	69	68	68
EL [2]	-	-	-	-	-	-	-
E	2	2	2	3	3	3	3
F	163	184	183	187	213	193	205
IRL [2]	-	-	-	-	-	-	-
I	0	1	0	0	0	0	0
L [2]	-	-	-	-	-	-	-
NL	9	10	8	8	9	8	8
A [2]	-	-	-	-	-	-	-
P [2]	-	-	-	-	-	-	-
FIN	138	138	142	141	137	144	145
S	25	31	30	31	29	31	34
UK	38	36	35	39	45	45	48
EU-15	50	54	54	57	62	59	62

Source: OEKO-Institut

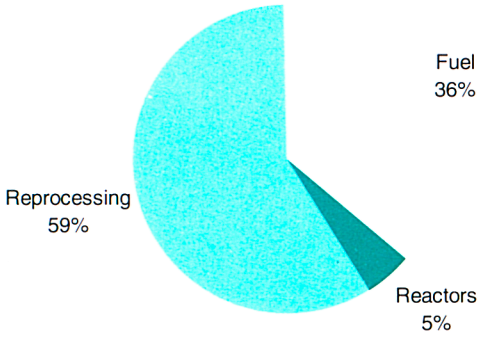
1) Attributed by reactor location per inhabitant of the country of origin of the emissions
2) In Denmark, Greece, Ireland, Luxembourg, Austria and Portugal, no nuclear power plants are operational.

Taking account of emissions from the fuel supply side (uranium production, conversion, enrichment, fuel element manufacture), based on currently applied safety standards and best estimates for actual and future emissions (Ref. 1), shows that, in terms of dose, emissions from the reprocessing stage of spent fuel dominate the whole production chain. For EU-15, 20 000 of the total of 33 900 man.Sv per year of emissions are caused by the reprocessing stage, while the fuel production part of the total chain adds approximately 12 000 man.Sv, with uranium mining and milling dominating this contribution. Emissions from reactor operation add only about 1 600 man.Sv per year of emissions.

This demonstrates that any emission reduction targets would be less effective on the reactor side, more effective on the fuel supply side, and most effective in the reprocessing stage. It shows further that the reprocessing and recycling of plutonium and uranium could not contribute to the reduction of emissions from the fuel supply stage. The specific emissions from reprocessing of spent fuel are always higher than those for the production of fuel from other sources, so that substitution with recycled materials has no reduction effect.

TX-6: Emissions of radioactive material (continued)

Contributions to the total dose from the whole EU nuclear electricity production chain (1990)



Source: OEKO-Institut

Relevancy: Green	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comparison of exposure from other sources

The total Committed Collective Effective Dose of approximately 18 000 (1985) to 22 000 (1991) man.Sv from reactors and the reprocessing of the produced spent fuel (where so attributed) can be compared to the total Committed Collective Doses from world-wide severe nuclear accidents (600 000 man.Sv, Ref. 1, mainly the Chernobyl accident) and from the past practice of atmospheric nuclear testing during the 50s and 60s (30 000 000 man.Sv, Ref. 1).

The above results can also be compared to annual doses to individuals from other sources, be they of natural or man-made origin. These doses differ due to a number of natural and man-made conditions, even within a given country, as shown below. The most significant sources are:

Typical individual effective doses from relevant sources in µSv/a (Refs. 1 and 3)

Source	Component	Exposure pathway	Typical individual doses µSv/a
Natural	Cosmic rays	All pathways	270 - 2 000
	Terrestrial radiation	All pathways	500 - 14 000
Man-Made	Occupational exposure	Mean exposure in the research, industrial, defence and medical sectors	1 100
	Medical exposure [1)]	Diagnosis [1)]	30 - 22 500

1) Medical therapy as opposed to diagnosis can give rise to very much higher exposures to the specific organs being treated.

References:

(1)[UNSCEAR 93] United Nations Scientific Committee on the effects of Atomic Radiation: UNSCEAR, 'sources and effects of ionizing radiation' - 1993 Report to the General Assembly, New York 1993

(2)[NRPB 95] J.G. Titley et al., 'Improved global dispersion models for iodine-129 and carbon-14', EUR 15880, Luxembourg 1995, ISBN 92-827-0090-9.

(3)[KRAUS 97] W.Kraus and A. Kaul, 'Review of exposure from radiation sources'; in 'Standing Conference on Health and Safety in the nuclear age' (proceedings), Radiation Protection 93, Luxembourg 1997, ISBN 92-828-1552-8.

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 concentration of people makes cities major contributors to local, regional and global environmental change. The pressures on urban environments come from air pollution, noise, traffic disturbance and land use. Noise levels in the urban environment have increased steadily with increased traffic activity and the use of machinery (for industry or private purposes). Urban areas are also responsible for producing pressures such as waste, waste water and air pollution.

Developments in the four target sectors of the Fifth Environmental Action 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. However, because of its cross-cutting nature, the 5EAP has not set specific targets for the urban environment.

Of particular importance are the activities to develop co-operation between cities in the promotion of local Agenda 21 plans.

Also the European Commission's Sustainable Cities project (1993) aims to:

- promote new ideas on sustainability in European urban settings,
- foster a wide exchange of experience,
- disseminate good practices on sustainability at the urban level, and
- formulate recommendations aimed at influencing policy at the EU, Member State, and regional and local level.

Development of indicators for the policy field *Urban Environmental Problems* is 'work in progress,' since the data situation is particularly difficult.

UP-1: Energy consumption

Definition

The consumption of energy per capita covers the total annual end use of energy in the form of electricity, fuel and heat, expressed in kg of oil equivalent per capita per year.

The consumption of energy is a measure of the energy intensity of society. The indicator includes the energy consumption of all economic sectors, except mining, air transport, agriculture and fisheries, expressed as amount per capita and not consumption of energy by households alone. The quantity of energy consumed per capita is directly related to individual and industrial energy consumption patterns and direct comparisons between countries can be made.

Energy use per capita

kg oe per capita

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
EU-15	2 173	2 203	2 236	2 229	2 225	2 219	2 254	2 227	2 238	2 210	2 246	2 356
B	2 841	2 927	2 957	2 984	2 953	2 938	3 084	3 108	3 037	3 087	3 143	3 312
DK	2 490	2 416	2 420	2 291	2 432	2 469	2 454	2 415	2 434	2 471	2 508	2 599
D	2 961	2 998	3 052	2 980	2 868	2 796	2 705	2 597	2 625	2 543	2 597	2 767
EL	1 001	1 005	1 077	1 107	1 159	1 144	1 171	1 168	1 165	1 182	1 234	1 339
E	1 076	1 093	1 109	1 212	1 251	1 300	1 363	1 369	1 347	1 425	1 441	1 482
F	2 231	2 247	2 257	2 214	2 248	2 241	2 337	2 328	2 340	2 238	2 290	2 411
IRL	1 627	1 706	1 738	1 732	1 799	1 875	1 849	1 864	1 841	1 926	1 946	2 048
I	1 625	1 642	1 739	1 766	1 839	1 851	1 897	1 898	1 888	1 850	1 927	1 933
L	7 870	7 701	7 499	7 707	8 242	8 371	8 897	8 738	8 770	8 419	7 243	7 313
NL	2 839	2 849	2 639	2 519	2 450	2 522	2 612	2 552	2 614	2 565	2 600	2 843
A	2 332	2 346	2 351	2 319	2 327	2 383	2 483	2 375	2 458	2 387	2 479	2 494
P	858	852	904	959	966	1 016	1 069	1 126	1 155	1 198	1 196	1 304
FIN	3 556	3 634	3 827	3 797	3 869	3 917	3 862	3 951	4 067	4 114	4 079	4 089
S	3 534	3 569	3 560	3 505	3 431	3 359	3 363	3 336	3 515	3 603	3 612	3 662
UK	2 103	2 174	2 198	2 234	2 218	2 205	2 286	2 281	2 257	2 246	2 246	2 394

Source: Eurostat

Problems

In Eurostat energy balances, final energy consumption corresponds to the final energy flow entered in the balance sheet, i.e. energy delivered to the final consumer for all energy purposes.

The final energy consumption of industry except mining, road and rail transport, households and services is included here.

Unfortunately, it is not possible to distinguish the share of energy used by the urban population (densely populated areas) at this stage. However on a per capita basis, these figures should give a good idea of the trend in urban energy use.

UP-1: Energy consumption

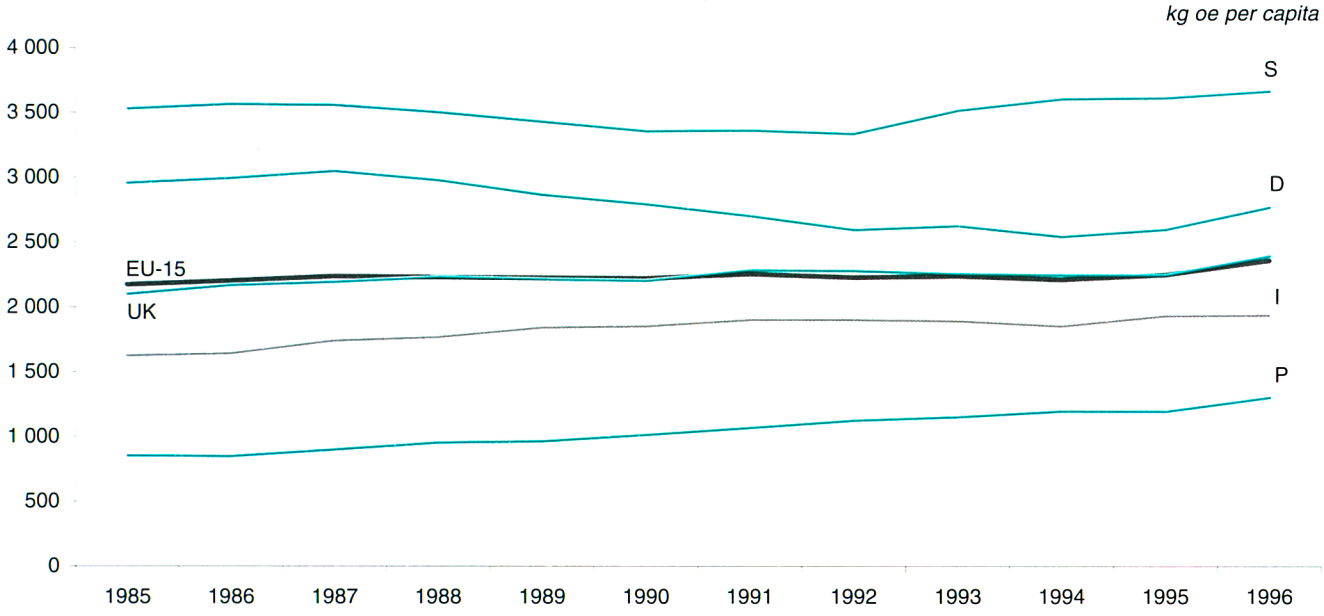
Purpose

Energy consumption has important impacts on the environment. The combustion of fossil fuels is a major source of emissions of CO_2, SO_2, NO_x, and particle emissions into the atmosphere. Most of the energy produced today is consumed in urban areas. The purpose of this indicator is to monitor trends in energy consumption by end uses and sources and thus the related pressure of atmospheric pollution emissions and concentration trends.

Targets

There are no international targets for this indicator. However, in the context of Local Agenda 21 initiatives, many targets have been formulated at individual city level.

Energy use per capita - selected Member States



Source: Eurostat

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

There has been a slow but steady increase since 1985 in all countries, except Germany ; 1996, however saw a larger increase, in particular in Netherlands, Portugal, United Kingdom, Greece and Germany.

Households and services, excluding transport, account for 45 % of this energy consumption in the EU, varying from 30 % in Spain to 57 % in Netherlands and Denmark. Road transport represents 27 % on average, varying from 16 % in Finland to 37 % in Spain.

UP-2: Non-recycled municipal waste

Definition

This indicator presents the percentage of municipal waste produced that is not recycled. Municipal waste includes waste originating from households, commercial activities, office buildings and institutions, and from businesses that dispose of waste at the same facilities. Municipal waste is classified according to the following main categories: paper, paperboard and paper products; plastics; glass; metals; food waste, garden waste and similar materials; other similar waste.

Below, data on the amount of municipal waste per capita either landfilled or incinerated, and therefore not recycled, is presented (*see also WA-1 and WA-2*).

Non-recycled municipal waste [1)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996
B	:	:	:	:	:	:	519
DK	:	:	:	**90**	403	391	400
D	1 092	:	:	743	:	:	:
EL	**296**	:	*289*	:	:	:	:
E	257	:	318	**309**	320	328	*18*
F	303	:	299	344	:	343	:
IRL	:	:	:	:	:	398	:
I	:	402	:	:	:	419	:
L	*369*	*369*	*364*	529	496	480	465
NL	:	407	:	:	330	:	:
A	261	249	241	223	203	203	211
P	242	:	287	:	:	:	:
FIN	492	:	**389**	**333**	258	**268**	:
S	316	:	:	:	286	:	:
UK	:	:	:	:	:	:	:
IS	:	:	1 071	1 064	1 056	1 053	1 079
NO	:	:	491	**395**	*100*	538	*101*
CH	438	:	478	:	382	:	:

Source: Eurostat

1) Italics: data on waste incinerated only ; bold: data on waste landfilled only.

Problems

Data availability and quality are the main obstacles to the presentation of this indicator. There are also variations between countries in the definitions of municipal waste.

UP-2: Non-recycled municipal waste

Purpose

The amount of municipal waste that is not recycled reflects one of the pressures of urban consumption patterns on the environment. The purpose of this indicator is to monitor that pressure.

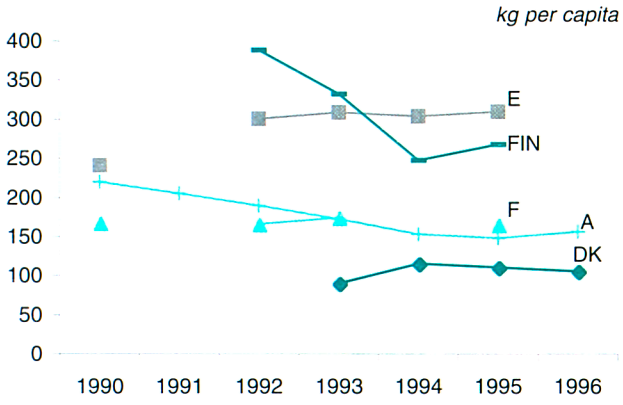
An increase in the amount of waste that is not recycled places significant pressure on the environment in terms of consumption of resources and contamination of soils, water and the atmosphere. It has direct and indirect effects on human health. Its environmental impacts are influenced by the type of waste produced and waste management methods.

Targets

The 5EAP calls for a stabilisation of municipal waste generated in Member States by the year 2000 to quantities not exceeding 300 kg per capita per year (1985 level) and for any waste which cannot be recycled or reused to be disposed of ideally by combustion as fuel ; failing that, by incineration and only to be sent to landfill as a last resort.

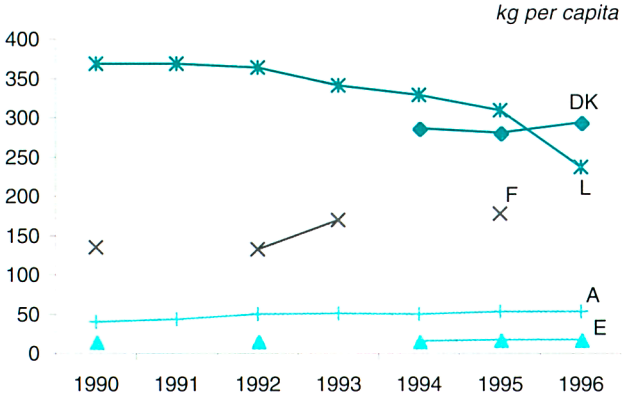
Some countries have set national targets e.g. Austria, to stabilise solid waste production at 1993 levels ; Denmark, to recycle 50 % of waste; and the Netherlands, to recycle 60 %.

Municipal waste landfilled - selected Member States



Source: Eurostat

Municipal waste incinerated - selected Member States



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Yellow	Comp.Space: Yellow

Comments

In 1995 six of the eight EU countries for which data is available exceeded the 300 kg per capita target. Four countries, (Ireland, Italy, Portugal and United Kingdom) have no municipal waste incineration facilities, and therefore send all non-recycled municipal waste to landfill.

Efforts to reduce the amount of municipal waste which is not recycled are bearing fruit in Germany, Luxembourg, Austria and Finland, where the overall trend in recent years is down.

UP-3: Non-treated waste water

Definition

The percentage of total waste water which is discharged to surface water, without being first submitted to treatment.

This percentage is linked to inadequate waste water management and treatment infrastructure in cities. In several cities the waste water of a large proportion of the population is still not submitted to primary or secondary sewage treatment. In addition, the most advanced form of treatment - tertiary treatment - is available for only a small percentage of the population.

Domestic waste water without treatment

m^3 per capita

	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995
B	52.67	51.74	42.21	:	41.06	:	:	:	39.42	:
DK	21.02	13.52	:	4.14	0.92	:	:	:	:	:
D	:	:	9.63	7.33	6.95	7.14	:	:	:	5.27
EL	:	:	40.86	36.96	36.38	:	36.38	:	:	:
E	:	46.92	44.95	38.87	:	33.4	31.81	:	:	28.31
F	:	:	:	:	:	:	18.68	:	:	:
IRL	:	:	48.62	:	30.66	30.66	:	:	:	:
I	52.97	:	:	:	:	:	:	24.21	:	:
L	33.51	:	8.84	7.91	:	:	:	:	5.91	5.82
NL	26.83	24.91	12.93	6.23	3.35	3.35	3.35	1.92	1.92	1.92
A	45.44	:	33.95	19.16	15.33	15.33	15.33	13.85	:	13.85
P	:	:	34.77	34.34	:	:	:	:	:	:
FIN	45.33	21.02	11.83	5.85	2.63	2.63	2.63	2.63	2.63	2.63
S	18.33	9.36	8.87	2.96	2.96	2.96	2.46	:	:	:
UK	:	:	7.64	7.21	:	:	:	:	:	5.52

Source: TAU

Problems

Major problems are the lack of data and the quality of available data. Data on urban waste water is collected at local level. OECD/Eurostat collect information on the population connected to sewerage and served by waste water treatment plants at the national or regional level, but a complete data set is not available. A possible alternative definition of the indicator would be the number of people served by treatment plants by type of treatment.

As well as regular untreated discharges, the indicator should also address accidental discharges through storm water overflows. However, there is a severe lack of information in this area.

UP-3: Non-treated waste water

Purpose

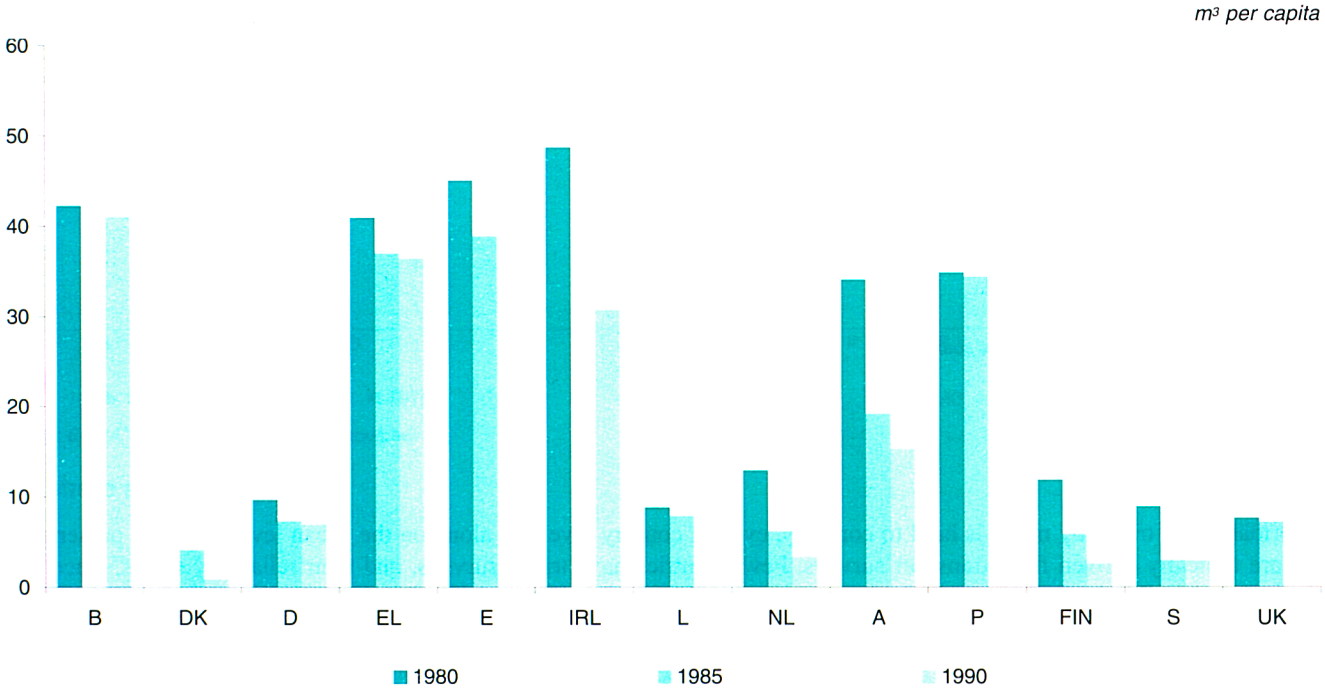
The discharge of non-treated urban waste water is a major cause of pollution of surface water and eutrophication problems. The purpose of this indicator is to monitor trends in the pressure from urban waste water on surface water.

Non-treated waste water can cause 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.

Targets

The Directive on Urban Waste Water Treatment (91/271/EEC) sets deadlines for applying secondary treatment before discharge. These deadlines vary and depend on the population equivalents (p.e.) in the urban agglomeration. In addition, agglomerations of more than 10 000 p.e. situated in sensitive areas must have tertiary treatment facilities for all their discharges by the end of 1998.

Domestic waste water without treatment



Source: TAU

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

The percentage of non-treated waste water has drastically decreased since 1970. Nonetheless there are still areas where most of the population is not connected to sewage treatment.

UP-4: Share of private car transport

Definition

The share of urban car transport as an urban problem has been defined within this project as 'the amount of passenger-km travelled by private car per year in urban areas as a percentage of the total amount of passenger-km travelled in urban areas by all transport modes.' The transport modes included for calculating the indicator are: cars, motorcycles, buses, urban rail, mopeds, bicycles and walking. Trains and ships are excluded.

Car share of urban transport

% of passenger-kilometres

	1970	1975	1980	1985	1990	1995
B	:	:	:	:	:	:
DK	:	:	:	:	:	:
D	:	:	:	:	:	:
EL	:	:	:	:	:	:
E	:	:	:	:	:	:
F [1]	:	:	73	:	:	76
IRL	:	:	:	:	:	:
I	:	:	:	:	:	:
L	:	:	:	:	:	:
NL	50	56	56	57	57	59
A	:	:	:	:	:	:
P	:	:	:	:	:	:
FIN	65	69	72	79	82	76
S [2]	51	54	52	54	59	56
UK	:	:	:	:	:	:

*Source: E*M*A*I*L (adapted from various sources)*

1) Excluding mopeds
2) Excluding buses

Problems

Information on travel by mode is hard to come by, even at country level, let alone on the urban level. Data on passenger-km are typically derived from transport surveys. Few countries have travel surveys, and their reliability varies, since the methodologies differ significantly. There are a number of European sources under development that look promising as a source on urban transport for the future, however. One of the most useful in this respect could be the Dutch SESAME database.

A 'top-down' calculation approach was chosen due to the lack of urban data and the difficulties involved with data availability and aggregation. Country data on passenger-km by transportation mode were obtained from several sources and were multiplied by the percentage of the pertaining transport mode that takes place within urban areas. How this percentage is derived varies. In some cases these percentages had to be deduced. Inland shipping was excluded due to the differences in potential for this mode of urban transport in the different countries. Train, although a significant factor in some cases, was excluded due to a lack of data and methodological problems.

There is no unified concept of what is to be considered 'Urban transport'. There is not even a unified concept of urban areas in the EU, which is a serious obstacle not only for the developing of transport-related urban indicators.

It is to be expected that there are great differences in the urban car share between Member States. Urban morphology differs between countries, but public transport availability and transport preferences also differ greatly (bicycle preference in the Netherlands, scooters in Italy and mopeds in Greece). The presence of a metrorail in a city has also an important influence on travel patterns.

UP-4: Share of private car transport

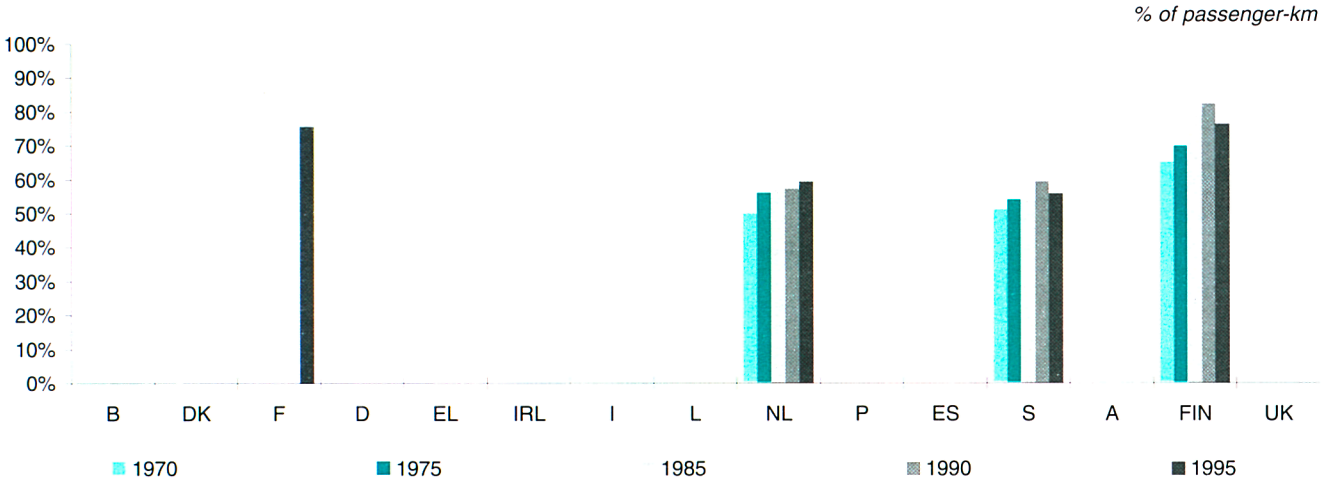
Purpose

The share of the car in urban transport is a major source of pressure on the local environment. Traffic-generated environmental pressures, such as lead, particles, nitrogen oxides, hydrocarbons, smell and noise are increasing problems, both in inner cities and in the urban sprawl. The SESAME project, for example, has shown that the share of private car transport in urban areas is directly related to urban patterns and trends. Concentration of jobs, length of road network and number of cars per household have a strong positive correlation to the mode choice, whereas city density, public transport supply and time used for travel have a strong negative correlation. The increased share in passenger-km travelled by car in urban areas is correlated with decentralisation of the urban structure in the majority of cities.

Targets

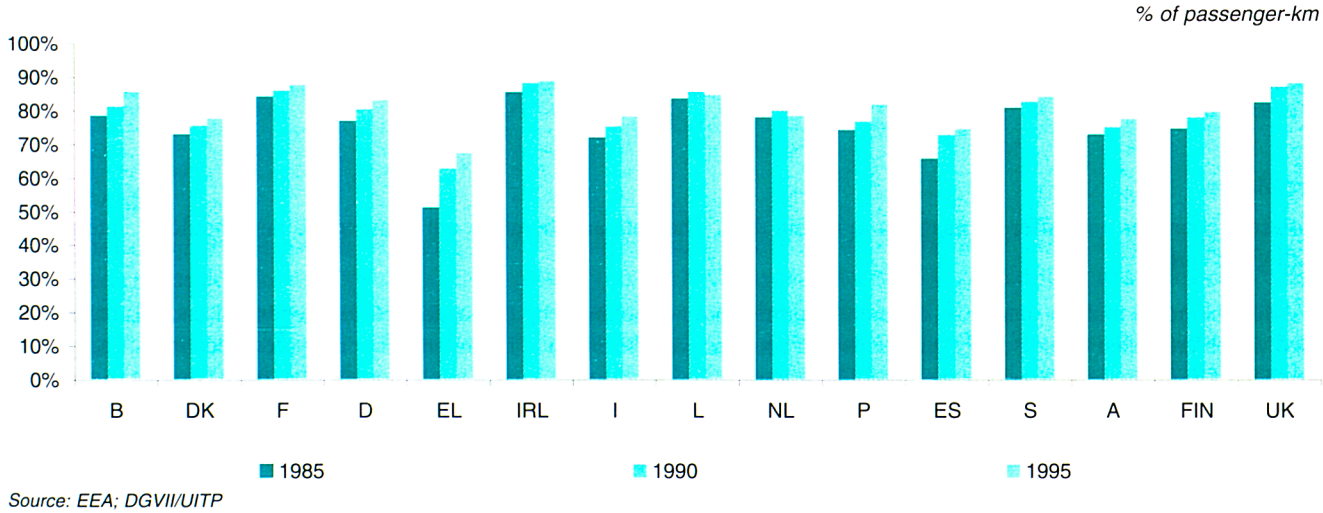
No targets have been established for this subject.

Car share of urban transport



*Source: E*M*A*I*L (adapted from various sources)*

Car share at country level



Source: EEA; DGVII/UITP

Relevancy: Green	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

The figures for Sweden do not include urban bus transport, and moped and motorcycle share were assumed to be nil. The figures are therefore overestimated. The indicator shows great differences between the different countries. With the exception of Finland, the car share in urban areas is significantly lower than the car share at country level.

UP-5: People endangered by noise emissions

Definition

The indicator provides insight into the pressure from noise emissions. It shows the percentage of population exposed to noise levels greater than 55 dB(A) and 65 dB(A) at a national scale.

Levels exceeding 55 dB(A) are harmful to the quality of life and to general well-being. Levels exceeding 65 dB(A) are unacceptable for residential environments because of serious harmful effects on communication, sleep and rest, performance and on long term health. Levels above 75 dB (A) are considered a direct threat to human health.

Since road traffic is the major source of offending noise in urban areas, the data refer primarily to road traffic.

Noise exposure due to road traffic - early 1980s and 1990s

% of the total population

	1980*		1992**	
	1980: >55 dBA	1980: >65 dBA	1992: >55 dBA	1992: >65 dBA
B	69	12	69	12
DK	38	12	29	10
D	45	12.5	50	15
EL	50	20	:	:
E	74	23	73	23
F	44	13	57	10
IRL	:	:	:	:
I	:	:	:	:
L	:	:	:	:
NL	40	6	53	3
A	50	16	50	16
P	:	:	:	30
FIN	:	:	17	4
S	38	11	16	2
UK	50	11	56	10
EU-12	:	:	60.4	19.6

Source: 1980 data: OECD, 1992 data: von Meier (1993), EU-12 data: Lambert and Vallet (1994), estimation based on data from 7 countries representing 71 % of the total population of the EU-12.

Problems

Different countries use different methods to obtain data. The data are therefore not comparable and should be interpreted with great care[1].

It should be noted that the data from different countries are not obtained by the same method. In general, models have been used which are based on noise measurements and acoustic calculations in a limited number of typical locations. The results are then extrapolated to the whole country. The accuracy and representativity of such models vary from country to country, and some of the models appear rather simplified.

[1] The European Commission has set up 5 technical working groups who should provide assistance in the development of the new EU noise policy in the following areas: perception, description and abatement of environmental noise (noise indicators, dose effect, computation and measurements, noise maps and noise abatement). One of the targets is the harmonisation of the different indices, methodologies and limits throughout Europe. The same applies for the collection of data regarding the assessment of the accoustic environment.

UP-5: People endangered by noise emissions

Purpose

Exposure to noise above acceptable levels in urban areas is a major cause of stress for the urban population. It is related particularly to road and air traffic and causes serious health risks. The purpose of this indicator is to monitor the pressure from urban noise trends.

More than 50 % of the European population is exposed to noise levels above 55 dB (A) and 16 % of the population is exposed to noise levels over 65 dB(A).

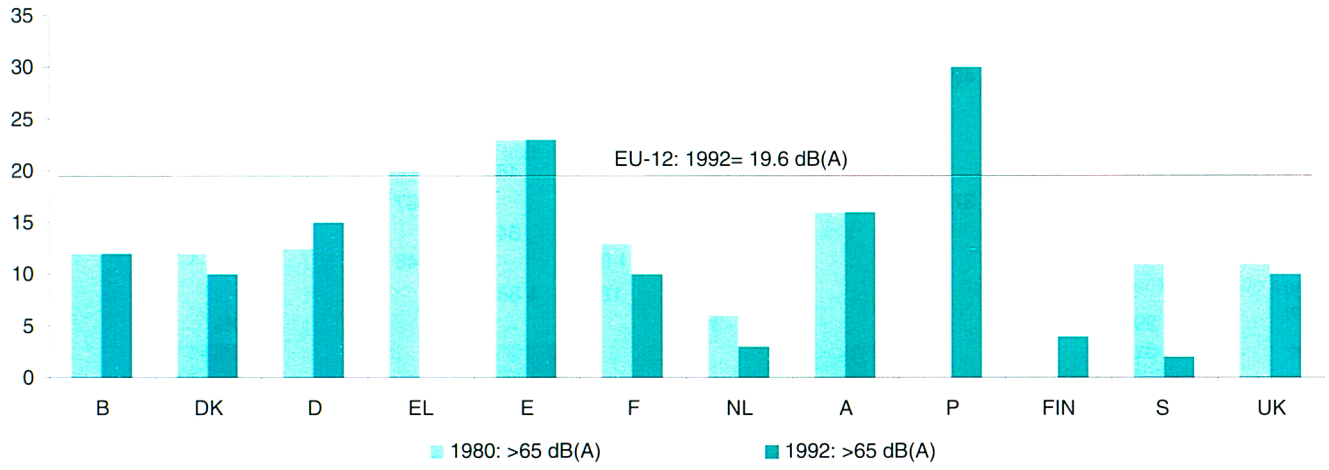
Targets

EU targets up to 2000 include:

- exposure of population to noise levels in excess of 65 dB (A) should be phased out;
- % of population exposed to levels between 55 dB (A) and 65 dB (A) should not increase;
- the population exposed to levels below 55 dB (A) should not be exposed to levels above 55 dB(A).

Noise exposure due to road traffic [1)]

% of population exposed to Leq,24h > 65 dB(A)



Source: OECD; von Meier (1993), Lambert and Vallet (1994)

1) Warning: given the comparability problems, this indicator should be interpreted with great care

Relevancy: Green	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Red

Comments

A careful comparison between the data from 1980 (representing 'early eighties') and 1992 would suggest that the noise environment has deteriorated. This is not so evident within the high exposure range of L_{eq}> 65 dB(A), which appears to have stabilised, but seems to be evident within the lower level range of the 55 to 65 dB(A), apparently as a result of the fast growing volume of road traffic. Due to the different methodologies in the various Member States, such a comparison can only be regarded to be indicative. For a sound comparison, both the methodology used and the data gathering should be harmonised. The WHO Healthy Cities Programme could provide a framework for data gathering.

The Commission itself started in summer 1998 the preparation of a 2-step directive which will harmonise the noise exposure indicators and the related computation and measurement methods, and foresees the creation of an EU databank. Expert working groups will prepare in 1999 a proposal for a Directive covering the first step.

UP-6: Land use (change from natural to built-up area)

Definition

The trend in land use for human settlements: the change in the total built-up area per year, related to the total population changes. In addition to the residential areas, built-up areas also include the areas for infrastructure, industrial purposes and recreation sites.

The conversion of *natural* areas and other areas to *built-up* areas is related to population growth. In addition, the physical development of human settlements, particularly urban sprawl and sub-urbanisation, are major driving forces for land conversion.

Built-up and related area [1]

m² per capita

	1980	1982	1985	1986	1988	1990	1991	1992	1993	1995	Change 90/80	Average annual change of m² per capita
B	441	:	491	:	:	509	:	:	:	529	15%	5.85
DK [2]	423	451	:	500	:	:	:	:	:	498	10%	4.40
D [3]	487	:	:	:	:	493	:	:	495	:	1%	0.64
EL	507	:	:	:	:	:	:	:	:	:	:	:
E [4]	495	:	498	505	509	497	:	:	:	:	0%	0.12
F	471	454	476	:	519	498	:	491	:	508	6%	2.49
IRL [5]	:	:	:	:	:	:	:	:	:	267	:	:
I	:	:	:	:	:	:	:	:	236	:	:	:
L	:	:	:	:	:	:	:	466	:	:	:	:
NL [6]	359	:	371	:	:	369	:	:	367	:	3%	0.53
A	:	:	:	:	:	354	351	346		:	:	-4.13
P	:	:	:	:	:	1 429	1 083	:	948	:	:	:
FIN	:	:	:	:	:	1 883	1885	1 884	:	:	:	0.50
S [7]	1 295	:	:	:	:	1 298	:	:	:	:	0%	0.30
UK	311	:	:	:	:	405	:	:	:	:	30%	9.41

Source: EEA, Eurostat and national sources

1) The average annual change in m² per capita is calculated with the data available for the period from 1980 to 1995.
2) DK: for the first three years, data refer to urban areas of over 200 inhabitants (this includes all landuse categories inside these communities) and the summer residence areas, 1980 data refer to 1978, 1986 OECD/Eurostat questionaire 1988, 1995 Corine database: Artificial areas, change: 95/82
3) D: data refer to West Germany. In 1993, including the former East Germany, the built-up and related area is 495 m² per capita, 1980 data refer to 1981, 1990 data refer to 1989, change: 89/81
4) E: 1988 data refer to 1987
5) IRL: Ordnance Survey, Ireland: urban mapping programme only includes villages or towns with population over 1 000 persons. Also all traffic areas are not included. Therefore the total built-up and related area is assessed on 5 to 10 % of the total area
6) NL: 1980 data refer to 1979, 1990 data refer to 1989, change: 89/79
7) S: although 83.1 % of the total population in Sweden lives in localities with at least 200 inhabitants (urban areas), the area of these localities is only 30% of the total built-up area.

Problems

Comparable data on the conversion from *natural* area to *built-up* area in European countries are not available. There is insufficient statistical knowledge of the loss of natural areas directly caused by building activities in urban areas in most countries.

For statistical reasons and because of the lack of available data, it is not possible to define the share of the built-up area in use by cities in comparison with built-up areas in smaller settlements.

UP-6: Land use (change from natural to built-up area)

Purpose

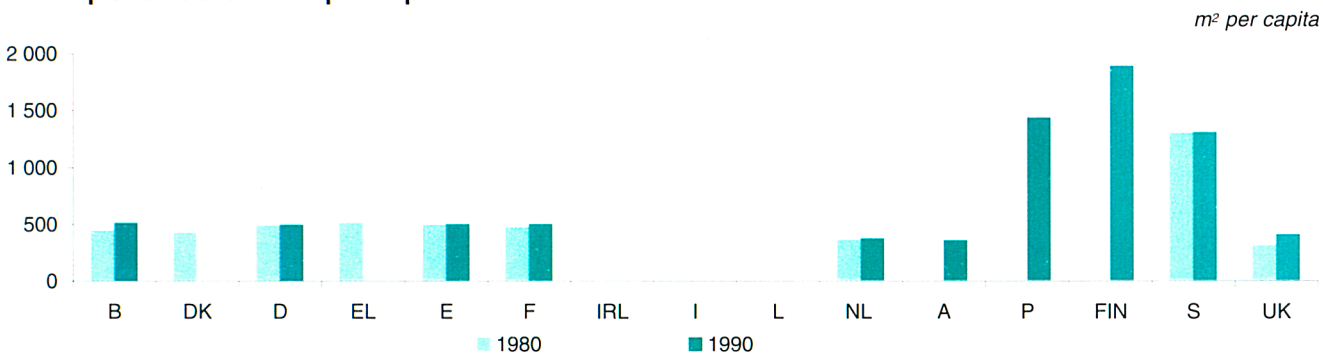
The purpose of this indicator is to monitor the trends in land use changes and determine the environmental pressure of urban development patterns. Land conversion due to urbanisation is a major cause of the loss of natural habitats and biodiversity, and the disruption of watersheds.

The increase in urban built-up area is a relevant indicator for the increase in loss of open land and green space around cities.

Targets

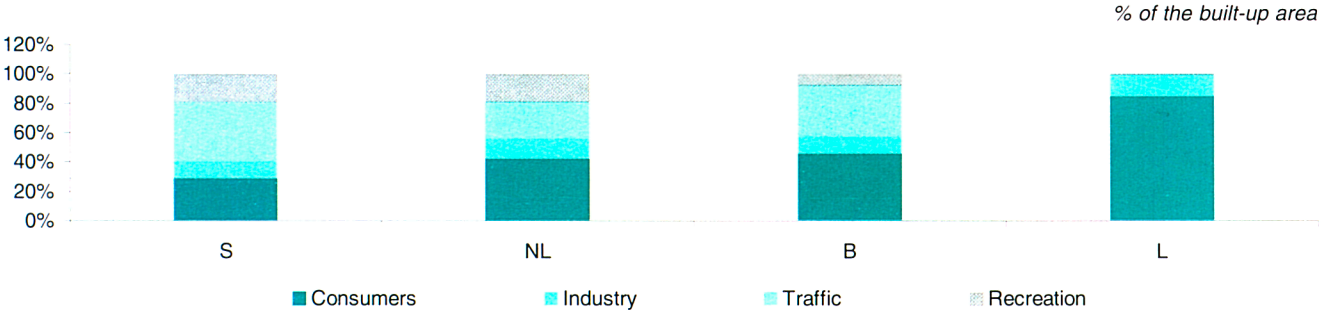
No policy targets have been defined for this subject yet.

Built-up and related area per capita



Source: EEA, Eurostat and national sources

Built-up area by sector



Source: national sources, Eurostat

Relevancy: Yellow	Accuracy: Green	Comp.Time: Yellow	Comp.Space: Green

Comments

The overall picture shows that in 1990 the number of square metres of built-up land per capita was similar for most countries. The Scandinavian countries are marked by a higher level of built-up area per capita. However, in Sweden the area of localities with at least 200 inhabitants (urban areas) is only 30 % of the total built-up area, in which 83.1 % of the total population in Sweden lives. The majority of the built-up area in Scandinavian countries is for infrastructure and recreational purposes. The high levels of built-up area per capita provided for Portugal is probably due to the methodology used.

Belgium, Denmark and France have a high growth rate, indicating a rapid sub-urbanisation. The high percentage change for the United Kingdom is most likely due to changes in statistical definitions and/or methods of collecting data. Since the table is based on the relationship between the changes in population and built-up area, a negative change rate indicates that the population growth outnumbers the growth of built-up area, resulting in a decline of available built-up area per capita: the built-up area is becoming more densely populated. This does not mean the absolute built-up area is declining.

There is a distinct relationship between this indicator and RD-3 from the *Resource Depletion* policy field, which shows the increase in the total built-up area per country.

WASTE



Introduction

Waste is defined in Article 18 of Directive 75/442/EEC [1].

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

Hazardous and non-hazardous waste present risks to the environment. The environmental impacts that have been most closely associated with waste management are, for example:

- pollution of ground and surface water,
- soil contamination,
- greenhouse effect (e.g. methane emissions from landfill sites),
- additional health impacts from odour, noise (e.g. waste transport) and nature deterioration.

Moreover, the proper treatment of waste is an economic burden on industry, municipalities and households.

One of the key tasks for the 1990s, as outlined in the Fifth Environmental Action Programme, is to halt and reverse current trends in waste generation, in terms of both volume increase and environmental hazard and damage. The European Union defined its waste policy in Council Resolution of 7 May 1990 which focuses on prevention, reuse, promotion of recovery, minimisation of final disposal, regulation of transport and remedial action. This policy was completed by a strategy for waste management defined in Council Resolution (97/C 76/01) [2].

The Basle Convention on the control of transboundary movements of hazardous waste and their disposal has also had a major influence on the waste management policies of Member States. The Convention requires generation and transboundary flows to be reported, for different types of hazardous waste, as laid down in the Annexes 1 and 2 of the Convention [3]. 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) [4].

Compilation of waste statistics at Community level has shown that the data in the Member States are very heterogeneous. A statistical methodology was proposed in order to remedy this situation, including a system of statistical surveys in industry, local authorities and the processing sector. 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.

[1] OJ L 194 of 25.7.1975, p.2
[2] OJ C 076 of 11.3.97, p.1-4.
[3] The Annex 1 list consists of 45 categories, 18 of which (Y1-Y18) are source oriented waste types, Y19-Y45 refer to hazardous substances or chemicals incorporated in wastes. Annex 2 lists two specific types of waste: Y 46 'Waste collected from households' and Y 47 'Residues arising from the incineration of household waste'.
[4] OJ L 22 of 24.1.1997, p. 14.

WA-1: Waste landfilled

Definition

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, e.g. 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.

Municipal waste landfilled [1) 2) 3)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1996 (%)
B	:	:	:	:	:	:	230	:	29
DK	:	:	:	90	116	110	106	:	19
D	987	:	:	637	:	:	:	:	:
EL	296	:	:	:	:	:	:	:	:
E	241	:	301	309	304	310	:	:	81
F	168	:	166	174	:	165	:	:	28
IRL	:	:	:	:	:	398	:	:	:
I	:	402	:	:	:	419	:	:	93
L	:	:	:	187	167	170	228	184	40
NL	:	240	:	:	187	:	:	:	33
A	220	205	190	172	153	149	157	:	31
P	242	:	287	:	:	:	:	:	86
FIN	482	:	389	333	248	268	:	:	60
S	164	:	:	:	137	:	:	:	38
UK	:	:	:	:	:	:	:	:	:
IS	:	:	416	408	407	401	418	:	63
NO	:	:	393	395	:	435	:	:	75
CH	87	:	165	:	89	:	:	:	15

Source: Eurostat/OECD

Hazardous waste landfilled [2) 4)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997	1996 (%)
B	:	:	:	:		68	97	:	49
DK	:	:	:	:	13	14	16	:	32
D	58	:	:	40	:	:	:	:	36
EL	:	:	:	:	:	:	:	22	65
E	25	:	:	:	:	:	:	:	57
F [4)]	12	11	14	12	13	13	12	:	9
IRL	:	:	:	:	:	1	:	:	2
I	:	5	:	:	:	11	:	:	24
L	:	:	:	51	110	42	:	:	9
NL	18	:	28	10	11	10	6	:	10
A	:	:	:	:	:	:	:	:	:
P	:	:	:	:	15	:	:	:	11
FIN	9	:	5	:	:	:	:	:	4
S	:	:	:	:	:	:	:	:	:
UK	:	:	26	16	:	:	:	:	45
IS	:	:	:	:	:	:	:	:	:
NO	:	:	2	:	:	:	:	:	5
CH	:	24	26	25	30	25	24	:	19

Source: Eurostat/OECD

1) B, DK, A: household waste data only ; D: public 'municipal waste landfills' data (2522 landfills in 1990 and 560 in 1993) for enlarged German Republic
2) % 1996 refers to the percentage of municipal or hazardous waste landfilled versus the total amount of municipal or hazardous waste generated in 1996 or the latest year for which data are available.
3) FIN: % 1996 refers to 1994 data ; NO: % 1996 refers to 1992 data
4) F: % 1996: refers to 1990 data

Problems

Data is only available for municipal and 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 (*hazardous waste, non-hazardous waste, municipal waste, inert or construction residuals* landfill sites) can collect waste from other types than those for which they have been designed.

As statistical data collection is always limited to legal activities, the data quality in a certain field with a significant percentage of illegal activities 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 towards 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 landfilling pressure.

WA-1: Waste landfilled

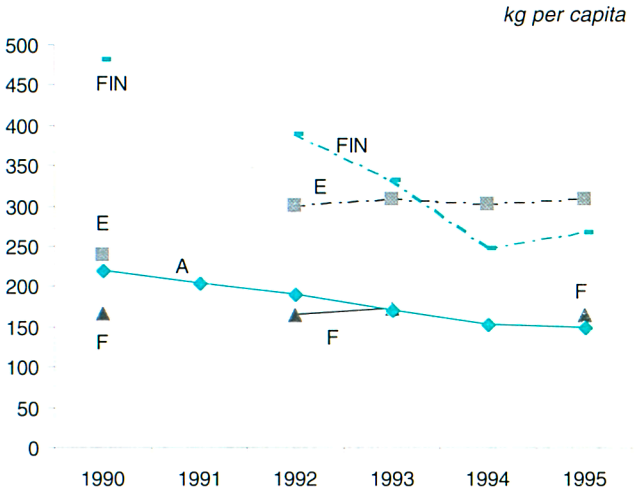
Purpose

The indicator measures the amount of waste landfilled, a practice that may lead to several environmental problems.

Targets

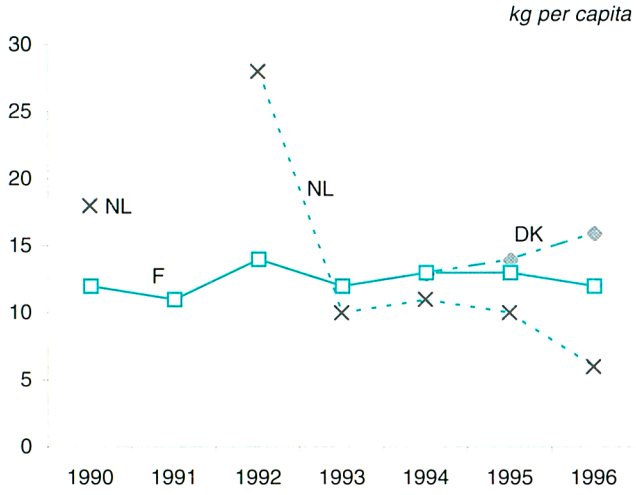
The Council Directive on the landfill of waste [5], which is due to come into force in 1999, will regulate and restrict landfilling in Europe. It identifies waste types excluded from landfilling, defines application and permission rules, lists the control and monitoring procedures during the operational and closure phase of a landfill and the technical waste acceptance procedures to be established. When the Directive comes into force the activity of landfilling will become highly regulated. The environmental burden from landfilling will decrease and the economic importance (costs and benefits) rise.

Municipal waste landfilled - selected Member States



Source: Eurostat/OECD

Hazardous waste landfilled - selected Member States



Source: Eurostat/OECD

Relevancy: Green	Accuracy: Yellow	Comp.Time: Red	Comp.Space: Red

Comments

EU data on landfilling are not very up to date and no long time series are available, making it impossible to compare countries and years in a comprehensive way. It would also be useful to know the number of landfills, the technical equipment and the amount of transport (in tonnes-km) for waste collection. Concerning data quality, some countries are only able to make broad estimations while others have detailed and more reliable data at their disposal.

The definition of *municipal waste* can vary from one country to another. In Germany more than 600 kg per capita were landfilled in 1993 but this figure is at least 200 kg too high because it includes non-municipal waste deposited at municipal landfills. For the other countries, the amounts vary between around 100 and 400 kg per capita.

Concerning *hazardous waste*, it would also be useful to know more about the generation of hazardous waste itself and about the developed treatment methods. Amounts landfilled are close to or below 20 kg per capita in all countries except B (97 kg), D (40 kg) and L (42 kg).

[5] OJ C 156 of 24.5.1997, p.10

WA-2: Waste incinerated

Definition

The indicator covers the total amount of all types of waste incinerated (hazardous/non-hazardous, industrial/commercial/private). It does not differentiate between different types of facilities, e.g. for reducing pollution or recovering energy. Wastes which are incinerated via co-combustion in special industrial furnaces like cement-ovens, blast-furnaces and kilns are included. The indicator therefore only reflects the total amount of waste incinerated either in special waste incineration plants or co-combusted.

To evaluate the environmental pressure, incineration capacity, pollution abatement facilities attached to incinerators, energy recovery potential and actual energy recovery at incinerators and residuals (including gaseous emissions) from waste incineration should also be taken into account.

Municipal waste incinerated [1) 2)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1996 (%)
B	:	:	:	:	:	:	289	37
DK	:	:	:	:	287	281	294	54
D	105	:	:	106	:	:	:	:
EL	:	:	289	:	:	:	:	:
E	16	:	17	:	16	18	18	5
F	135	:	133	170	:	178	:	30
IRL	:	:	:	:	:	:	:	:
I	:	:	:	:	:	:	:	:
L	369	369	364	342	329	310	237	51
NL	:	167	:	:	143	:	:	25
A	41	44	51	51	50	54	54	10
P	:	:	:	:	:	:	:	:
FIN	10	:	:	:	10	:	:	2
S	152	:	:	:	149	:	:	41
UK	:	:	:	:	:	:	:	:
IS	:	:	655	656	649	652	661	100
NO	:	:	98	:	100	103	101	16
CH	351	:	313	:	293	:	:	49

Source: Eurostat/OECD

Hazardous waste incinerated [2) 3)]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1996 (%)
B	:	:	:	:	:	11	15	7
DK	:	:	:	:	4	4	4	33
D	31	:	:	25	:	:	:	22
EL	:	:	:	:	:	:	:	:
E	6	:	:	:	:	:	:	:
F	16	16	17	18	21	21	22	13
IRL	:	:	:	:	:	14	:	20
I	:	:	:	:	:	2	:	4
L	:	:	:	:	:	:	:	:
NL	12	:	11	10	10	12	10	17
A	8	:	13	12	12	11	13	17
P	:	:	:	:	4	:	:	3
FIN	6	:	9	:	:	:	:	8
S	:	:	:	:	:	:	:	:
UK	:	:	3	3	:	:	:	9
IS	:	:	:	:	15	11	:	60
NO	7	:	:	:	4	:	:	4
CH	:	37	42	37	42	40	42	34

Source: Eurostat/OECD

1) B, DK, A: data refer to household waste only
2) % 1996 refers to the percentage of municipal or hazardous waste incinerated versus the total amounts of municipal or hazardous waste generated in 1996 or the latest year for which data are available
3) D: 1990 and 1993: including co-combustion in industrial furnaces (about 40 %)

Problems

Waste incineration is a highly ambiguous topic because it leads both to positive effects, such as waste reduction and production of hygienic waste, energy recovery and replacement of primary resources via co-combustion, and to negative effects, e.g. hazardous residues, highly polluted gaseous emissions and polluted water from flue gas cleaning.

Waste incineration must be seen as one treatment method, which is in competition with other treatment methods. Therefore the pressure (and the environmental benefit) from incineration should be related to possible alternatives, e.g. a waste management system including *sorting* followed by *material-recovery, composting of biodegradable components* and *final disposal.*

WA-2: Waste incinerated

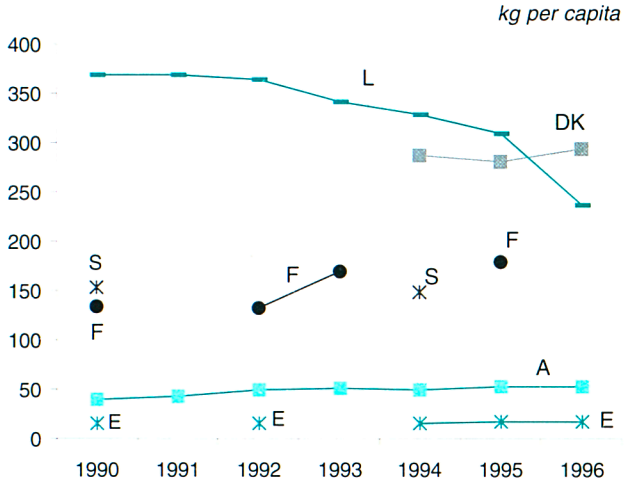
Purpose

The main purpose of this indicator is to represent the total amount of waste incinerated.

Targets

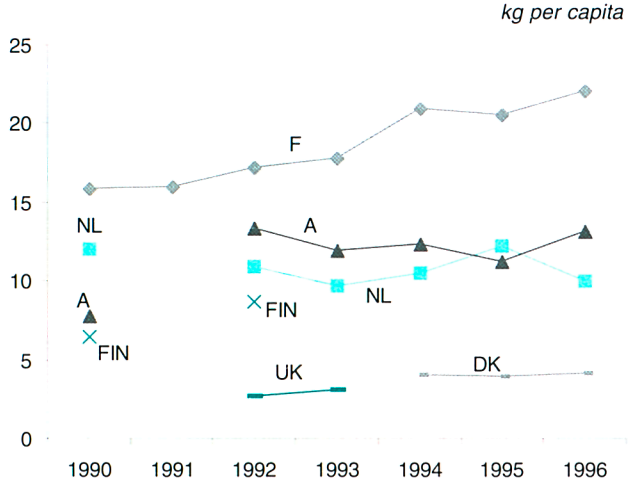
The proposal for a Council Directive on the incineration of waste (COM (1998) 558 final) fixes as objectives the prevention of waste incineration and, where not practicable, the reduction of negative effects on the environment as far as possible. Municipal waste incineration and all types of incineration, among which co-incineration, are included.

Municipal waste incinerated



Source: Eurostat

Hazardous waste incinerated



Source: Eurostat

Relevancy: Green	Accuracy: Yellow	Comp.Time: Red	Comp.Space: Red

Comments

This indicator, like the indicator on landfilling, is based on 2 different data sets: *hazardous waste incineration* and *municipal waste incineration*, and faces the same data problems although to a lesser extent than landfilling.

The data on *municipal waste incineration* remain stable over time for most countries which possess time series. Only France and Netherlands show significant changes over time, which can be explained by the installation of new incinerators for France and by the closure of incinerators in the Netherlands. Denmark, Belgium, Luxembourg and Greece have a high rate of incineration (about 300 kg per capita). France, Netherlands, Sweden and Germany have a modest degree (between 100 and 180 kg per capita), while Finland, Austria and Spain possess only 1 or a maximum of 3 incinerators (Spain) and thus only incinerate small quantities. The remaining countries do not incinerate municipal waste at all.

The *incineration of hazardous* waste is not as closely related to incineration capacities as municipal waste incineration for two reasons: 1) hazardous waste is to a large extent co-combusted in industrial furnaces and 2) the relevant list of waste which is considered hazardous has often changed at national and European level. This can lead to unchanged amount of incineration of certain waste types but increased amount of 'hazardous' waste, because of changes in definition. Hazardous waste incineration is expressed 'per capita' and as percentages in relation to hazardous waste generated because there is no close causal relation between hazardous waste generation and population. Based on the latest data available, EU countries on average incinerate about 10 % of hazardous waste, with only Germany, Ireland, Netherlands and Austria significantly above this level.

WA-3: Hazardous waste generated

Definition

Council Decision 94/904/EC, established a list of hazardous waste (HWL) pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste. Within the EU, a waste type is considered hazardous if it is included in this list. Annex III of Directive 91/689 lists 14 properties of wastes which render them hazardous. At national level, certain waste types may be declared hazardous if, in the opinion of a Member State, they display any of the properties on this list. Moreover, Annexes 1 and 2 to the Basle Convention have defined different types of hazardous waste for which generation and transboundary movements have to be reported. The Basle Convention also introduced a ban on the export of hazardous wastes to non-OECD countries, which was transposed into Community legislation by Council Regulation (97/120/EC).

The table presents the data available on total amounts of hazardous waste generated by Member States and EFTA countries.

Hazardous waste generated [1] [2]

kg per capita

	1990	1991	1992	1993	1994	1995	1996	1997
B	:	:	:	:	:	164	200	:
DK	:	:	:	:	37	48	51	:
D	165	:	:	112	:	:	:	:
EL	44	:	44	:	:	:	:	33
E	44	:	:	:	87	:	:	:
F	123	:	:	:	:	:	:	:
IRL	:	:	:	:	:	69	:	:
I	:	60	:	:	:	47	:	:
L	303	:	:	215	202	485	383	339
NL	70	:	94	58	54	64	60	:
A	87	:	51	:	60	64	72	75
P	:	:	:	:	137	:	:	:
FIN	113	:	111	:	:	:	:	:
S	18	:	:	:	16	:	:	:
UK	*51*	*51*	42	36	:	:	:	:
IS	:	:	:	:	:	:	:	:
NO	47	:	35	:	115	:	:	*155*
CH	:	109	122	103	124	122	126	:

Source: Eurostat/OECD

1) B refers to Flanders and Wallon region only
2) Italics: non-validated data

Problems

As the indicator is titled *Hazardous waste generation*, the data should correspond to the HWL derived from the European Waste Catalogue. However the main source currently available in Eurostat is the Eurostat/OECD joint questionnaire on waste, which is not based on the HWL.

The breakdown of hazardous waste totals into the Y1-Y18 codes of the Basle Convention is available only to a limited extent. Among EU countries, only Flanders, Denmark and the Netherlands have provided a breakdown for more than about 40 % of their total. For the remaining countries only about 20 % or less is broken down according to these codes.

WA-3: Hazardous waste generated

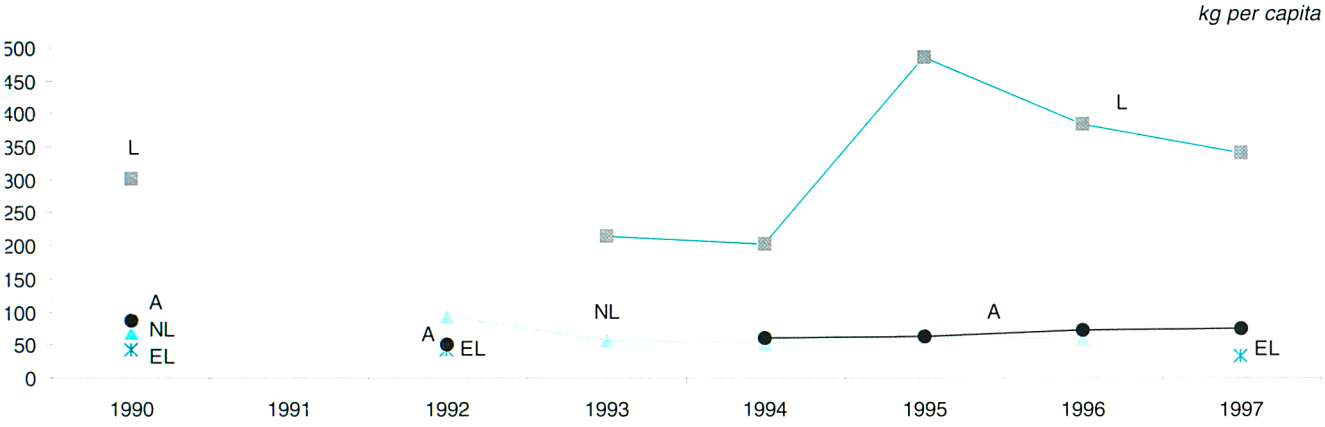
Purpose

The main purpose of this indicator is to show the trend in the amount of hazardous waste generated in EU Member States. It should also show how far society has progressed in changing consumption patterns and technologies towards less hazardous materials and products. A breakdown into the different types of hazardous waste is needed as different types of waste present different risks to the environment and to human health. Areas of particular concern are the potential contamination of soil and pollution of fresh and ground water.

Targets

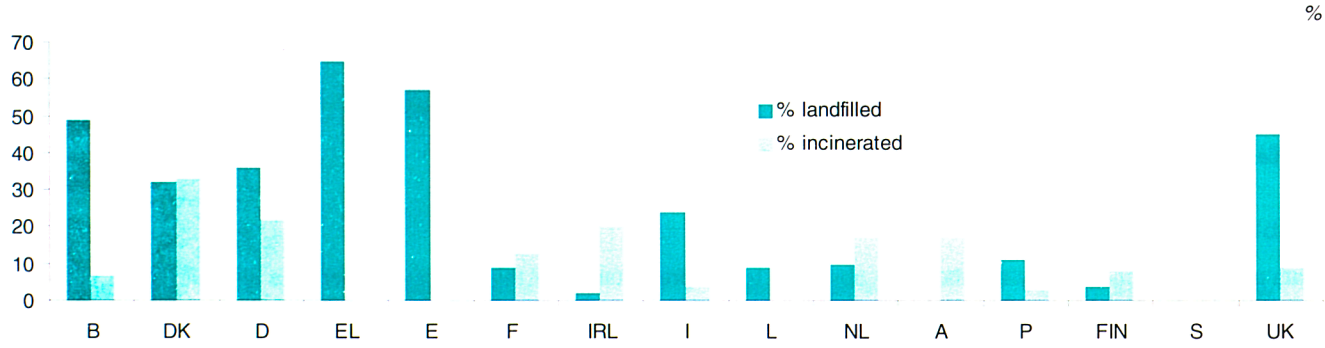
EC Council Regulation 259/93 lays down a policy of reduction of waste shipments to the absolute minimum for waste destined for disposal (principle of proximity) and adopts the OECD control system, including a standard consignment note for those movements that do occur. Since 1. January 1998, an amendment to EC Regulation 259/93 has prohibited all exports of hazardous waste from the rich world to non-OECD countries.

Hazardous waste generated - selected Member States



Source: Eurostat/OECD

Hazardous waste landfilled versus incinerated as a percentage of total hazardous waste generated - EU-15 (1996)



Source: Eurostat/OECD

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

At the moment only a restricted interpretation of the hazardous waste data is possible. Amounts generated per capita in EU-15 vary from about 20 kg to more than 400 kg and the large variations over time in some countries suggest that the calculation procedure or the list of wastes considered hazardous has changed during the period observed.

The data situation should change dramatically in the near future, when data produced by Member States to fulfil reporting obligations of the Basle Convention and the Commission become available. This will allow differentiation by types of risk and of hazardous waste (e.g. infectious waste, industrial waste and environmental technology waste).

WA-4: Municipal waste generated

Definition

Municipal waste includes waste originating from households, commercial activities, office buildings and institutions, and from businesses that dispose of waste at the same facilities. Municipal waste is classified according to the following main categories: paper, paperboard and paper products; plastics; glass; metals; food waste, garden waste and similar materials; other similar waste.

Statistics supplied to Eurostat by Member States are generally derived in the countries from the 2 different sources *waste collection* and *waste treatment*.

The amount of municipal waste is in general determined to a large extent by private household waste and should therefore be highly related to population.

Municipal waste generated

kg per capita

	1980	1981	1983	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
B	:	:	:	:	:	:	:	:	:	:	:	:	:	489	496	:
DK	399	:	:	475	:	:	:	:	:	:	460	:	521	534	545	:
D	:	:	:	:	:	:	:	:	634	:	:	537	:	:	:	:
EL	261	:	:	302	:	:	:	:	296	:	291	:	:	:	:	:
E	271	:	:	261	275	:	:	:	323	:	355	:	365	381	390	:
F	:	:	:	:	:	:	:	:	534	:	472	586	:	598	:	:
IRL	:	:	:	:	:	:	:	:	:	:	:	:	:	368	:	:
I	:	:	:	265	:	:	:	:	353	:	460	:	:	451	:	:
L	:	:	:	:	:	:	:	:	591	565	503	509	489	480	465	461
NL	:	496	490	480	:	519	:	535	:	542	:	562	564	549	563	:
A	:	:	:	:	:	:	:	:	629	:	608	420	:	445	510	:
P	:	:	:	235	:	:	:	:	302	:	332	:	354	353	:	:
FIN	:	:	:	511	:	:	:	:	623	:	:	:	414	:	:	:
S	302	:	:	318	:	:	:	:	375	:	:	:	366	:	:	:
UK	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
IS	:	:	:	:	:	:	:	:	:	:	655	656	649	652	661	667
NO	417	:	:	458	:	:	:	:	472	:	520	:	545	626	632	619
CH	443	:	:	525	:	:	:	:	613	:	603	:	602	:	606	:

Source: Eurostat

Problems

Data availability and quality are the main obstacles to the presentation of this indicator. There are also variations between countries in the definitions of municipal waste.

The concept of municipal waste is very complex and leads to the production of non-comparable data. There would be two possibilities for calculating a meaningful indicator in this field: 1) breaking down the available country data on municipal waste into comparable components[6] such as *household waste, separate collection waste,...*, or 2) revising the Eurostat/OECD questionnaire.

[6] Such an effort was undertaken in 1996 by the Dutch Ministry of Housing, Spatial Planning and Environment (comparison of household waste figures for various countries in Europe, 1997) and is one of the main tasks of the ETC/Waste

WA-4: Municipal waste generated

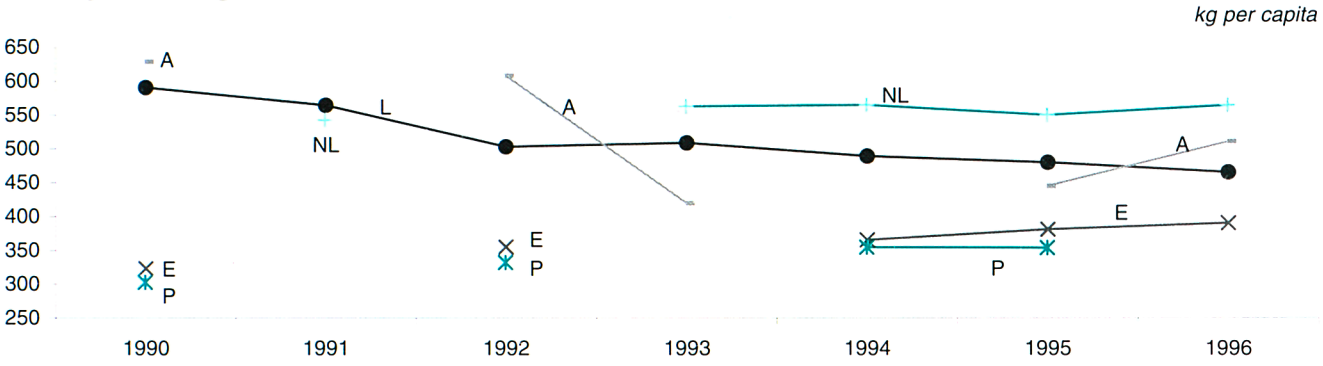
Purpose

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

Targets

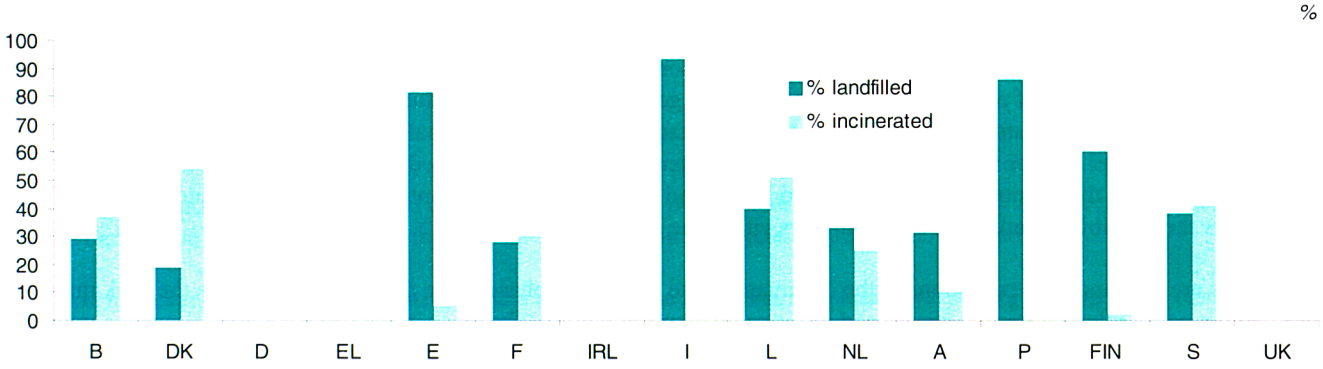
No specific target exists for this indicator. However, the 5EAP has formulated a strategy to stabilise waste production at the 1985 level by the year 2000.

Municipal waste generated - selected Member States



Source: Eurostat

Municipal waste landfilled versus incinerated as a percentage of total municipal waste generated - EU-15 (1996)



Source: Eurostat

Relevancy: Green	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

In the EU, Denmark, Germany, France, Netherlands and Austria generate levels of municipal waste of more than 500 kg per capita. These levels have remained relatively stable in the last reported years, except in Germany and Austria where the amounts generated have changed a lot: a decrease of about 13 % in Germany between 1990 and 1993, and a decrease of about one third in Austria between 1992 and 1993 followed by an increase of about 20 % by 1996. Spain, Greece, Ireland, Sweden and Portugal generate modest waste levels below 400 kg per capita, although Spain and Portugal have seen a considerable increase over the past few years. In between, Belgium, Finland, Italy and Luxembourg have waste amounts comprised between 400 and 500 kg per capita. Both Finland and Luxembourg have seen important reductions in recent years.

WA-5: Waste per product during the lifetime of a number of products [7]

Definition

This indicator refers to waste generation per product within the different life cycle stages, from the extraction and production of raw materials and auxiliaries via waste from energy production and use, to post-consumer waste generation and recycling. Two products have been selected to illustrate the indicator, cars and dwellings, as these products cause EU priority waste streams.

Demolition phase of dwellings

1000 tonnes

Country and year	Waste generation	Recycling	Landfill	Incineration
NL 1990	12 200	8 600	200	3 400
NL 1993	10 906	8 400	2 500	6
NL 1994	12 150	9 800	2 200	150
NL 1995	13 550	12 400	1 000	150
F 1990	9 000	:	:	:
F 1993	1 788	:	:	:
F 1995	1 360	:	:	:
UK 1990	70 000	21 000	49 000	:
D 1993	137 139	:	:	:

Source: data survey IVAM; data are indicative!

Problems

The major problem with this indicator is that data for time series on the dominant life cycle phases for waste generation per product (often the mining of resources) are not available in general. Individual products within one product type may differ very much in resource consumption, and data on the percentage of secondary material in metals for instance are only known at a very global level. Moreover, data per country can in general not be constructed from these, as most products are not used or discarded in the country where they are produced, and hardly ever in the country where the raw materials came from. This limits the possibility and value of country-specific time series.

Dwellings are an important exception, as the dominant waste producing phase is the demolition phase (as the bulk minerals used do not cause relevant mining waste) and mining and disposal mainly take place in the same country. However, country-specific time series data on demolition waste disposal is at present not sufficient. Until now, statistical information has been limited to one or a few years, with unclear definitions and system boundaries. However, a new study on demolition waste is expected from DG XI.

Using this indicator to compare similar products is unwarranted, as the available data is not detailed enough for this. Besides, products should be compared on all relevant environmental aspects, not just on waste production.

[7] Note to the reader:
The elaboration of the indicator has not yet reached the same stage as the other waste indicators. Product selection and level of elaboration have up to now not been sufficient, and the quality of the underlying data does not match the normal standard of a statistical publication. Therefore, this indicator is **for discussion only**. We recognize, however, the importance of product-related indicators for waste policy, and the upcoming discussion on sustainable consumption patterns, and would therefore appreciate comments and proposals on how the topic could be reflected better in the next issue of the publication.

WA-5: Waste per product during the lifetime of a number of products

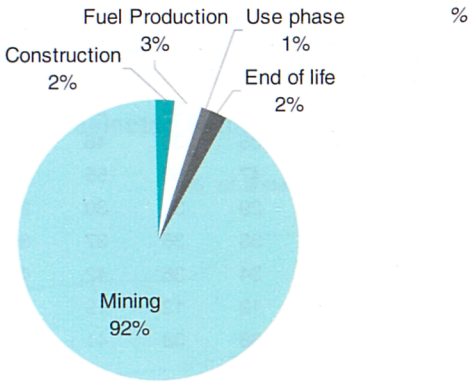
Purpose

The indicator could be used to show possible developments for the major life cycle contributing to waste generation, when time series are available for this. At present, such time series are hardly ever collected as statistical information. Nevertheless the operationalisation per product is shown, as an example.

Targets

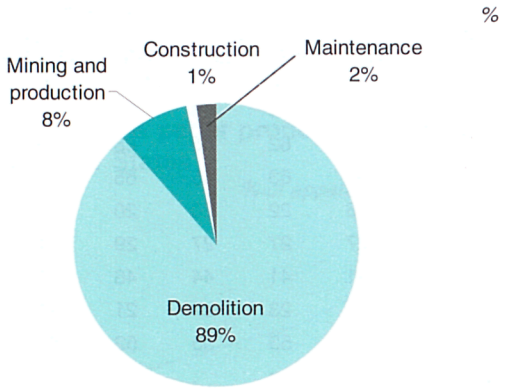
No targets have been formulated yet for the issue addressed by this indicator.

Waste over the entire life cycle of a car (indicative total: 10 tonnes)



Source: Schweimer & Schuckert, 1996 (cars)

Waste over the entire life cycle of a dwelling (indicative total: 160 tonnes)



Source: Mak et.al., 1996 (dwellings)

***Warning**: given the comparability problems, this indicator should be interpreted with great care*

Relevancy: Red	Accuracy: Red	Comp.Time: Red	Comp.Space:Red

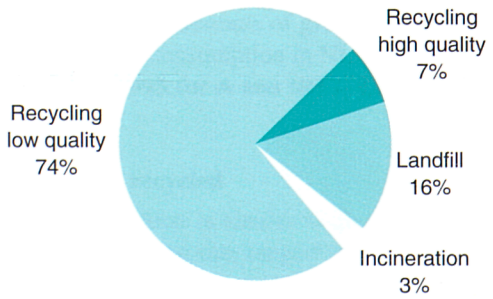
Comments

For *dwellings*, most waste is produced during the demolition phase according to LCA. It may thus seem sufficient to focus on the demolition phase of houses to indicate developments in life cycle waste production and treatment.

For *cars* however, the majority of waste is produced during the metal mining phase. The 300 kg mining waste resulting from fuel extraction is included in fuel production. In this case, it is clear that for the total waste production due to a car the amount of primary versus secondary materials (especially metals) used in production is the most relevant indicator, as more use of secondary metals will reduce the total amount of (hazardous) waste due to mining. This would be a more relevant indicator than the amount of end-of-life waste from a life cycle point of view.

For *dwellings* the following figure shows the distribution of the waste generated by waste management technique:

Waste disposal over the entire life cycle of a dwelling (indicative total: 160 tonnes)



Source: Mak et.al., 1996 (dwellings)

WA-6: Waste recycled/material recovered

Definition

Recycling is defined in Directive 94/92/EC on packaging and packaging waste (OJ L 365 of 31.12.94, p. 10) 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 in relation to production and consumption can be differentiated: 1) Recycling during production, 2) recycling during product-use (product-recycling) and 3) recycling after product use. The definition applied to this indicator will refer to recycling of wastes and therefore to recycling *after product use* [8].

Glass recycled

% of apparent consumption

	1990	1991	1992	1993	1994	1995	1996
B	59	55	54	55	67	67	66
DK	62	62	65	68	63	68	71
D [1]	54	63	65	65	75	75	79
EL	16	22	20	20	25	25	25
E	27	27	27	29	31	32	35
F	41	41	44	46	48	50	50
IRL [2]	19	23	27	21	21	29	29
I	49	53	53	52	54	53	53
L	:	:	:	:	:	:	:
NL	66	70	73	76	77	80	81
A	60	60	64	68	76	76	:
P	26	29	31	29	32	42	42
FIN	46	31	44	46	50	50	63
S	35	44	58	59	56	61	72
UK	21	21	26	29	28	27	27
IS	70	75	75	80	80	85	:
NO	34	22	44	67	72	75	75
CH	65	71	72	78	84	85	:

Source: ETC/Waste (EEA for IS and CH)

1) Container glass only
2) IRL: 1994 = 1993 figures from the Irish EPA; 1996 = 1995 figures from the Irish EPA

Paper, paperboard & paper products recycled

% of apparent consumption

	1990	1991	1992	1993	1994	1995	1996
B	33	33	34	38	36	37	38
DK	35	35	36	46	42	44	52
D	44	47	50	55	59	67	71
EL	28	29	30	30	30	31	31
E [1]	*51*	38	36	37	36	41	41
F	34	34	36	42	42	38	41
IRL	12	12	12	19	19	17	17
I	37	38	38	41	:	28	31
L	:	:	:	:	:	:	:
NL	57	58	59	59	67	69	69
A	52	54	56	68	66	66	71
P	41	41	39	38	39	37	39
FIN	33	37	38	37	38	38	39
S	46	46	50	50	60	59	66
UK	31	32	32	31	35	35	40
IS	10	10	:	:	:	20	:
NO	25	25	31	38	38	41	44
CH	49	51	54	54	59	61	:

Source: ETC/Waste (EEA for IS and CH)

1) E: 1990 data is uncertain and should therefore be interpreted with great care

Problems

Up to now data compiled at EU level do not allow the construction of indicators on the different aspects of recycling. The analysis of waste recycling activities via the recycling rate (% of apparent consumption) may lead to some confusion, the calculation of apparent consumption is likely to be approximate due to the difficulties in calculating the exact amounts of materials contained in finished products which are imported or exported.

[8] Recycling after product use refers to recycling of materials which are traditionally metals, glass, paper and cardboard and textiles. A relatively new branch of material recycling is recycling of plastics and used oils.

WA-6: Waste recycled/material recovered

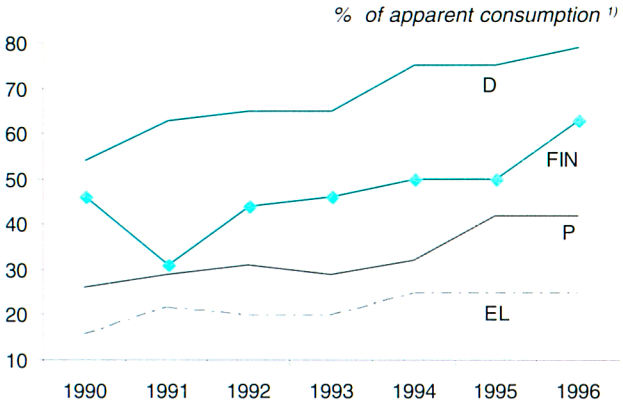
Purpose

The main purpose of the 'recycling' indicator, operationalised by *Recycling amount divided by Apparent consumption*, is to show the extent to which raw materials are replaced and/or replaceable by recycled materials. Waste recycling seems to be an important component for reaching sustainability. The greater the amount of recycled waste, the smaller the need for resources and for disposal (e.g. incineration, landfill).

Targets

Directive 94/62/EEC on packaging and packaging waste sets as a target that Member States achieve by June 2001, a recovery of 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, and that some developed countries should establish voluntary targets for the proportion of waste recycled. Several countries have already set recycling targets for the packaging industry, industrial waste, municipal waste, etc., but no general targets have been agreed upon. The 5EAP has formulated a strategy to stabilise waste production at the 1985 level by 2000.

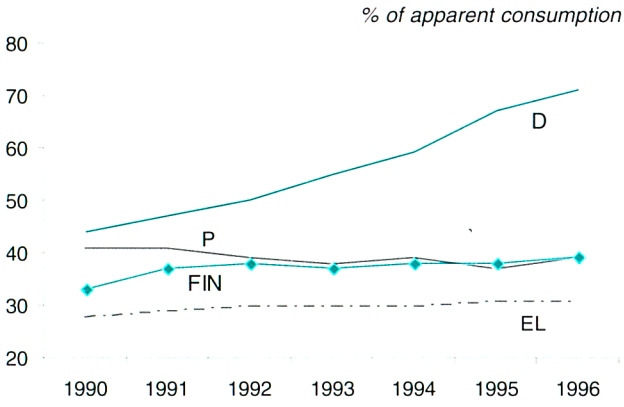
Glass recycled - selected Member States



Source: ETC/Waste

1) D: container glass only

Paper, paperboard & paper products recycled - selected Member States



Source: ETC/Waste

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

The recovery rate presented in the tables equals the ratio of the amount of waste recycled to the apparent consumption. Apparent consumption is the sum of the amount of domestic production plus imports minus exports.

- **Glass recycled**

Glass recycling refers only to so-called *packaging glass* (bottles [9], container glass,..), because for flat-glass no technical facilities have been developed so far.

The figures provided show big differences in the amounts of glass recycled from one country to another. In 1996, the rate of glass recycled ranged from 81 % of apparent consumption in NL to 27 % in UK. Of the EU-15 countries, 9 had recycling rates equal to or higher than 50 % in 1996 (1995 for A and IRL). There is an overall tendency towards an increase in the amount of glass recycled.

- **Paper, paperboard and paper products recycled**

The trend for paper, paperboard and paper products is similar to glass, that is an overall tendency towards more recycling, except in Italy and Portugal. In 1996, the recycling rate ranged from 71 % (Germany and Austria) to 17 % (Ireland). Five Member States had a recycling rate higher than 50 %.

[9] Refillable bottles are included in packaging glass only when they are taken out of the circuit and forwarded to recycling.

WATER POLLUTION



Introduction

A wide range of human activities affect water availability and quality especially in areas with a high population density, concentrated industrial activity and intensive agriculture.

Only a small fraction of the world's population has access to tap water that is suitable for drinking. In the European Union, this service is taken for granted, and it is forgotten that this is not the case everywhere. The indicators selected by the panels of water experts will give a comprehensive description of the pressures imposed on quality and availability of water resources and of the success of environmental policy to reduce them.

The Fifth Environmental Action Programme lists the following key targets for the year 2000:

- the prevention of over-exploitation of ground water and surface water for drinking water or industrial or other purposes;
- the prevention of pollution of ground water from diffuse sources; and
- a better ecological quality of surface and marine water.

The indicators formulated by the Scientific Advisory Group for the policy field *Water Pollution & Water Resources* go into more detail: nutrients, overuse of ground water resources, pesticides, heavy metals and organic matter are listed as the most important pressures on water. A more general indicator 'wastewater treated' is also included as a measure of the efforts invested in the protection of water quality.

WP-1: Nutrient (N + P) use (eutrophication equivalents)

Definition

The indicator is defined as the average annual load of nitrogen and phosphorus from land sources (households and economic sectors) discharged into aquatic ecosystems. The indicator is expressed in tonnes per year or kg per hectare per year, reported separately for nitrogen and phosphorus. In the indicator calculation, only emissions from households and agriculture are considered, due to the scarcity of data on industrial emissions.

The emissions from households are 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. Emissions from agriculture are included in the indicator by means of the soil surface nitrogen balance, per unit area. This balance takes into account the inputs of mineral nitrogen and nitrogen of animal origin, input from biological nitrogen fixation and atmospheric deposition, uptake by crops, and estimations on grass consumed based on fodder requirements.

N emissions from households, after treatment

kg N per capita

	1970	1980	1985	1990	1991	1992	1993	1994	1995
B	4.35	4.18	:	4.16	:	:	:	4.13	:
DK	4.18	:	3.56	3.04	:	:	:	:	:
D	:	3.64	3.53	2.90	2.52	:	:	:	1.62
EL	:	4.38	4.30	4.29	:	4.29	:	:	:
E	:	4.30	4.24	:	4.13	4.06	:	:	3.96
F	:	:	:	:	:	3.75	:	:	:
IRL	:	4.28	:	4.20	4.20	:	:	:	:
I	4.33	:	:	:	:	:	3.25	:	:
L	4.34	3.81	3.78	:	:	:	:	3.57	3.49
NL	4.13	3.73	3.50	3.36	3.31	3.23	3.05	2.80	2.80
A	4.34	4.06	3.74	3.61	3.03	3.03	2.83	:	2.83
P	:	4.38	4.38	4.28	:	:	:	:	:
FIN	4.13	2.42	1.95	1.80	1.78	1.78	1.78	1.75	1.75
S	3.92	2.07	1.41	1.32	1.30	1.24	:	:	:
UK	:	3.71	3.71	3.38	:	:	:	:	3.33

Source: TAU

P emissions from households, after treatment

kg P per capita

	1970	1980	1985	1990	1991	1992	1993	1994	1995
B	0.98	0.93	:	0.92	:	:	:	0.92	:
DK	0.90	:	0.75	0.64	:	:	:	:	:
D	:	0.78	0.75	0.62	0.54	:	:	:	0.36
EL	:	0.98	0.96	0.96	:	0.96	:	:	:
E	:	0.95	0.93	:	0.91	0.89	:	:	0.86
F	:	:	:	:	:	0.81	:	:	:
IRL	:	0.96	:	0.91	0.91	:	:	:	:
I	0.96	:	:	:	:	:	0.71	:	:
L	0.95	0.81	0.80	:	:	:	:	0.76	0.74
NL	0.90	0.80	0.75	0.71	0.70	0.69	0.65	0.60	0.60
A	0.96	0.89	0.81	0.78	0.66	0.66	0.62	:	0.62
P	:	0.98	0.98	0.95	:	:	:	:	:
FIN	0.91	0.53	0.43	0.39	0.39	0.39	0.39	0.38	0.38
S	0.84	0.45	0.31	0.29	0.29	0.27	:	:	:
UK	:	0.79	0.79	0.72	:	:	:	:	0.71

Source: TAU

Soil surface nitrogen balance (estimates)

kg N per hectare [1)]

	EU-15	B	DK	D	EL	E	F	IRL	I	L	NL	A	P	FIN	S	UK
1990	:	106	93	105	84	40	47	47	62	124	229	:	27	:	:	40
1993	:	109	92	101	61	37	54	60	83	124	212	:	23	:	:	39
1995	60	103	72	102	58	37	57	62	76	121	213	16	22	51	38	40

Source: Eurostat

1) The area considered includes arable crops, permanent crops and permanent pastures and meadows

Problems

The engineering data used in the estimations reflect the potential efficiency in pollution removal. The efficiency values used in the indicator estimation, expressed as percentage of the pollution 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 efficiencies are average data, Member States with efficiencies higher than the average have lower actual 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.

For the soil surface nitrogen balance, actual results of the calculation of the balance are still rough indications of the real losses and the potential impacts to the environment. Some variables in the balance that contribute to the change in stock have not been taken into account, either for lack of data or because they are negligible. The soil surface phosphorus balance is not available at this stage. The nitrogen surplus is closely related to the emissions to water but other losses such as those to the atmosphere and soil fixation should also be considered.

WP-1: Nutrient (N + P) use (eutrophication equivalents)

Purpose

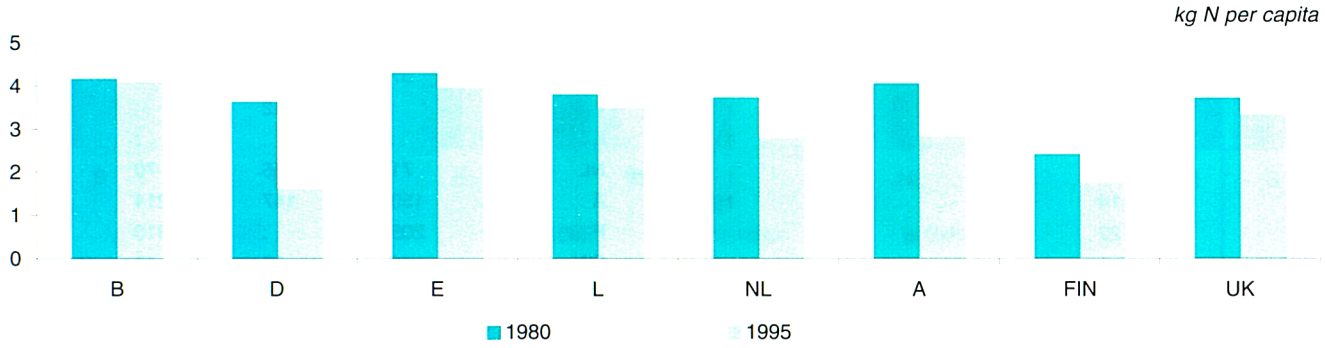
The indicator shows the potential for nutrient releases into aquatic ecosystems, the main cause of eutrophication. It reflects the negative externalities of fertiliser use, as well as domestic and industrial discharges of nitrogen and phosphorus. It also indicates inadequate sanitation and/or wastewater treatment facilities, or inadequate pollution control.

Excess concentrations of nutrients in water bodies lead to over-nourishment, proliferation of blue-green algae, reduced light penetration, depletion of dissolved oxygen in surface water, disappearance of benthic invertebrates, production of toxins which are poisonous to fish, cattle and humans, and changes in biological structure. These effects are generally most apparent in lakes, reservoirs and coastal areas, and also in large, slow-flowing rivers.

Targets

The Directive on Nitrates (91/676/EEC) restricts the use of manure to 170 kg N/ha per year in vulnerable zones by the end of 2003. The Directive on Drinking Water (80/778/EEC) recommends nitrates level of 25 mg/l and a limit value of 50 mg/l. The Directive on Urban Waste Water Treatment (91/271/EEC) requires a tertiary treatment before discharging for agglomerations of more than 10 000 p.e. situated in sensitive areas, by the end of 1998.

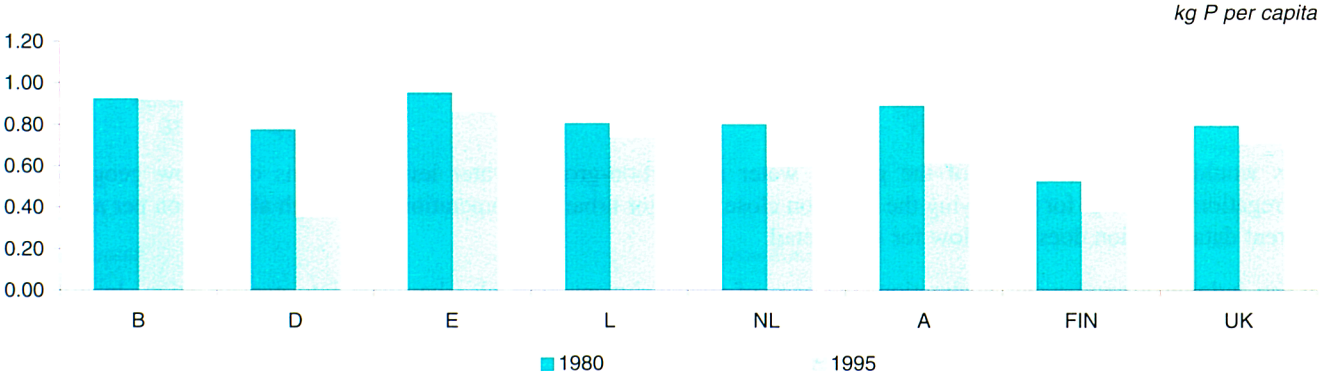
N emissions from households, after treatment [1)]



Source: TAU

1) For Belgium, the years considered are 1980 and 1994.

P emissions from households, after treatment [1)]



Source: TAU

1) For Belgium, the years considered are 1980 and 1994.

Relevancy: Green	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Yellow

Comments

The improvements in phosphorus and nitrogen emissions from households are a consequence of the rising share of population connected to treatment plants and the improvement in the efficiency of such plants. This improvement is quite unequal between countries; for example, Sweden, Finland and Germany reduced their emissions by around 60 % in the period for which data is available, while in several countries the improvement does not exceed 10 %.

WP-2: Ground water abstraction

Definition

This indicator shows the annual gross water abstraction from fresh ground water resources for different economic and human uses: public water supply, industry, agriculture, energy, urban amenities, tourism, etc.

Eurostat statistics on fresh ground water abstraction correspond to the water removed from any source, either permanently or temporarily. Mine water and drainage are included in these figures. Water abstractions from ground water resources in any given time period are defined as the difference between the total amount of water withdrawn from aquifers and the total amount charged artificially or injected into aquifers.

Fresh ground water abstraction per surface area

mm^3 per hectare

	1980	1985	1990	1995
B	25	:	:	:
DK	:	:	28	21
D	:	:	31	:
EL	12	:	:	:
E	10	11	11	11
F	13	11	11	10
IRL	2	:	:	:
I	:	40	:	:
L	:	:	:	11
NL	27	29	25	:
A	14	13	20	16
P	22	:	33	:
FIN	1	1	1	1
S	1	1	1	1
UK	:	:	:	:

Source: Eurostat

m^3 per capita

	1980	1985	1990	1995
B	79	:	:	:
DK	:	:	233	170
D	:	:	97	:
EL	163	:	:	:
E	137	141	142	140
F	130	112	109	94
IRL	37	:	:	:
I	:	212	:	:
L	:	:	:	71
NL	71	76	70	:
A	150	147	214	171
P	205	:	310	:
FIN	40	65	48	48
S	72	74	71	73
UK	:	:	:	:

Source: Eurostat

Problems

A better indicator should translate the simple abstraction figures into, for example, '*% of area where ground water abstraction seriously affects ground water levels.*' Such an indicator would both take account of the climate differences between Member States, and of the fact that the most serious risk of water abstraction is the effect of lower ground water levels on ecosystems.

This would require modelling of the ground water abstraction-ground water level functions on a low geographical aggregation level, e.g. for portraying the situation close to major urban agglomerations with high abstraction per area. The current data situation does not allow for such detail.

When judging ground water abstraction, the ease of replenishment must also be taken into consideration. In a sandy underground, the percentage of rainfall entering the ground water layer is much higher than in the case of rocks, where almost all of the water is evacuated as surface runoff.

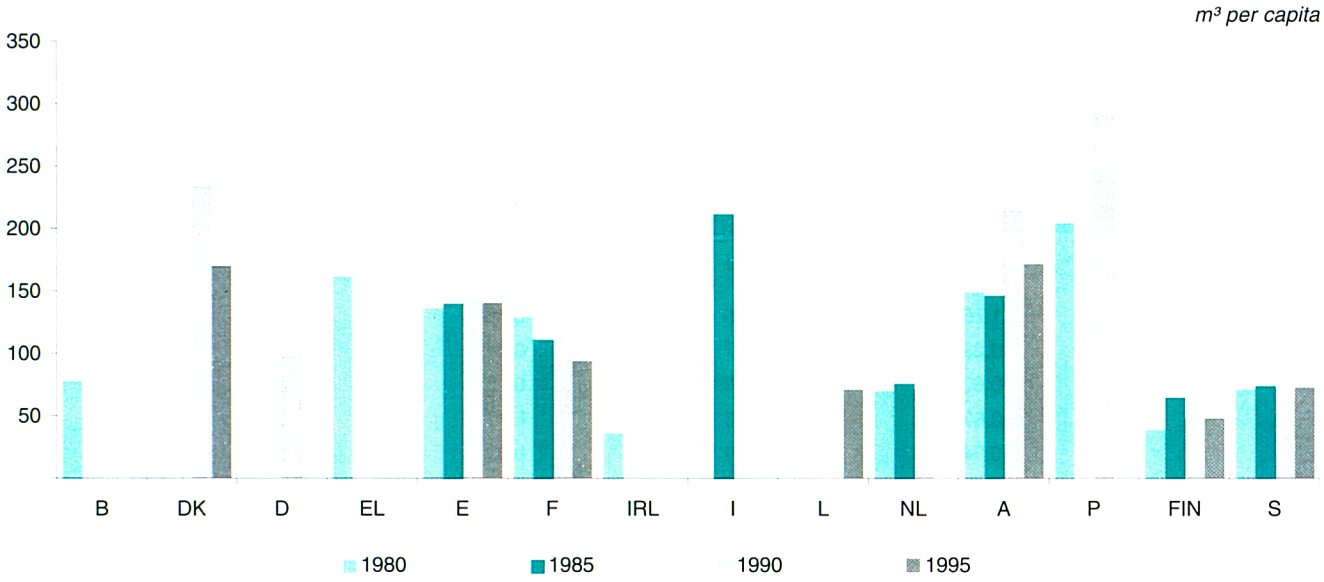
The best option would be to compare the ground water abstraction with the annual renewal part of the ground water. However this data is not (yet) available.

WP-2: Ground water abstraction

Purpose

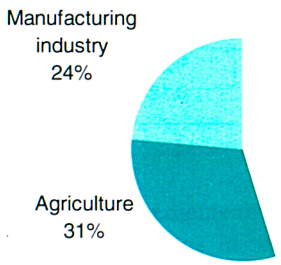
This indicator makes it easier to assess the degree to which available water resources are being exploited. Water abstraction is a major form of pressure on ground water when available resources are not sufficient to cover all needs. This overexploitation affects the water cycle as a whole and as a consequence the biological resources depending on it. It shows the uses of and requirements for ground water, so that supply and demand policies can be adjusted accordingly.

Fresh ground water abstraction

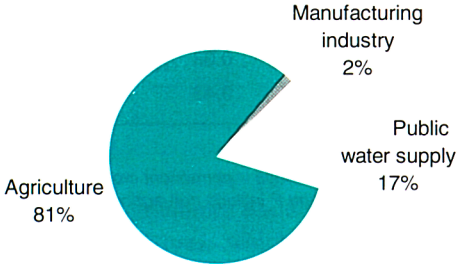


Source: Eurostat

Fresh ground water abstraction by sector - DK (left) and E (right) (1995)



Source: Eurostat



Source: Eurostat

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

Comments

The variations of this indicator over time and between countries depend on climate, population and economic development.

Because of differences in data quality, this indicator should be interpreted with care.

The sectoral breakdown is not, or only partly, available for most Member States.

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

Definition

The total quantity of pesticides by type (herbicides, fungicides, insecticides and other pesticides) used per year on agricultural land.

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. 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.

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.

Sales of pesticides for agricultural use (1996)

kg of active ingredients per hectare of agricultural area [1]

	Fungicides	Herbicides	Insecticides	Other pesticides	Total
EU-15	0.89	0.84	0.26	0.17	2.16
B	1.76	4.36	0.88	0.62	7.62
DK	0.23	1.07	0.01	0.03	1.34
D	0.60	0.96	0.23	0.24	2.03
EL	0.63	0.53	0.47	0.28	1.91
E	0.34	0.29	0.32	0.15	1.10
F	1.62	1.20	0.18	0.09	3.10
IRL	0.17	0.26	0.02	0.14	0.58
I	1.51	0.59	0.54	0.25	2.89
L	:	:	:	:	:
NL	1.86	1.55	1.16	0.52	5.09
A	0.50	0.45	0.03	0.07	1.04
P	2.50	0.41	0.19	0.10	3.19
FIN	0.05	0.32	0.03	0.04	0.43
S	0.08	0.40	0.00	0.01	0.49
UK	0.43	1.52	0.11	0.18	2.24

Source: Eurostat / ECPA

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

Problems

Ideally, a description of the risks associated with the application of pesticides would have to take into account the differences in toxicity of 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*).

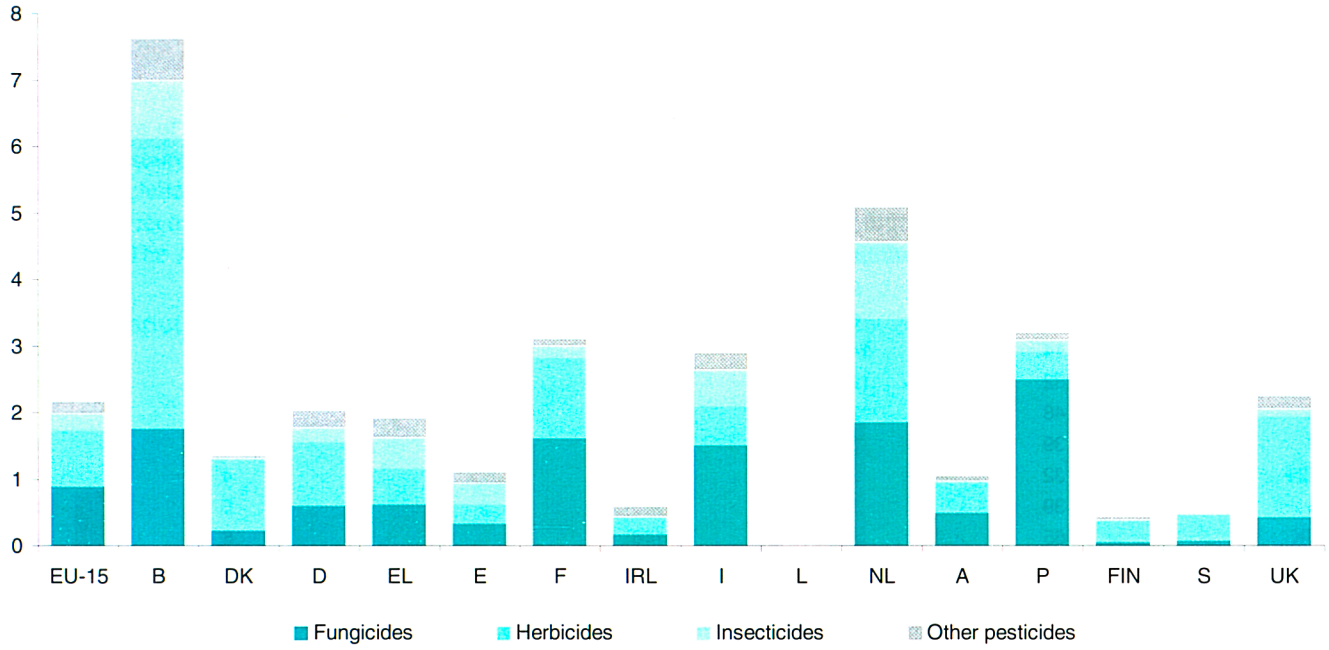
WP-3: Pesticides used per hectare of utilised agriculture area

Purpose

The use of agricultural pesticides that add persistent organic chemicals to ecosystems is an important aspect of the threats to the quality of water resources. Pesticides can be persistent, mobile and toxic in soil, water and air; they may have an impact on humans and wildlife via the food chain. Some tend to accumulate in the soil and in biota, and residues may reach surface and ground water through leaching.

Sales of pesticides for agricultural use (1996)

kg of active ingredients per hectare of agricultural area



Source: Eurostat

Relevancy: Green	Accuracy: Green	Comp.Time: Green	Comp.Space: Green

Comments

In terms of active ingredients the overall amount of pesticides used in the EU in agriculture has decreased since the early 1990s, although variations in sales figures are very dependant on weather conditions, which influence the need for fungicides, herbicides, and plant disease treatments. The introduction of new, low dose herbicides based on the sulphonyl-urea group of chemicals has also contributed to the reduction.

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

Definition

This indicator refers to the total 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.

Nitrogen inputs (1995)

kg per hectare [1)]

	Livestock manure A	Mineral fertiliser B	Total A + B	Atmospheric deposition	Biological nitrogen fixation	Total inputs
EU-15	57	75	131	16	7	155
B	206	110	316	33	5	354
DK	72	107	179	18	11	208
D	65	103	168	32	7	207
EL	47	96	142	7	4	154
E	28	36	64	6	8	78
F	54	85	139	20	9	167
IRL	109	98	207	10	4	221
I	45	63	108	12	11	131
L	114	143	257	27	5	289
NL	282	195	477	31	2	510
A	48	37	85	20	5	111
P	39	35	73	4	5	82
FIN	32	84	116	5	4	125
S	39	70	109	5	5	119
UK	65	81	146	18	6	169

Source: Eurostat

1) Area refers to agricultural area including: arable land, permanent crops and permanent meadows and pastures but excludes rough grazing

Problems

This presentation does not provide information on whether there are sensitive areas utilised by more intensive agriculture and exceeding this average. This indicator relates only to the potential environmental pressure from nitrates used in agriculture. It does not allow for absorption of nitrogen by crops, volatilization of ammonia from manure, emissions of N or N oxides, or binding of N in the soil. This indicator also assumes that fertilisers and manure are distributed evenly over the whole agricultural area. A regional breakdown would give a better overview of the problem areas. See forthcoming Eurostat publication 'Nutrients in Agriculture' 1999.

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

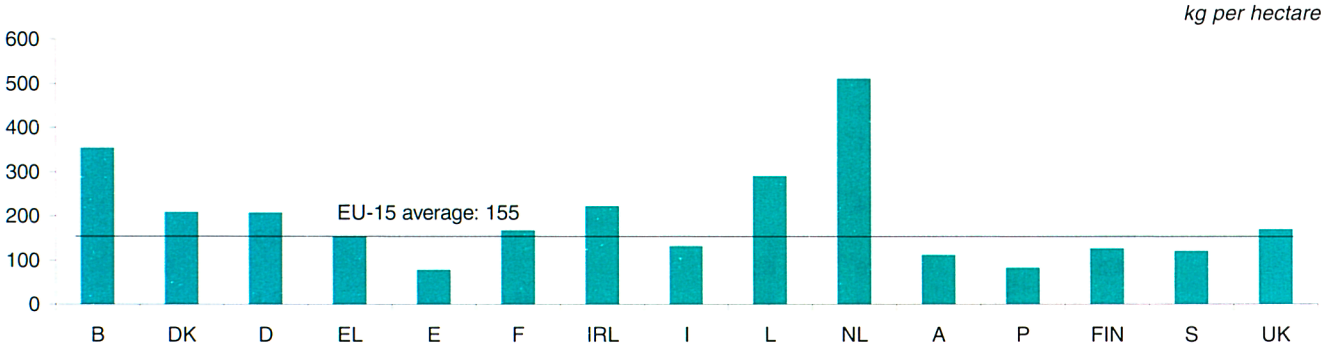
Purpose

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 (intensive) 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. Over-application may lead to nitrogen saturation in the soil, causing losses of nitrates into shallow ground water. Between 10 to 60 % of fertilisers are not used by the target plants, and in some parts of Europe, agriculture is responsible for more than 80 % of nitrogen emissions to aquatic ecosystems. 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.).

Targets

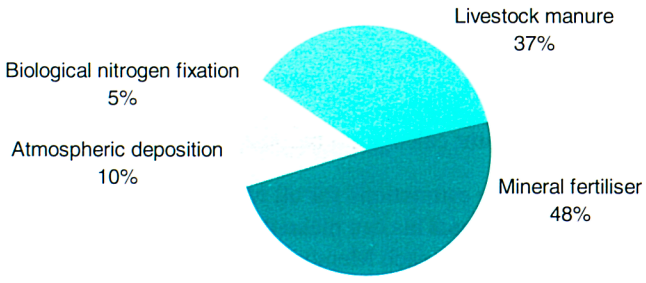
The objective of the Directive on Nitrates (91/676/EEC) is to reduce water pollution caused or induced by nitrates from agricultural sources. Member States must establish action programmes for all areas designated as vulnerable zones. These measures include limiting the use of fertilizers and restricting the application of manure to a maximum 170 kg N per ha per year. The Directive on Drinking Water (80/778/EEC) indicates a recommended nitrates 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 - EU-15 (1995)



Source: Eurostat

Nitrogen inputs by source - EU-15 (1995)



Source: Eurostat

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Yellow	Comp.Space: Yellow

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.*

WP-5: Water treated/water collected

Definition

This indicator attempts to evaluate the overall level of waste water treatment. In general, there are three levels of waste water treatment, ranging from primary treatment to the most advanced tertiary treatment. A fourth option is no treatment at all.

The indicator is calculated by attributing a weighting factor to the different types of treatment. The weighting factor is based on the potential removal of nitrogen, phosphorus and BOD (Biochemical Oxygen Demand) for each type of waste water treatment. The removal efficiencies are averages, and the same weighting factors have been used for all Member States. These factors 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 weighting factors 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 household waste water treatment

	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995
B	98.1	97.2	88.3	:	87.3	:	:	:	85.7	:
DK	84.1	74.7	:	56.8	42.7	:	:	:	:	:
D	:	:	60.6	56.3	43.9	37.2	:	:	:	18.9
EL	:	:	99.7	95.2	94.4	:	94.4	:	:	:
E	:	95.3	94.1	90.1	:	84.2	81.9	:	:	77.7
F	:	:	:	:	:	:	67.6	:	:	:
IRL	:	:	94.4	:	86.1	86.1	:	:	:	:
I	95.8	:	:	:	:	:	:	58.3	:	:
L	94.2	:	64.6	62.9	:	:	:	:	58.6	57.1
NL	83.1	79.2	64.3	55.2	49.0	48.0	46.6	42.1	37.3	37.3
A	95.8	:	82.9	67.0	61.7	50.3	50.3	45.4	:	45.4
P	:	:	99.7	99.5	92.8	:	:	:	:	:
FIN	85.6	49.3	35.4	23.2	18.7	18.2	18.2	18.2	17.7	17.7
S	73.4	35.3	28.7	12.3	10.4	9.9	8.4	:	:	:
UK	:	:	60.4	59.9	54.3	:	:	:	:	52.1

Source: TAU

Problems

Industrial waste water is not included in the indicator calculation because of the scarcity of data.

As the same weighting factor has been used in the estimations for all Member States, the actual indicator value for those with more efficient treatment systems would be lower. This can make the comparison between Member States difficult, but the indicator provides clear information on the trend in each Member State.

WP-5: Water treated/water collected

Purpose

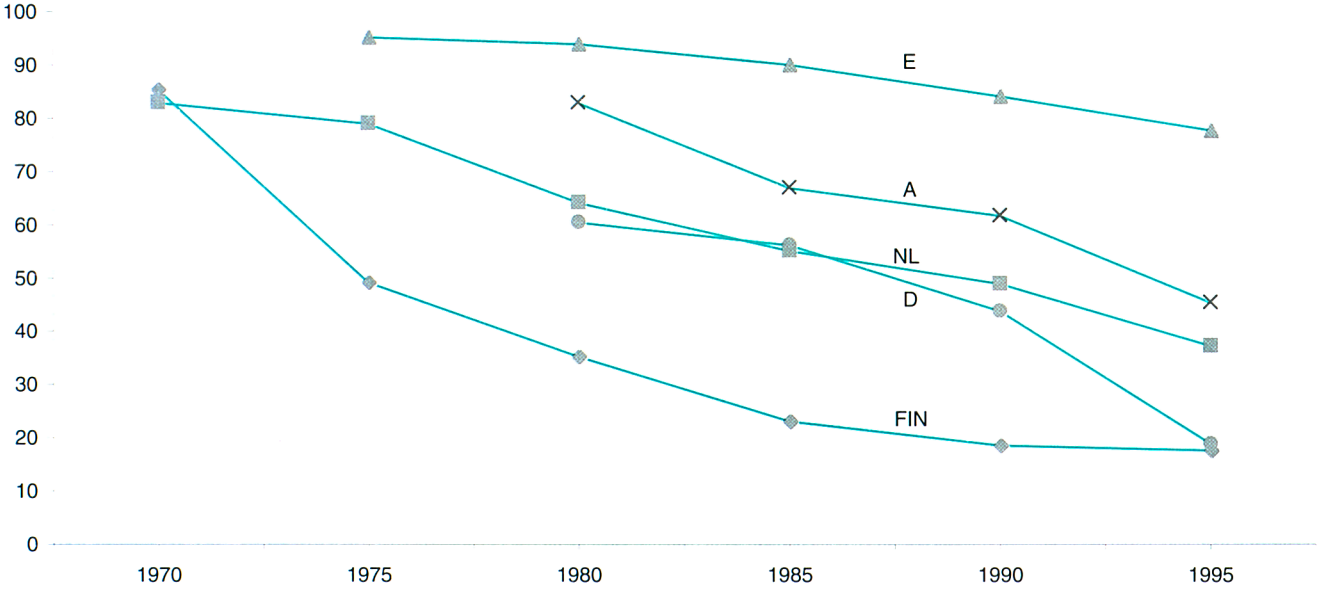
This indicator reflects both the pressure of human activities on surface waters and society's response to waste water treatment and the protection of health and ecosystems.

The pollution of water bodies by waste water, through direct discharges or inadequate treatment, increases concentrations of pollutants such as organic matter, suspended particulates, phosphorus, ammonium, heavy metals or (increasingly important) micro pollutants such as pesticide residues, thereby causing adverse effects to human health (water unfit for human consumption, diseases) and undesirable changes in the composition of aquatic biota (bacterial concentration, oxygen deficiencies, etc.), as well as increasing economic costs (water treatment to meet EU standards, less water of good quality available for specific uses).

Targets

The Directive on Urban Waste Water Treatment (91/271/EEC) sets deadlines for applying secondary treatment before discharge. These deadlines vary and depend on the population equivalents (p.e.) in the urban agglomeration. In addition, agglomerations of more than 10 000 p.e. situated in sensitive areas must have tertiary treatment facilities for all their discharges by the end of 1998.

Index of household waste water treatment [1)]



Source: TAU

1) 100 = no treatment is applied; 0 = all waste water receives tertiary treatment

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Yellow

Comments

The marked decrease shown by the indicator in several countries is due to the increase in the population connected to treatment plants and the introduction of more efficient treatments. The overall situation shows great improvement, especially in Finland, Sweden, Germany, the Netherlands and Denmark.

Compliance with the Directive on Urban Waste Water Treatment will cause the indicator to show a decreasing trend, especially in those countries with a higher treatment deficit.

The indicator does not consider the volume per capita of waste water from households, which varies significantly between countries according to water consumption.

WP-6: Emissions of organic matter as BOD

Definition

The indicator is defined as the quantity of organic matter discharged by human activities (domestic, industrial and agricultural) measured in terms of Biochemical Oxygen Demand (BOD).

At this stage, indicator calculation includes only domestic waste water because of the scarcity of data on emissions from agriculture and industry.

Emissions of BOD from households, after treatment

kg BOD per capita

	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995
B	21.2	20.9	17.6	:	17.2	:	:	:	16.7	:
DK	15.6	12.3	:	7.0	4.2	:	:	:	:	:
D	:	:	8.1	6.9	6.0	5.9	:	:	:	4.4
EL	:	:	21.8	20.1	19.9	:	19.9	:	:	:
E	:	20.1	19.6	18.1	:	16.0	15.4	:	:	14.1
F	:	:	:	:	:	:	10.7	:	:	:
IRL	:	:	19.8	:	16.5	16.5	:	:	:	:
I	20.3	:	:	:	:	:	:	10.4	:	:
L	19.5	:	8.7	8.1	:	:	:	:	7.8	7.7
NL	15.5	14.2	9.2	6.5	4.5	4.5	4.4	3.7	3.4	3.4
A	20.2	:	16.0	10.5	8.9	8.1	8.1	7.4	:	7.4
P	:	:	21.7	21.7	19.1	:	:	:	:	:
FIN	16.7	8.8	5.8	3.6	2.6	2.6	2.6	2.6	2.5	2.5
S	12.4	6.1	5.4	2.7	2.5	2.5	2.3	:	:	:
UK	:	:	7.4	7.2	7.1	:	:	:	:	6.5

Source: TAU

Problems

Due to the lack of statistical data on efficiency of the treatment plants in most Member States, the estimations have been made by applying engineering data. They reflect the potential efficiency to treat domestic waste water, and the actual efficiency does not necessarily match the potential one. Therefore, the indicator can be interpreted as the potential BOD load from households.

The efficiency values used in indicator estimation, expressed as percentage of the pollution removed, are 30 % for primary treatment, 85 % for secondary treatment, and 95 % for tertiary. As these efficiencies are average data, Member States with efficiencies higher than the averages have lower actual emissions than those estimated. This can make the comparison between Member States difficult, but the indicator provides clear information on the trend in each Member State.

WP-6: Emissions of organic matter as BOD

Purpose

The indicator reflects the impact of household and industrial pollution on water resources, as well as the results of efforts to reduce this type of pollution.

Organic matter produced through various types of human activity is a major source of pollution in rivers. Because the breakdown of organic matter uses up oxygen, severe organic pollution may lead to rapid deoxygenating of river water and hence to the disappearance of fish and aquatic invertebrates. The decomposition of organic waste also releases ammonium, which, though not toxic in itself, may be converted into ammonia which is poisonous to fish.

The main sources of organic waste in rivers are domestic and industrial sewage. In the last 20 years, biological treatment of domestic and industrial waste water has intensified and the organic matter loading in rivers has consequently declined in many parts of Europe. Nevertheless, in some countries where sewage treatment is inadequate, many rivers still suffer from organic pollution and will continue to do so if discharges of large amounts of untreated sewage remain unchecked.

High levels of organic pollution can restrict water use and development or require expensive treatment. Diseases caused by organic pollution can in turn diminish adult working capacities and affect children's growth and education. Organic pollution of freshwater is likely to increase concentrations of pathogenic micro-organisms and to lead to deteriorate the living environment of biological communities.

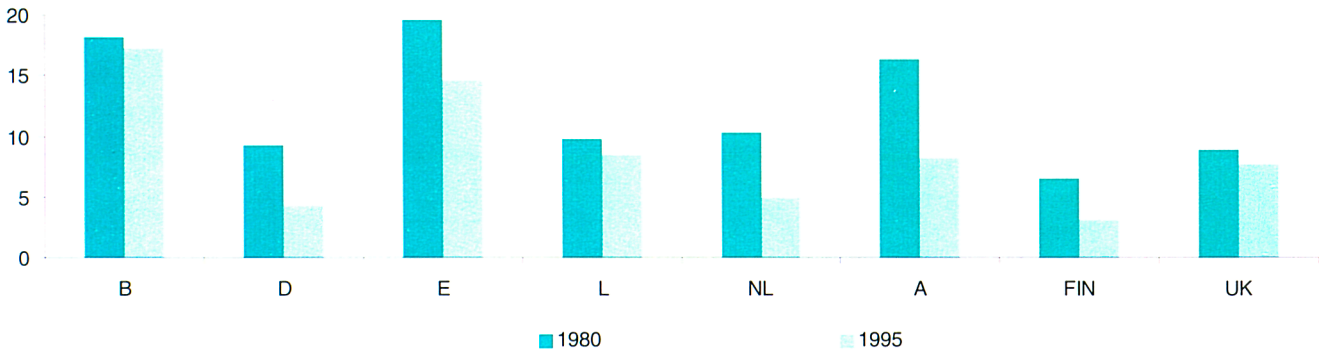
Targets

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

The Directive on Urban Waste Water Treatment (91/271/EEC) establishes different deadlines, depending on the population equivalents in the agglomeration, to apply secondary treatment before discharge. In addition, the Directive requires tertiary treatment by the end of 1998 before discharging for agglomerations of more than 10 000 p.e. situated in sensitive areas.

Emissions of BOD from households, after treatment [1)]

kg BOD per capita



Source: TAU

1) For Belgium, the years considered are 1980 and 1994.

Relevancy: Yellow	Accuracy: Yellow	Comp.Time: Green	Comp.Space: Yellow

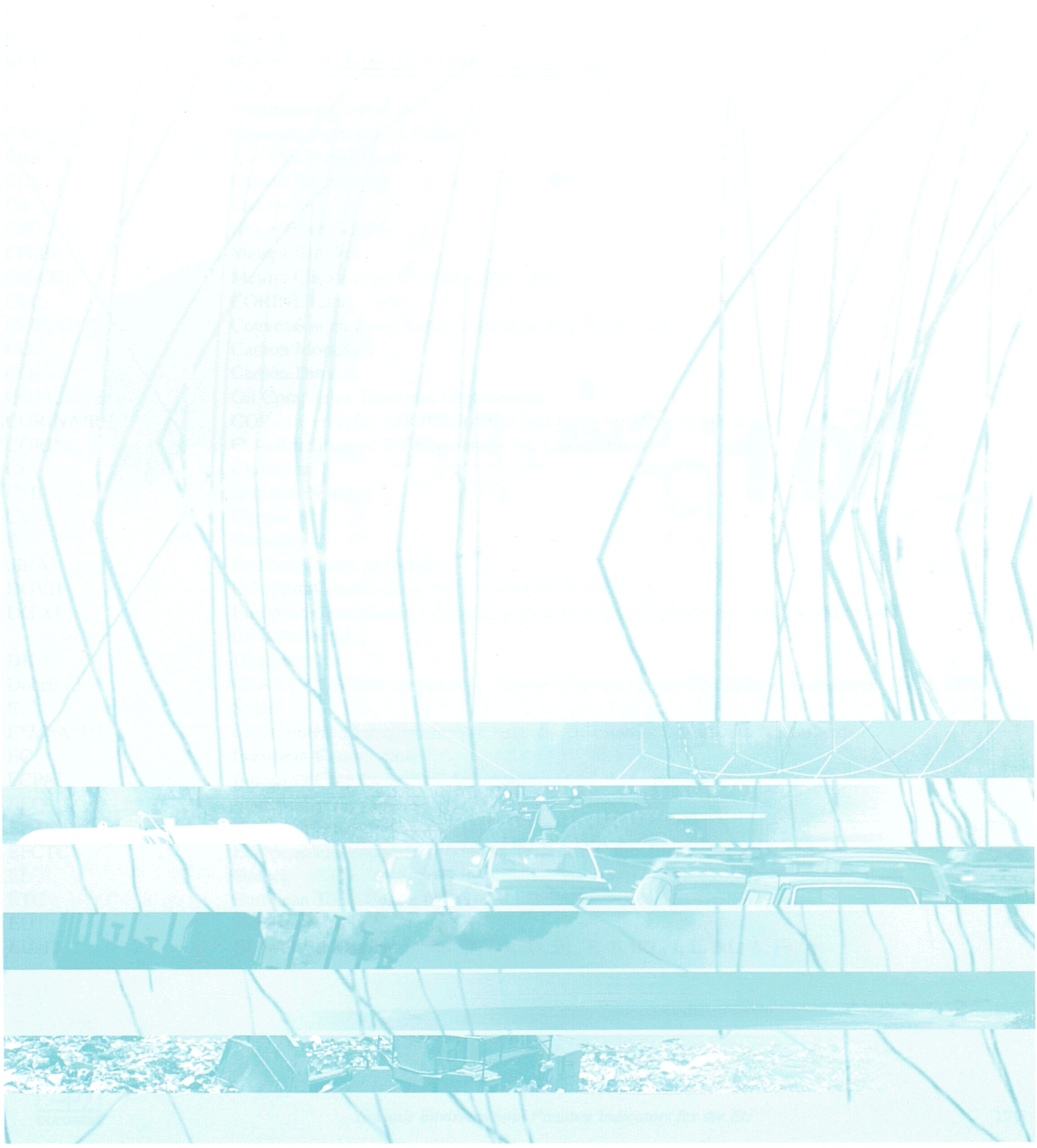
Comments

The variation in organic pollution discharges is related to variations in the population connected to treatment plants and the efficiency of waste water treatment (efficient plants can break down up to 90% of the organic matter present).

The situation is quite unequal between Member States. Countries such as Finland, Sweden, the Netherlands and Denmark show an emissions reduction between 60 % and 80 % in the period with available data, while in several countries the improvement does not exceed 20 %.

Compliance with the Directive on Urban Waste Water Treatment will cause the indicator to show a decreasing trend, especially in those countries with a higher treatment deficit.

ABBREVIATIONS, ACRONYMS AND SYMBOLS



Abbreviations, Acronyms & Symbols

.	Not applicable
:	No data available
_	Nil
¦	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)
A	Austria
AFEAS	Alternative Fluorocarbon Environmental Acceptability Study
As	Arsenic
As-EEQ	Arsenic Ecotoxicology Equivalents
B	Belgium
Bq	Bequerel
BOD	Biochemical Oxygen Demand
C	Carbon
C_{14}	Radioactive Carbon 14
CAP	Common Agricultural Policy
CBS	Statistics Netherlands
CCl_4	Carbon Tetrachloride, a Chlorinated Carbon
Cd	Cadmium
CFCs	ChloroFluoroCarbons
CH_3Br	Methyl Bromide
CH_3CCl_3	Methyl Chloroform, a Chlorinated Carbon
CLC	CORINE Land Cover
CLRTAP	Convention on Long Range Transboundary Air Pollution
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CONCAWE	Oil Companies' European Organisation
CORINAIR	CORe Inventories AIR (Corinair90-pan-European & Corinar 94-EU-15+3)
CORINE	CO-oRdination of INformation on the Environment
Cr	Chromium
CSB	Statistics Sweden
Cu	Copper
D	Germany
dB(A)	Decibel(s); unit of sound
DGVII	European Commission's Directorate-General VII (Transport)
DG XI	European Commission's Directorate-General XI (Environment, Nuclear Safety and Civil Protection)
DK	Denmark
Dobris+3	EEA's 1998 follow-up report to 'Europe's Environment: The Dobriš Assessment' (EEA 1995)
E	Spain
E*M*A*I*L	Environment Management And Information Liaison; Leiden, the Netherlands
EC	European Commission
ECPA	European Crop Protection Association
EEQ	Ecotoxicity-Equivalent
EEA	European Environment Agency
EFCTC	European Fluorocarbon Producers Technical Committee
EL	Greece
ETC	European Topic Centre (EEA)
EU	European Union
EU-12	EU with 12 Member States (B, DK, D, EL, E, F, IRL, I, L, NL, A, P)

Abbreviations, Acronyms and Symbols

EU-15	EU with 15 Member States (EU-12 + FIN, S, UK)
Eurostat	Statistical Office of the European Communities
EWC	European Waste Catalogue
F	France
FAO	UN Food and Agriculture Organization
FCCC	United Nations Framework Convention on Climate Change
FIN	Finland
F_{si}	Significance Factor
g	Gramme
γ-HCH	Gamma-Hexachlorocyclohexane (Lindane)
GHG	Greenhouse Gas(es)
GNP	Gross National Product
Halons	Bromofluorocarbons
HCFCs	HydroChloroFluoroCarbons
HFCs	HydroFluoroCarbons
HELCOM	Helsinki Commission
Hg	Mercury
hPa	HectoPascal (100 Pascal; new term for millibar)
I	Italy
I-TEQ	International Toxic Equivalent
IFR	Instrument Flight Rules
IIUE	The International Institute for the Urban Environment; Delft, the Netherlands
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IPPC	International Pollution Prevention Control
IRL	Ireland
IS	Iceland
ITOPF	International Tanker Owners Pollution Federation
IUCLID	International Uniform Chemical Information Database
IVAM-ER	IVAM Environmental Research; Amsterdam, the Netherlands
JRC	Joint Research Centre (European Commission); Ispra, Italy
kg	Kilogramme
km	Kilometre
kg oe	Kilogramme of oil equivalent
kt	Kilotonne
kWh	Kilowatt hour
L	Luxembourg
LACOAST	LAnd use in COASTal zones; a project of the JRC in Ispra, Italy
LCP	Large combustion plants
Leq 24h	Energetic averaged sound pressure level
LPG	Liquified Petroleum Gas
LRTAP	UNECE Convention on Long-Range Transboundary Air Pollution
man.Sv	Collective Effective Dose from emissions of radioactive materials
mg	Milligramme
Mio	Million
µSv	Micro Sievert
N	Nitrogen
N	Norway
NH_3	Ammonia
Ni	Nickel

Abbreviations, Acronyms and Symbols

NL	Netherlands
NMVOCs	Non-Methane Volatile Organic Compounds
NO_x	Nitrogen Oxides
NPP	Nuclear Power Plant
ODP	Ozone Depletion Potential
ODP tonnes	ODP-weighted tonnes (metric tonnes * ODP)
OE	Oil Equivalent
OECD	Organization for Economic Co-operation and Development
Oeko-Institute	Öko Institut, Darmstadt branch; Germany
OSPAR	Oslo and Paris Commissions
P	Phosphorus
P	Portugal
p.e.	Population Equivalents
Pb	Lead
POPs	Persistent Organic Pollutants
ppmv	Parts Per Million by Volume
P_{rel}	Release Potential
PRODCOM	Eurostat statistical nomenclature and database on products
P_{tox}	Toxic Potency
RfD	Oral Reference Dose
RID	Riverine Inputs and Direct Discharges 1995
S	Sulphur
S	Sweden
SAG	Scientific Advisory Group (of the Eurostat Pressure Indices Project)
SEA	Strategic Environmental Assessment
SESAME	Pan-European Database-project for Policy on Transport and Land-use
SHYLOC	System for Hydrology using Land Observation for Model Calibration
SNAP	System of Nomenclature for Air Pollution
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
t	Tonne(s) (1000 kilogrammes)
TAU	TAU Consultora Ambiental; Madrid, Spain
TBFRA	Temperate and Boreal Forest Resources Assessment
TEN	Trans European Transport Network
TEQ	Toxicity-Equivalent
TNO	Netherlands Organisation for Applied Science
toe	Tonnes of oil equivalent
Tot-N	Total Nitrogen
Tot-P	Total Phosphorus
UITP	Union Internationale des Transports Publics
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	UN Framework Convention on Climate Change
UNSCEAR	United Nations Scientific Commission on the Effects of Atomic Radiation
UV-B	Ultraviolet-B radiation
VKI	Institute for the Water Environment; Hørsholm, Denmark
VOCs	Volatile Organic Compounds
WHO	UN World Health Organization
Zn	Zinc

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