Environmental statistics and accounts in Europe

One of the priorities of the European Commission is a better environment for everyone, now and for generations to come. Statistics are increasingly important for the definition, implementation, monitoring and evaluation of environmental policies.

Environmental statistics and accounts in Europe- presents a selection of environmental statistics and accounts available at Eurostat and its partner institutions, such as the Directorate-General for the Environment of the European Commission and the European Environment Agency with its Topic Centres. It is an attempt to provide standardised information on various aspects of the environment to the general public.

The publication is based on analyses and interpretation of raw data from the 27 Member States, the candidate and EFTA countries. It covers key areas related to environmental statistics and accounts: European household consumption patterns, material flows, waste, water, air emissions, chemicals, biodiversity, land use, agri-environmental indicators, forestry, environmental protection expenditure and environmental taxes.

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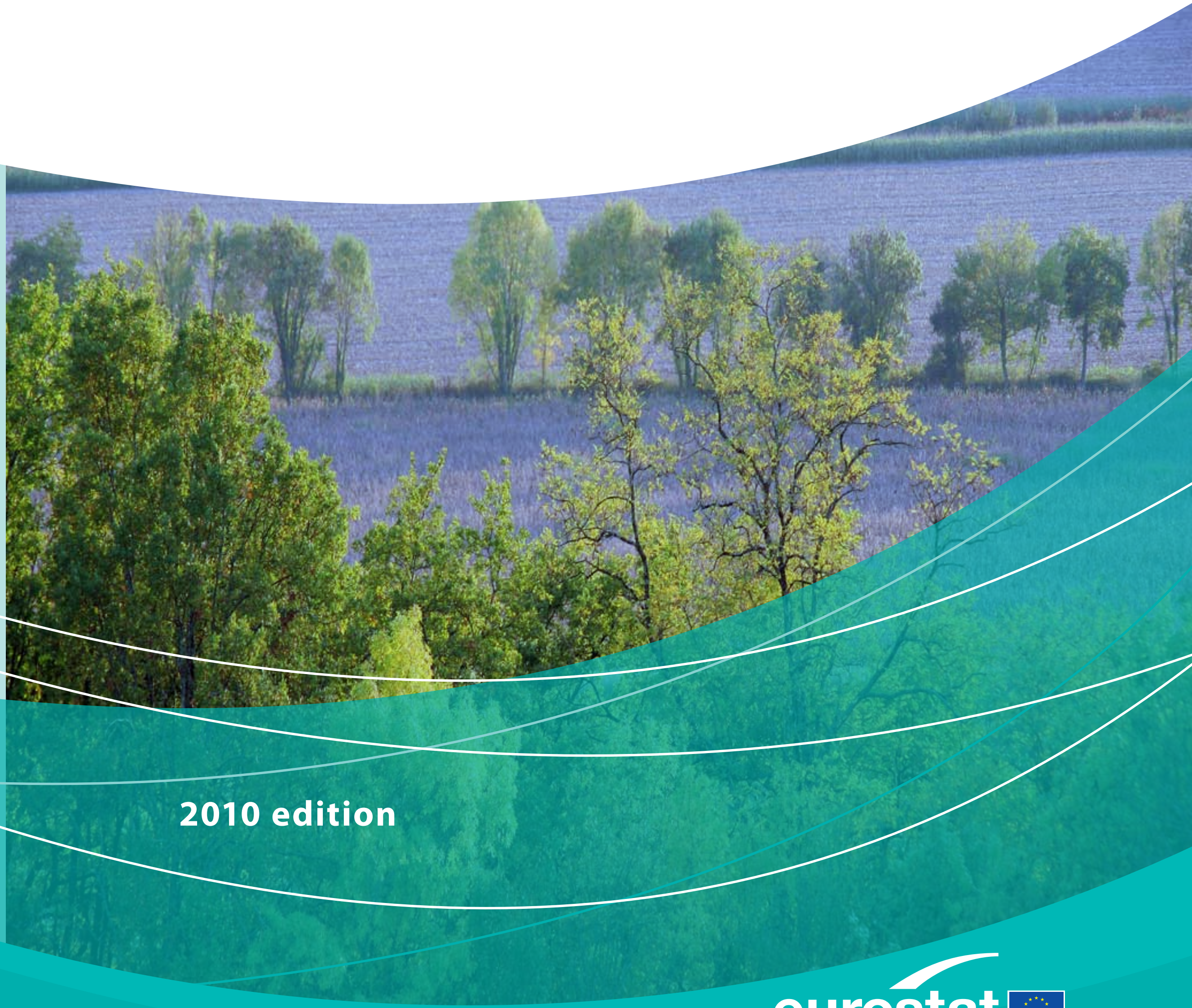

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Foreword

Dear Reader,

Statistical information is essential for understanding our complex and rapidly changing world. Eurostat, the Statistical Office of the European Union, collects, produces and disseminates harmonised statistics at European level. It gets most of its data from the national statistical authorities in the Member States and then processes, analyses and publishes that data following common statistical concepts, methods and standards. Eurostat also supports and encourages the development of similar statistical systems in countries neighbouring the European Union, thereby driving a process of statistical harmonisation.

One of the priorities of the European Commission is a better environment for everyone, now and for generations to come. Statistics are increasingly important for the definition, implementation, monitoring and evaluation of environmental policies, in particular the sixth environment action programme, its implementing seven 'thematic strategies', the environmental dimension of the EU sustainable development strategy, and the Europe 2020 strategy for smart, sustainable and inclusive growth, adopted by the European Council in June 2010. Reliable statistics are also needed to facilitate policy coordination among Member States and to reinforce a commitment towards sustainable development and environmental goals.

This publication covers key environmental statistics and accounts available at Eurostat and its partner institutions, such as the Directorate-General for the Environment of the European Commission and the European Environment Agency with its Topic Centres. It is an attempt designed to provide standardised information on various aspects of the environment to the general public.

The aim of this publication is to give you a flavour of some of the environmental statistics and accounts which enable us to identify environmental pressures related to our production and consumption patterns. It provides a wide-ranging overview of developments over recent years in the European Union, its Member States and selected partner countries. It is also an eloquent testimony to the progress made by the countries to reach environmental targets and highlights those areas where increased efforts will be needed to reach our goal of a better environment.

The 11 chapters of this publication cover our work on environmental topics with data from the 27 Member States and the candidate and EFTA countries. In addition, methodological sections provide essential meta-information on the data presented. The aim is to encourage readers to track down the environmental data available on the Eurostat website and make their own analyses.

Our website (http://ec.europa.eu/eurostat) offers you free access to nearly all Eurostat data presented in this publication. I hope this publication will encourage you to use Eurostat's data for your information needs and daily work.

I wish you an enjoyable reading experience!

Walter Radermacher

Director-General, Eurostat

Chief Statistician of the European Union

Abstract

An easy-to-use publication

This publication provides a picture of the interactions between the environment and the EU society on its way towards sustainable development.

It is based on analyses and interpretation of raw data in the key areas related to environmental statistics and accounts: European household consumption patterns, material flows, waste, water, air emissions, chemicals, biodiversity, land use, agri-environmental indicators, forestry, environmental protection expenditure and environmental taxes.

Using environment statistics and accounts means having a finger on the pulse of current developments in Europe: the publication presents background figures and facts needed to understand these developments.

The publication is divided into 11 chapters, each of which contains information relating to a particular topic.

Within each chapter, double facing pages focus on a particular subject: most start with a short **introductory text** that provides contextual information (such as policy background), as well as the relevance of the information presented.

The **core** of each chapter presents main findings, features and facts on the subject concerning the situation and trends at European level, comparisons between countries and the evolution of the subject compared to policy targets. To facilitate international comparison, some chapters include the comparable data for other countries outside the EU. Graphs, figures, tables and maps are introduced with a sentence that summarise the key messages provided. Examples and European legislation and policies related to the topic are highlighted in green boxes.

Eurostat offers a wide range of statistical information on its website that can be consulted online or downloaded free of charge. Other European institutions are developing publications on the environment. For these reasons, **'Further information'** is included at the end of each chapter to indicate how to get more Eurostat data and analysis and what other information is available at other European institutions or internationally recognised organisations.

At the end of each chapter, **Methodological notes** provide definitions and a brief description of the data sources and the quality of the data.

The balance of the information presented within the publication reflects to some degree the volume of information available under each of the themes within Eurostat's dissemination database, while also attempting to provide information that is of particular interest for the general public.

A publication designed for everyone with an interest in the environment

The publication is part of Eurostat's current dissemination strategy accompanying the vast array of official statistics freely available on Eurostat's website.

The publication provides an overview of data that is available within Eurostat's dissemination database.

However, the publication is not a mere collection of environment statistics and accounts, but shows how benchmark figures and indicators have developed over recent years in the European Union and the EU Member States, allows comparisons between countries and between the EU and other parts of the world and evaluates progress towards environmental policy targets.

Eurostat publications can be ordered via EU Bookshop (http://bookshop.europa.eu). All publications are also downloadable free of charge in PDF format from the Eurostat website (http://ec.europa.eu/eurostat).

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Contents

Introduction: Environmental statistics and accounts in Europe

Background

The Statistical Office of the European Communities (Eurostat) is a directorate-general of the European Commission; its overall mission is to provide the European Union with high quality statistical information services. It is responsible for collecting and disseminating data at European level, not only from the 27 Member States of the European Union, but also from the three candidate countries (Croatia, the former Yugoslav Republic of Macedonia and Turkey) and the four EFTA countries (Iceland, Liechtenstein, Norway and Switzerland).

The statistical authorities in the Member States compile, verify and analyse national data and send them to Eurostat. Eurostat consolidates the data and ensures their comparability. To fulfil its mission, the role of Eurostat is not only to compile statistics and accounts, but to encourage and coordinate production and delivery by the authorities of the Member States and to lead the way in the harmonisation of statistics in close cooperation with the national statistical authorities. Eurostat also supports non-member countries in adapting their statistical systems. Regular production of statistics and accounts is encouraged and the implementation of data management systems that allow regular and efficient production of the statistics and accounts supported. The validated data are made available once loaded into the Eurostat dissemination database.

Publications play an important role in Eurostat work as it enables the link between basic data and user needs by providing ready made analytical tools. They are a way of responding to public demands for environmental information, and they assist in the implementation, development and harmonisation of environmental policies. They also help to incorporate environmental concerns in decision-making, to promote sustainable development at national and international level and to evaluate national and European environmental performance. Statistics and analyses are published in short notes such as the *Statistics in Focus, Pocketbooks* and *News releases* and in larger thematic publications, such as the *Statistical books*, *the Eurostat yearbook*, *Monitoring reports*, etc.

The need for environmental statistics and accounts

Comprehensive, reliable and relevant statistics, accounts, and indicators are needed for developing, implementing and monitoring the Community's environmental policy, in particular the sixth environment action programme (1) (sixth EAP), its seven thematic strategies, the environmental dimension of the EU sustainable development strategy (2) and the Europe 2020 strategy for smart, sustainable and inclusive growth, adopted by the European Council in June 2010 (3). The sixth EAP also emphasises the need to ensure better and more accessible information on the environment for policy-makers, businesses, the citizen and other stakeholders.

Environmental concerns, such as climate change, natural resources, biodiversity, water quality, land degradation, air quality, waste management, natural resources and biodiversity, have increasingly become the subject of policies both at European and national levels. Growing pressures on the environment and increasing environmental awareness have generated the need for countries to accurately value and account for their environmental and natural

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(1) The four main policy areas identified by the sixth EAP are climate change; nature and biodiversity; environment and health and quality of life; natural resources and waste.

(2) See http://ec.europa.eu/environment/eussd/.

(3) See http://ec.europa.eu/eu2020/index_en.htm.

resources as a means of developing appropriate policies. Sound policy decisions must be made using timely and reliable information and environment statistics and accounts are a basic tool to collect and organise environmental information as well as a prerequisite for environmental indicators and national 'State of the environment' reports. In addition, to provide policy-makers with more accurate information on progress towards sustainable development, efforts are being made to integrate the environment into national accounts. The communication on 'GDP and beyond' (4) addresses the need to supplement economic indicators with social and environmental data.

At EU level, data assessment and interpretation are needed to monitor environmental trends, to identify the problems, to evaluate progress and to set up environmental targets. They also serve to design policy measures addressed to precise sectors to achieve the environmental targets.

In cooperation with other Commission services and the European Environment Agency, Eurostat plays a major role in the production and further development of environmental statistics and accounts in the EU.

Users of Eurostat's output include the services of the European Commission and other institutions of the European Union, national governments of the Member States, international organisations (OECD, UN agencies, etc.), businesses, professional organisations, universities, research institutes, libraries, NGOs, the media, citizens and a wide range of other users.

The activities in Europe (and worldwide) on environmental statistics and accounts have been quite extensive in the last decade.

Recently acquired knowledge on climate change, loss of biodiversity and their estimated consequences for the sustainability of resources and the future of the globe have turned environmental issues and, consequently, also environmental statistics and accounts into an issue of very high importance and priority today.

Attempting to set up worldwide coherent data collections on the main environmental issues, in 1988 Eurostat joined the data collection established by OECD through a 'State of the environment' questionnaire. This OECD/Eurostat joint questionnaire is a voluntary reporting exercise based on a gentlemen's agreement. Collection of yearly data are undertaken every two years for national territories covering several domains of environmental statistics (inland waters, wildlife, waste, noise, land use, environmental expenditure, etc.).

Environment statistics are also collected with a particular regulatory or administrative purpose in mind. They are usually developed in individual sets and often their definition and classification respond to specific policy concerns (waste statistics regulation (5), set of agri-environmental indicators (6), etc).

The field of environmental statistics is wide and complex and embraces many different domains. Several of these are clearly linked to statistics already available in other fields like agriculture, transport, energy, business, production, and trade statistics. Many are complex (e.g. ecosystems and biodiversity) and linked to fields not covered by the traditional statistics. Also, several of these fields do not follow the traditional paths for collecting and processing data. For example, remote sensing or specific counts (birds etc.) are used to collect the relevant information. Different networks for collecting and processing these data have been established between European organisations.

In parallel to environment statistics, Eurostat is developing environmental accounts to link environmental and economic statistics. Environmental accounts follow a framework (called

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(4) Communication from the Commission to the Council and the European Parliament 'GDP and beyond — Measuring progress in a changing world' (COM(2009) 433).

(5) Regulation (EC) No 2150/2002 of the European Parliament and of the Council of 25 November 2002 on waste statistics.

(6) Communication from the Commission to the Council and the European Parliament 'Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy' (COM(2006) 508 final).

'national accounting matrix including environmental accounts' (NAMEA)) which divides the economy into industry and households categories, showing how each industry or the households contribute to a variety of environmental concerns. Eurostat ensures regular collection and production of a core set of accounts in areas where methods and data sources currently exist such as emissions into the air and economy-wide material flows.

Environmental accounts are consistent with the national accounts which means that the environmental data can be directly compared to well-known macroeconomic indicators, such as gross domestic product (GDP), employment and investments, developed in the System of National Accounts (SNA).

Combined with the national accounts, the environmental accounts provide a powerful tool to analyse the extent to which production and consumption patterns are degrading natural resources or are polluting the environment. Environmental accounts can thus provide a complement to environmental statistics and answer political questions such as: Are we reaching the desired decoupling (economic growth with less impact on the environment)? Are we respecting environmental targets or are we importing/exporting environmental pressures by relocating production activities? What are the more or less harmful economic sectors for the environment? What is the productivity from natural resources at European level? Are market-based policy instruments increasingly used?

Over the last few decades, a strong effort has been made by Eurostat to encourage the European countries to compile environmental statistics and accounts providing both methodological and financial support to pilot projects. The environmental statistics and accounts framework is now mature and robust enough for comprehensive implementation and analysis of environmental data. The air emissions accounts and the material flow accounts are the most advanced areas of environmental accounts.

This publication analyses and presents material flow and air emissions accounts and statistics on waste, water, chemicals, biodiversity, land use, agri-environmental indicators, forestry, environmental protection expenditure and environmental taxes.

Success in the conception, development, implementation, monitoring and further improvement of environmental policies depends crucially on the availability of robust data. In order to ensure the provision of such data, Eurostat, the Directorate-General for the Environment, the European Environment Agency (EEA) and the Commission's Joint Research Centre (JRC) agreed to establish 'Environmental Data Centres' as a joint system in the provision of data in some of the most important environmental fields.

At Eurostat, environmental statistical and accounts work is thus coordinated with the EEA and its Topic Centres, interested directorates-general of the European Commission, the JRC, the recently established Environmental Data Centres and other international institutions.

Over the coming years, Eurostat will continue to further develop and implement statistical regulations, contribute to the development of the data centres operated by the EEA and the JRC, improve Eurostat's statistics, accounts and indicators and ensure a better dissemination of environment statistics and accounts through the data centres, new publications, and improved databases and websites.

Executive summary

The purpose of this publication is to provide a spectrum of Eurostat's environmental statistics and accounts which allow answering to a number of questions such as:

What is the responsibility and role of households for the situation of our environment? What are the consumption patterns of households in the European Union? What are the consumption categories with the greatest pressures on the environment? What are the direct and indirect environmental pressures of households' daily choices?

What is the EU dependency on natural resources and what is the progress in terms of decoupling economic growth from resource use?

How much waste is being generated in different countries and how are countries managing the waste? Where does the waste come from?

What is the availability of our water? How much water do we use?

How do we contribute to climate change? Can production grow without air emissions growing at the same rate? Why are the air emission patterns changing in our economy?

What is the role of the EU chemical industry? What is the trend in the production of toxic and environmentally harmful chemicals? What are the patterns of production, trade and consumption of toxic chemicals in the EU? How is the EU monitoring and reducing the risks of chemical products?

How is our biodiversity faring and how are we using the land?

Is our agriculture environmentally friendly?

How are we using our forests? Is there enough wood for products and for the rising demand for energy? What about carbon storage in our forests in the face of multiple demands and of climate change?

How are we applying the 'polluter pays' principle?

Households

European households affect the environment through their day-to-day choices of which goods and services to buy and how to use them, where to live, where to work, how to use leisure time and how to travel. Such choices are made within certain boundaries conditioned by urban planning, transport infrastructure and available housing. For example, increased spending on transport has implications for energy use, air quality and climate change. Driving a car or heating the home, for example, give rise to CO_2 emissions directly. Households also contribute to the rise of CO_2 emissions indirectly by purchasing goods and services in which the CO_2 emissions of production, distribution and disposal are embedded.

Figures show that European households are becoming smaller (fewer people per household). This means, in general, that household members are using more space, more goods and services, more energy and water, and generating more waste and emissions per person.

Most European households have progressively acquired a greater quantity and variety of food from all over the world, more vehicles, and more electronic devices. Figures provide evidence of an increase in private car and second home use and ownership, in consumption of electronic consumer goods, in consumption of highly processed and packaged food, and in the increasing generation of household waste.

Household expenditures on food and beverages have increased, but not as much as the total budget. Consequently, the share of household budget spent on food and beverage consumption has decreased. Household expenditures shifted from basic needs such as food and beverages to other consumption categories such as leisure activities or communications.

Household diet choices can significantly influence the use of resources and the environmental effects of the production, retail, and distribution phases of products' life cycles. For example, consumers can choose to consume more organic food, adopt a less meat-intensive diet, or choose local fruit and vegetables in season. By choosing food products with a low environmental impact (e.g. locally grown fruits and vegetables in season rather than off-season fruits and vegetables transported over long distances) consumers can achieve a reduction in the indirect environmental impacts of their food consumption.

The energy efficiency of European houses has increased, mainly as a result of the use of improved insulation and energy efficiency of heating systems and conventional appliances. On the other hand, Europeans live in larger homes and buy and use an increasing number of electronic devices. As a result, final energy consumption from households has remained relatively stable although electricity consumption has increased in most European households.

European households are very car-dependent and are travelling progressively larger distances. Fuelled transport gives rise to pollution and private cars and air transportation are the most energy-intensive and fastest-growing forms of transportation used by European households. Regulations which promote improvements in technologies and fuel efficiency have been successful in reducing emissions of certain air pollutants such as acidifying substances but much can still be done to steer mobility behaviour in a more sustainable direction.

Whether household environmental pressures are direct or indirect does not necessarily indicate whether households can have full control over them. For example, the energy required for space heating will depend largely on the construction of the dwelling, as well as on the temperature at which the space is maintained. The possibility of private citizens exerting influence on these issues varies. Energy consumed by personal travel, and the resulting CO_2 emissions, depend on the fuel, the vehicle, the distance travelled, and the number of passengers travelling together. The amount of fuel consumed also depends on the driving patterns of the household, which in turn depend on urban planning, infrastructure and alternative transportation systems. In many cases, households have few alternatives to private cars for commuting, shopping, visiting and other errands. For long distance travel, energy consumption depends primarily on the destination (distance) and secondarily on whether the trip is made by car (direct household consumption) or aircraft (indirect). In the case of lighting, the number of lights, the wattage, the efficiency and the amount of time they are on are determined by the household. On the other hand, the electrical energy consumed by a refrigerator is determined primarily by the efficiency built into the appliance, not by how it is used. However, a household purchasing a new refrigerator may be able to consider energy efficiency among other characteristics if appliances have energy efficiency labels. Energy conservation measures and the associated emissions reductions that households can control include building insulation, buying fuel efficient vehicles or using public transport, buying more efficient lighting, using fuel wood for heating, and reducing stand-by power consumption.

Wastewater from households represents a significant pressure on the environment. Many EU countries have implemented the urban waste water treatment directive, which prescribes the level of treatment required before discharge. In northern and western Europe, most of the population is now connected to wastewater treatment plants and many have tertiary treatments, which remove nutrients and organic matter. However, the percentage of the population connected to wastewater treatment is still relatively low in central and eastern Europe, although it is increasing.

European household consumption can be a major cause of increased environmental pressures affecting the environment through the use of its natural resources and through the generation of unwanted by-products such as greenhouse gas emissions, household waste or wastewater. However, household consumption can also provide the opportunity for the development of goods and services that are more 'environmentally friendly' if demanded by consumers (e.g. eco-labelled products, more energy-efficient appliances and less packaging). Organic food labelling is a policy measure that helps consumers to take informed decisions about what to buy to enable more sustainable food consumption. Also, the energy rating label enables consumers to compare the energy efficiency of appliances. Products that meet defined ecological and performance criteria are awarded with eco-labels at national, regional or EU levels and can be identified according to the logos used on packaging. These logos provide consumers with simple and straightforward information on the environmental quality of products to help them make informed environmental choices in their purchases.

In the EU-15, the rises in income levels and household expenditure tend to lead to an overall rise in environmental impacts related to household consumption. Households become smaller with the increasing per capita living area and more and more resources to fulfil daily needs.

Material flow accounts

Economic data and the national accounts show how money flows through our economies — but this does not provide information about the physical flows of materials. Material flow analysis (MFA) techniques provide a better understanding of the physical materials needed in our economies. Typically, as economies grow, more materials such as energy, construction materials and metals are needed. By using materials more efficiently and getting more economic value out of each unit used, the growth rate of the use of materials can be less than the economic growth rate. When the growth rate of material use is less than the economic growth rate, this is called 'decoupling' material use from economic growth.

Domestic material consumption (DMC) measures the total amount of materials directly used by an economy and is defined as the annual quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports. The DMC indicator provides an assessment of the absolute level of the use of resources. From 2000 to 2007 the DMC of the EU-27 increased by 7.8 %. Domestic extraction used (DEU) makes up the larger part of DMC, 85 %, with the physical trade balance (imports less exports) accounting for roughly 15 %. After some variation, DEU in 2007 was 4.9 % higher than in 2000. In contrast, the physical trade balance (PTB) rose constantly over 2000 to 2007 by 26.5 %. This means that the EU-27 is a net importing region from the rest of the world.

In 2007, the main materials extracted from the national territories of the EU-27 were non-metallic minerals including sand and gravel (61 %), biomass (24 %), fossil energy materials/carriers (13 %) and metal ores (2 %).

For most countries, the material requirements for a country's economy are dominated by domestic raw material extraction but the EU-27 as a whole is no longer self-sufficient for all materials it needs. Materials that are not available or are too expensive to produce nationally are obtained from foreign countries. Most European countries are thus net importers and require more resources from the rest of the world than they provide to them. Among the EU countries, in 2007 only Latvia and Sweden were net exporters of materials though at relatively low absolute amounts. Norway, on the other hand, is the largest net exporter of the EU and EFTA countries. Norway has a largely natural resource-based economy due to its high extraction and export of domestic oil and gas as well as fish and timber.

Direct material input (DMI) measures the direct input of materials for use into the economy, i.e. all materials which are of economic value and are used in production and consumption activities. DMI equals domestic (used) extraction plus imports. The relation of DMC (which equals DMI less exports) to DMI indicates to which extent material resource inputs are used for own domestic consumption or are exported for consumption in other economies.

By making a side-by-side DMI and DMC comparison, different types of economies can be characterised, like (a) through-transport countries with both high imports and exports (Belgium and the Netherlands), (b) extraction used mostly at home (in particular Bulgaria, Cyprus, Finland, Ireland, Hungary, Poland and Romania), and (c) extraction exporting countries (especially Norway). Norway is a resource-rich country which exports much of its extracted natural resources and that requires little direct imports. This means that only a small part of its direct material requirements is used for its own domestic consumption. In contrast, the Netherlands is a country with high levels of imports. But all of the imported goods to the Netherlands are not consumed nationally because the country is also acting as an entry point for foreign goods to other European countries. This phenomenon is sometimes called the 'Rotterdam' effect. As a result the Dutch DMC per capita is the second lowest of all EU countries. Denmark is more of a 'typical' country of the EU because it takes most of its direct material requirements from the domestic environment but still imports a significant part and uses the major part of this direct input for its own domestic consumption.

Resource productivity (GDP/DMC) is the EU sustainable development indicator for policy evaluation. Over the entire period 2000–07 an increase of resource productivity for the EU-27 of almost 8 % was observed. But DMC treats extracted materials differently to imports and exports. And, in quantitative terms, domestic extraction dominates DMI and DMC. Therefore, a closer look at domestic extraction industries is useful. In making this comparison, domestic extraction productivity (gross value added (GVA)/DEU) is used. The trends show that for the EU-27 as a whole, more and more materials are extracted for using in the economies but there is less and less value added to the overall performance of the economy from these activities. The positive trend for overall resource productivity as GDP/DMC is obviously not reflected in a positive productivity development of the domestic extracting industries. An important issue in this context appears to be increasing net imports which are not counted the same way, i.e. as raw materials, like domestic extraction and thus result in a distorted picture which is getting worse over time with increasing net imports. Using the idea of converting the mass of traded products into mass of raw materials needed for producing the products provides a good example of how this methodology can be adapted to give a more balanced picture. Eurostat is supporting this type of development work to try to improve these indicators.

Waste

From extraction, production and distribution, and final consumption of goods and services, as well as during waste collection and treatment (e.g. sorting residues in recycling facilities, incinerator slag), all human activities are potential sources of waste.

The nature and dimension of waste impacts on the environment depend upon the amount and composition of waste streams as well as on the method adopted for treating them. Improper management of waste has already caused numerous cases of contamination of soil and groundwater, threatening the natural functioning of ecosystems and the health of the exposed population. The generation of waste represents also an inefficient use of valuable resources.

Almost 3 billion tonnes of waste (6 tonnes per capita) were generated in the EU-27 in 2006. Around 3 % of total waste generated in the EU-27 in 2006 was hazardous (88 million tonnes) which poses substantial or potential threats to human health or the environment. Construction, mining and quarrying as well as manufacturing activities are the major sources of waste in the European Union: a third of all waste generated in the EU-27 (970 million tonnes) came from the construction sector, a quarter (741 million tonnes) from mining and quarrying, and manufacturing activities generated 364 million tonnes of waste. Households accounted for 7 % of the waste generated in 2006 in the EU-27 (215 million tonnes). The quantity and the compositon of waste generated across the European countries reflect differences in the economic structure, the consumption patterns and the different degree of implementation of waste policies.

Of the total amount of waste treated in EU-27, disposal (which includes landfilling as well as land treatment and release into water bodies) represented slightly more than 50 %. The other main waste treatment modes are incineration, energy recovery and recycling (material recovery). In some countries, restrictions on the landfill of certain waste streams have been imposed and a great proportion of total waste generated is now recovered or incinerated.

Through the Waste Data Centre, operated by Eurostat, Member States report data under European waste legislation to a single entry point. Data for specific waste streams as well as official waste statistics are becoming available in a common reporting, processing and dissemination environment to allow for cross validations and assessments. This one-stop-shop approach allows policy-makers, stakeholders, users from other European bodies and the interested public to find the data needed to assess the effectiveness of the European Union's waste policy. Data and indicators will show the development in (the reduction of) the amount of waste generated, the sound management of waste and the better use of resources; elements that are crucial for the protection of the environment, but also for the development of the EU economy, which is highly dependent on natural resources not available in Europe.

Eurostat will continue its effort towards a better comparability of data by use of common methodologies, classifications, and definitions in the field of waste. The integration of data collections into official statistics will streamline reporting and should also lead to a reduction of the burden for respondents.

Water

Water is used for a variety of activities and sectors such as households, industries, agriculture and the production of electricity. The risk of depleting, and of course contaminating, water resources through current uses is high.

Most European countries for which data are available appear to have reduced pressures on water resources by reducing or stabilising their abstraction rates per capita between 1989 and 2007.

Although the situation can widely differ within a given country, the water exploitation index (WEI) shows that in most European countries the reduction in water abstraction rates has reduced the pressure on water resources in the period 1990–2007. In particular, the decrease was important in some new Member States, such as Bulgaria, the Czech Republic, Romania, Lithuania and Estonia. Some countries show an increase in the WEI which is due to increases in water abstraction. This is the case for Turkey, Greece, the Netherlands and Slovenia.

Most of the European population is connected to urban wastewater treatment. In all European countries the share of the population served by urban wastewater treatment stands at least at 70 % with only few exceptions, such as Slovakia, Romania, Turkey, Iceland and Croatia.

High-quality data are needed to evaluate the effectiveness of EU water policies. Data on water collected by Eurostat is mainly focused on water quantity (resources, abstractions, uses) and wastewater treatment, dealing only marginally with the issues of water quality. However, the availability of these data is increasing in importance to meet the demand for information in the water domain, including for the development of key environmental indicators and to complement work initiated by the water framework directive. Filling gaps and ensuring data comparability across European countries are among the main objectives of the efforts of Eurostat in the water domain. During the coming years, Eurostat will also continue to support countries in establishing data aggregations for the level of river basin districts — an important step to complement the work done in relation to the water framework directive and thus to support the modern river basin-oriented water policies.

Air emissions accounts

Eurostat's air emissions accounts are a statistical information system that records emissions of greenhouse gases and air pollutants in a format compatible with the standardised system of national accounts which is used to portray economic activities. Air emissions accounts are directly linkable to economic production and consumption activities enabling integrated analyses. Air Emissions Accounts are provided for the latter purposes and cannot be used for target monitoring of international agreements such as the Kyoto and the Gothenburg protocols. The European Environment Agency (EEA) is the body responsible for target monitoring the EU and Member State data on air pollutant and greenhouse gas emissions for policy purposes related to international protocols which have their specific and own inventorying rules.

European production systems result in emissions of air pollutants and greenhouse gases. Four industry groups accounted together for 80 % to 90 % of the direct emissions of greenhouse gases, acidifying gases and tropospheric ozone forming precursors in the EU-25 in 2006. These industries correspond to the primary sector (agriculture, forestry and fishing), electricity, gas and water supply, the manufacturing industries, and transport services. Although these industries contribute the majority of emissions, they only account for around 43 % of total monetary output, with manufacturing alone accounting for 30 %.

Economic–environmental profiles provide for selected industries an overview on their performance in both economic and environmental terms. The manufacturing industry is characterised by its sizeable contributions to both gross output and employment, combined with similarly significant contributions to the emissions of greenhouse gases and ground-level ozone precursors. The service industry (including construction, but excluding transport) shows a characteristically high level of contribution to EU-25 total production output and employment, while being the source for only a fraction of the direct emissions pressures.

Both total greenhouse and acidifying emissions intensities decreased dramatically between 1995 and 2006 in the EU-25. The reason for the emissions intensity decreasing so noticeably is mainly due to an increase in the monetary gross production rather than a decrease of emissions to air.

Countries show different environmental pressures for the same type of economic activities. It reflects the different choices made and the state of technology regarding production systems in different countries. For example, countries such as Denmark, Germany and Poland whose energy mixes still rely heavily on coal present higher direct greenhouse gas intensities in electricity and heat generation than countries like Norway, Sweden and France. To tackle acidifying emissions, countries have deployed end-of-pipe technologies allowing them to reduce, over time, their acidification emissions intensities associated with electricity and heat generation. Germany, Denmark and Poland managed to reach levels closer to those of Norway, Sweden and France.

An index decomposition analysis helps to identify the underlying causes for trends observed in greenhouse gas and acidifying emissions. Total direct greenhouse gas emissions more or less remained on the same level between 1995 and 2006 in the EU. This overall trend is composed of several underlying factors: +41 % due to economic growth, – 7 % due to structural changes in the composition of industries, and – 34 % due to other factors including technology. The following decomposition explains the 27 % decrease in acidifying emissions: economic growth + 37 %, changes in the composition of the economy – 11 %, and decrease due to other factors including technology – 54 %.

Chemicals

One of the recent priorities of Eurostat has been the development of indicators on chemicals (index of 'production of toxic chemicals, by toxicity class', 'apparent consumption of chemicals, by toxicity class' and 'production of environmentally harmful chemicals') to monitor whether consumption and production patterns are shifting towards the use and production of safer chemical substances.

The European chemical industry has become very specialised and operates in an interwoven network, leading to increased transportation of 'intermediate' and final chemical products.

The chemical industry and chemical products are key elements in the development of society as well as key drivers for economic development and wealth.

Chemicals, through the different steps from their production to their handling, transport, and use, are also a potential danger for human health and for the environment. Workers in the chemical industry and all other economic sectors, and people in general, are confronted with the potential risks of chemicals on a daily basis.

Interest in the potential risks posed by chemicals to human health and the environment has constantly been a predominant concern both for the general public and for policy-makers.

The lack of toxicological data on a large number of chemicals which are deemed to be on the market as well as the potential long-term effects to humans and the environment resulting from exposure to low concentrations of chemicals have been continuously fuelling this interest.

In most industrial sectors a great number of substances are hazardous to the health of workers during their manufacture and use. It is therefore necessary to reduce the exposure of workers to these substances to the level needed in order to protect their health. With this aim, European legislation has established occupational exposure limit values for all substances to which workers are exposed. Across Member States a common set of European directives aimed at preventing health and safety risks in the workplace apply.

The new EU chemicals policy (REACH) is part of the Union's wider sustainable development strategy. Its overriding goal is to respect sustainable development by not only ensuring both a high level of protection of human health and of the environment as well as the free circulation of substances on the internal market, but also to enhance competitiveness and innovation.

In addition, REACH will very likely lead to more complete testing of toxicological properties, to better data provided by alternative testing methods such as modelling, to improved reporting, and to better information on exposure. In this way, the quality of the data (the completeness of the databases and to a lesser extent the quality of the individual data) is expected to improve and the uncertainty will, consequently, be reduced. This will be measured with a risk-based indicator set recently developed by Eurostat.

Biodiversity and land use

The EU's biodiversity is in decline, caused primarily by habitat change.

Loss of biodiversity is a matter for concern because with each loss, the ecosystems that are the life-support machines of our planet become less stable. The productivity of our natural ecosystems declines as species' diversity diminishes.

Therefore, biodiversity loss reduces the basis for the benefits we get from our natural ecosystems, the so-called 'ecosystem services', consequently bringing about socio-economic losses because these services play a central role in growth, jobs and human well-being.

Biodiversity is too complex to be fully quantified. It is measured directly by looking at changes in threatened species, or in common species and habitats that are typical for certain ecosystems. It can be measured indirectly by looking at changes in ecosystems, land use and land cover.

The most important changes in land cover between 2000 and 2006 were the increase in artificial areas and the decrease in arable land, pastures and mosaics, semi-natural vegetation, open spaces and wetlands, with a corresponding loss of ecosystems. These trends were broadly the same as between 1990 and 2000.

Biodiversity cannot be preserved only in protected areas, but should be taken into account in normal development everywhere. Rare species are now mostly well protected by the Natura 2000 network and the birds directive, while it is often more common species and habitats that are in decline.

Eurostat is preparing to publish the results of its 2009 land use and land cover field survey — LUCAS 2009 — including comparable indicators on the fragmentation, richness and dominance of the landscape. At the same time, Eurostat is preparing the next survey, foreseen for 2012, in cooperation with other European Union institutions such as the European Environment Agency and its Topic Centre on Biological Diversity. The possibility of collecting additional data focused on biodiversity is being discussed.

Agri-environmental indicators

Society's expectations of agriculture have evolved over the last few decades, and European farming has changed considerably to meet these new expectations. Technological developments have allowed farms to increase yields, but this has had important consequences on the environment. Changes in land use and farming practices, linked to specialisation and intensification, have for instance been associated with negative impacts on water, soil, air, biodiversity and habitats.

Statistical information on agriculture therefore no longer only covers production data and farm trends but should also reflect the new challenges faced by agriculture: the reduction of agricultural pressures on the environment, and the delivery of environmental services by farming.

A set of 28 agri-environmental indicators (AEI) has been developed to capture the main positive and negative effects of agriculture on the environment and to reflect regional differences in economic structures and natural conditions. These indicators cover farm management practices, agricultural production systems in the EU, pressures and risks to the environment and the state of natural resources.

Several indicators look into the relative intensification/extensification and specialisation of European agriculture. Information on such processes is, for instance, provided by the share of utilised agricultural area managed by high-intensity farms (26 % in the EU-27 in 2007), the share of specialised holdings (62 % in the EU-27 in 2007) or by the use of mineral fertilisers (64 kg/ha and 18 kg/ha of nitrogen and phosphorus respectively for the EU-27 in 2008). However, the evolution over time of these figures must be investigated in greater depth in order to reflect the actual trends. For instance, it appears that old EU Member States experienced a relative extensification over the period 2004–07, while farming instead intensified in the new Member States.

A reduction of the environmental pressure by the agricultural sector is shown by some indicators. Areas fully converted or under conversion to organic farming are growing and covered more than 4.5 % of the utilised agricultural area of the EU-27 in 2008. Most countries are below their national emissions targets for ammonia from agriculture due to reductions in emissions from 1990 to 2007 and greenhouse gas emissions from agriculture have seen a constant decline from 1990 onwards. Despite improvements in some areas, 26 % of species are threatened by pesticides and fertlisers like nitrates and phosphates.

For some indicators, significant differences were pointed out among Member States or among regions. This is for instance the case for the reduction in permanent grassland area, livestock densities or grazing livestock densities as well as irrigable areas. These indicators reflect the high variety of European agricultural systems that depend on abiotic conditions (climate, soil quality, etc.).

There are many challenges ahead in terms of improving data sets, spatial referencing and ensuring the timely delivery of indicators to policy-makers, and it is important to overcome the limitations that currently restrict the information potential of certain indicators. To this end, efforts are being made towards the conceptual and methodological improvement of these indicators and for the collection of the necessary data or better access to existing data.

Forests

The European Union's forests are multi-functional. Economic viability is not of paramount importance in all countries and regions: forests that protect dwellings and infrastructure from landslides or avalanches, forests that provide employment in rural areas, forests that protect and purify water resources, and forests in national parks and other protected areas are examples of multi-functionality.

Currently, more wood grows in forests available for wood supply than is cut. However, a conflict is emerging between wood for wood products and wood for energy and it is not clear yet whether there is enough wood available for both without resorting to imports. Data must be collected on the wood supply from all sources, not only from forests available for wood supply. Demand side data must also improve. Data available from certain countries seem to indicate that we are already using more wood than we were aware of. If this were to be generally true, there would be less room than expected for increasing the use of wood for energy purposes. Biomass energy targets could then only be met by mobilising a greater share of the existing resources and/or extending the forest area (for instance for energy plantations). This will depend on economic circumstances and policy choices, notably about land use priorities.

Because more wood grows than is cut, the European Union's forests are carbon sinks. In part, this is due to the area of forest increasing through abandonment of farmland and summer mountain pastures, but there are also a lot of absentee forest owners who live in cities and do not manage their forests. Trees store more carbon when they are in the growing phase than when they are old and grow more slowly. Therefore, a certain amount of cutting and management of forests increases the rate of carbon storage. However, older trees and deadwood are better for forest biodiversity, so there is a trade-off there, as there is with the goal of using more woody biomass for energy purposes.

Climate change will most certainly entail big changes in the current distribution of tree species and forest types. The ranges of many species will probably shift northwards, with a concurrent increase in the productivity of those forests. Southern areas, however, will be threatened by desertification.

Besides working on improving data on wood supply and consumption, Eurostat is planning to use its data on wood products to estimate how much wood is contained in our buildings and in other long-lived products at any one time. This is an area of carbon storage that interests policy-makers. Eurostat is also working to improve its data on the economic viability of forestry as part of the information on rural development in the EU.

Environmental protection expenditure

Environmental protection expenditure measures all actions and activities that are aimed at the prevention, reduction, and elimination of pollution as well as any other degradation of the environment. Thus it is an indicator of the commitment of society to protect the environment.

Three sectors, the public sector, private and public specialised producers, and industry account for most of the environmental expenditure. In 2006, the expenditure for protecting the environment in the EU-25 by these three sectors was equal to 1.8 % of GDP.

In the EU-25 (2006), most of the money spent by the public sector goes towards providing waste management services and services in the non-core domains. The EPE of specialised producers was mainly directed towards waste and wastewater management activities. Industrial EPE in most European countries was evenly distributed among environmental domains.

For many years, European statistical services have collected data on air pollution, on energy, water consumption, wastewater, solid waste, and their management, in addition to environmental data of an economic nature, as environmental expenditure. The links between all these data enable policy-makers to consider the environmental impacts of economic activities (resource consumption, air or water pollution, waste production) and to assess the actions (investments, technologies, expenditure) carried out to limit the causes and risks of pollution.

Eurostat has worked towards systematising the gathering of environmental statistics about the activities of all economic sectors within the EU. These statistics are used to assess the effectiveness of new regulations and policies. The second use of these statistics is for the analysis of the links between the pressures on the environment and the structure of the economy. Harmonised, comparable and comprehensive statistics about environmental expenditure and the sectors funding that expenditure should help to improve policy-makers' decisions.

Environmental taxes

Environmental taxes have long been a cost-effective instrument to influence consumers to buy less-environmentally damaging products and to change their behaviour in general. They also provide incentives for innovation to further improve products and processes. EU policies recommend the use of economic instruments in order to cope with environmental goals and the sustainable development strategy.

In 2007, energy taxes accounted for 72 % of total environmental taxes, transport taxes for 24 %, and pollution and resource taxes made up the remaining percentage in the EU-27 Member States.

The share of environmental taxes in the GDP and TSC has remained relatively stable or slightly decreased from 1999 to 2007 but environmental taxes form an increasingly significant share of households' and businesses' tax expenditures. This is especially the case of new Member States.

The reduction of tax revenue may be the consequence of stringent environmental protection. Revenues also change as a result of changes in the economy towards more or less environmentally-friendly production and consumption patterns. On the other hand, there has been a green tax reform in some European countries which has led to an increase in the weight being put on environmental taxes with respect to other forms of taxation (such as labour taxation).

Data on environmental taxes with a breakdown by industry are disseminated by Eurostat. They are found in the Eurostat dissemination database and are published in *Statistics in Focus* and larger publications.

Environmental tax revenue data are also regularly published, in an aggregate form, by Eurostat and the Taxation and Customs Union DG in the publication *Structures of the taxation systems in the European Union*.

Some experience has been gained by European countries in collecting and reporting environmental taxes to Eurostat. Currently, concepts, definitions and new developments concerning environmental taxes are being discussed at international level. Based on this, the current collection system and the statistical methodological guide on environmental taxes will be improved over the coming years.

Methodological notes

Data extraction

The statistical data presented in this publication were extracted from Eurostat's dissemination database in May 2010 and represent the data availability at that time.

Data coverage

Data are generally available up until 2007 or 2008.

Note that the space constraints associated with the format of this publication mean that time-series are generally presented from the year 2000, but longer time-series are usually available when consulting Eurostat's website.

The publication presents information for the European Union of 27 Member States (EU-27), the euro area, and the individual Member States. When available, information is also presented for the candidate countries and EFTA countries, as well as Japan and the United States. The EU-27 aggregate is only provided when information for all 27 Member States is available or has been estimated. In some cases it was not possible to calculate the EU-27 aggregate and in most of these cases the EU-25 or EU-15 aggregates are shown instead.

A footnote is added when the data refer to a partial total that has been created from an incomplete set of country information (no data for certain Member States, or only data for an older reference period). The data for the euro area cover the 16 Member States that, at the time of writing, share the euro as a common currency: Belgium, Germany, Ireland, Greece, Spain, France, Italy, Cyprus, Luxembourg, Malta, the Netherlands, Austria, Portugal, Slovenia and Finland. For all periods of time the data presented for the euro area covers all 15 participating countries, irrespective of when they joined the euro area; otherwise, a footnote is added.

Eurostat data code

A code (such as 'tec00001') has been inserted as part of the source of each graph, figure and table. This code allows the reader to easily access the most recent data on the Eurostat website — within the PDF version of this publication.

The data codes under each table and graph are presented as Internet hyperlinks. The data on the website is frequently updated and may also be more detailed or have a different measurement unit. For more information, consult the link to 'the Eurostat data code' under 'services' on the right-hand side of the Eurostat homepage.

Symbols used for data

An italic font is used in tables to show provisional data, estimates and forecasts (in other words, data that are likely to change in the future).

The colon (:) is used in tables to represent data that are not available, either because the value was not provided by the national statistical authority or because the value is confidential.

In figures (charts/graphs) missing information is footnoted as not available.

A dash (-) is used to indicate values that are not relevant or not applicable.

Abbreviations

AEI	agri-environmental indicator
AP	acidification potential
BTBPE	bis(2,4,6-tribromophenoxy)ethane
CAP	common agricultural policy
CBD	Convention on Biological Diversity
CEPA	classification of environmental protection activities
CH_4	methane
CITES	Convention on International Trade in Endangered Species
CFP	common fisheries policy
CLC	Corine land cover
CLRTAP	Convention on Long-range Transboundary Air Pollution
CMR	carcinogenic, mutagenic and reprotoxic
CN	Combined Nomenclature
CO	carbon monoxide
CO_2	carbon dioxide
COICOP	classification of individual consumption according to purpose
cont.	continued
Corine	Coordination of Information on the Environment
DAISIE	delivering alien invasive species inventories for Europe
DEHP	di-2-ethylhexyle phthalate
DEU	domestic extraction used
DiBP	disobutyl phthalate
DiMP	diisopropyl methylphosphonate
DnBP	di-*n*-butyl phthalate
DMC	domestic material consumption
DMI	direct material input
DVD	digital video disc
EAP	environment action programme
EBCC	European Bird Census Council
EC	European Commission
ECE	Economic Commission for Europe
ECHA	European Chemicals Agency
EEA	European Environment Agency
EFMA	European Fertiliser Manufacturers Association
EFSOS	European forest sector outlook study
EFTA	European Free Trade Association (CH, IS, LI, NO)
e.g.	for example (*exempli gratia*)
EIA	environmental impact assessment
ELV	end-of-life vehicles
EP	environmental protection
EPE	environmental protection expenditure
ESA 95	European system of integrated economic accounts
eSDS	extended safety data sheets

ETC-LUSI	European Topic Centre on Land Use and Spatial Information
EUR	euro
EU-SILC	EU statistics on income and living conditions
excl.	excluding
EXP	exports
FAO	Food and Agriculture Organisation (of the United Nations)
FAO FRA	Food and Agriculture Organisation's Forest Resources Assessment
FAWS	forest available for wood supply
FOWL	forest and other wooded land
FP6	sixth framework programme of the European Community for research and technological development
FTS	foreign trade statistics
GDP	gross domestic product
GFCM	General Fisheries Commission for the Mediterranean
Gg	gigagram
GHG	greenhouse gas
GHS	globally harmonised system
GVA	gross value added
GWP	global warming potentials
GWh	gigawatt hour
HBB	hexabromobenzene
HBCD	hexabromocyclododecane
HFCs	hydrofluorocarbons
HICP	Harmonised Index of Consumer Prices
HNV	high-nature-value
HWP	harvested wood products
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICES	International Council for the Exploration of the Sea
ICT	information and communication technologies
IES	Institute for Environment and Sustainability
ILO	International Labour Organisation
IMP	imports
incl.	including
INRA	Institut national de recherche agronomique
IOELV	indicative occupational exposure limit value
IPCC	Intergovernmental Panel on Climate Change
IRENA	integration of environmental concerns into agriculture policy
IT	information technology
ITTO	International Tropical Timber Organisation
IUCN	International Union for Conservation of Nature
JRC	Joint Research Centre
kg	kilogram
km	kilometre
kWh	kilowatt hour
LCD	liquid crystal display
LSU	livestock unit

LTTA	long-term annual average
LUCAS	land use/cover area frame survey
m	metre
MCPFE	Ministerial Conference on the Protection of Forests in Europe
MEA	Millennium Ecosystem Assessment
MFA	material flow analysis
Mg	megagram
n.e.c.	not elsewhere classified
n.e.s.	not elsewhere specified
NACE	statistical classification of economic activities in the European Community
NAI	net annual increment
NAMEA	National Accounting Matrix including Environmental Accounts
NH_3	ammonia
NGOs	non-governmental organisations
NMS-10	new Member States
NMVOC	non-methane volatile organic compounds
N_2O	nitrous oxide
NOx	nitrogen oxides
NUTS	nomenclature of territorial units for statistics
OB	over bark
OECD	Organisation for Economic Cooperation and Development
OJ	Official Journal
PC	personal computer
PBDEs	polybrominated diphenyl ethers
PCBs	polychlorinated biphenyls
PECBMS	pan-European common bird monitoring scheme
PFCs	perfluorocompounds
p-km	passenger kilometre (unit of measure representing the transport of one passenger over one kilometre)
PPP	purchasing power parity
PPS	purchasing power standard
PTB	physical trade balance
PWS	public water supply
REACH	regulation concerning the registration, evaluation, authorisation and restriction of chemicals
Rev.	revision
RME	raw material equivalents
RSPB	Royal Society for the Protection of Birds
SBL	safe biological limits
SBS	structural business statistics
SCP/SIP	sustainable consumption and production and sustainable industrial policy
SEA	strategic environmental assessment
SEBI	streamlining European biodiversity indicators
SERIEE	European system for the collection of economic data on the environment
SILC	Community statistics on income and living conditions
SF6	sulfur hexafluoride

SNA	system of national accounts
SO_2	sulphur dioxide
SoEF	state of Europe's forests
TBBA	tetrabromo bisphenole A
TEEB	the economics of ecosystems and biodiversity
toe	tonne of oil equivalent
TOFP	tropospheric ozone formation potential
TSC	total tax and social contributions
TV	television
TWh	terawatt hour
UAA	utilised agricultural area
UN	United Nations
UN-CSD	United Nations Commission for Sustainable Development
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VAT	value added tax
WEEE	waste electric and electronic equipments
WFD	water framework directive
WEI	water exploitation index
WstatR	waste statistics regulation
yr	year

European Union aggregates and Member States

EU	European Union
EU-27 (⁷)	European Union of 27 Member States from 1 January 2007 (BE, BG, CZ, DK, DE, EE, IE, EL, ES, FR, IT, CY, LV, LT, LU, HU, MT, NL, AT, PL, PT, RO, SI, SK, FI, SE, UK)
EU-25	European Union of 25 Member States from 1 May 2004 to 31 December 2006 (BE, CZ, DK, DE, EE, IE, EL, ES, FR, IT, CY, LV, LT, LU, HU, MT, NL, AT, PL, PT, SI, SK, FI, SE, UK)
EU-15	European Union of 15 Member States from 1 January 1995 to 30 April 2004 (BE, DK, DE, IE, EL, ES, FR, IT, LU, NL, AT, PT, FI, SE, UK)
Euro area (⁸)	At the time of writing the euro area is composed of BE, DE, IE, EL, ES, FR, IT, CY, LU, MT, NL, AT, PT, SI, FI; the euro area was initially composed of 11 Member States (BE, DE, IE, ES, FR, IT, LU, NL, AT, PT, FI) — as of 1 January 2001 Greece joined; as of 1 January 2007 Slovenia joined; as of 1 January 2008 Cyprus and Malta joined
EA-15	Euro area of BE, DE, IE, EL, ES, FR, IT, CY, LU, MT, NL, AT, PT, SI, FI
EA-13	Euro area of BE, DE, IE, EL, ES, FR, IT, LU, NL, AT, PT, SI, FI
EA-12	Euro area of BE, DE, IE, EL, ES, FR, IT, LU, NL, AT, PT, FI
EA-11	Euro area of BE, DE, IE, ES, FR, IT, LU, NL, AT, PT, FI

The order of the EU Member States used in the figures and tables is their order of protocol. It follows the alphabetical order of the countries' short names in their respective native languages. The

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(⁷) Note that EU aggregates are back-calculated when sufficient information is available — for example, data relating to the EU-27 aggregate is often presented for periods prior to the accession of Bulgaria and Romania in 2007 and the accession of 10 new Member States in 2004, as if all 27 Member States had always been members of the EU. The label is changed if a partial total has been created from an incomplete set of country information (no data for certain Member States or reference years).

(⁸) Note that the euro area aggregate is back-calculated when sufficient information is available — for example, data relating to the euro area is often presented for periods prior to the accession of Cyprus and Malta in 2008, Slovenia in 2007, and Greece in 2001, as if all 15 Member States had always been members of the euro area. A footnote is added when this is not the case and the data for the euro area refers to another aggregate based on either 11 (EA-11) or 12 (EA-12) or 13 (EA-13) participating Member States.

countries are identified by using the shortest official designation. The codes used are the two-digit ISO codes (ISO 3166 alpha-2), except for Greece and the United Kingdom, for which the abbreviations EL and UK are used.

BE	Belgium
BG	Bulgaria
CZ	Czech Republic
DK	Denmark
DE	Germany
EE	Estonia
IE	Ireland
EL	Greece
ES	Spain
FR	France
IT	Italy
CY	Cyprus
LV	Latvia
LT	Lithuania
LU	Luxembourg
HU	Hungary
MT	Malta
NL	Netherlands
AT	Austria
PL	Poland
PT	Portugal
RO	Romania
SI	Slovenia
SK	Slovakia
FI	Finland
SE	Sweden
UK	United Kingdom

Candidate countries to the European Union

HR	Croatia
MK (9)	the former Yugoslav Republic of Macedonia
TR	Turkey

Member States of the European Free Trade Association (EFTA)

IS	Iceland
LI	Liechtenstein
NO	Norway
CH	Switzerland

Other countries

JP	Japan
US	United States

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(9) The code MK is provisional and does not prejudge in any way the definitive nomenclature for this country, which will be agreed following the conclusion of negotiations currently taking place on this subject at the United Nations.

Further information

Free access to Eurostat data is available through the Eurostat website, which can be found at: http://ec.europa.eu/eurostat.

There are two main resources for accessing data, either in the form of standardised tables or through user-defined extractions from databases; there are links to both of these from the Eurostat homepage. In addition, the website presents an array of additional information in the form of publications (in PDF format) and methodologies, each structured primarily by subject/theme.

Various classifications (COICOP and NACE among others) are used in the publication. A complete listing of each of these may be obtained from the Eurostat website, by accessing the RAMON classifications server at: http://ec.europa.eu/eurostat/ramon.

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Households

Household consumption patterns and the environment

The environmental impact of European households

Households consume a significant proportion of the goods and services produced in the economy. Household spending accounts for a significant proportion of gross domestic product (GDP), averaging just above 60 % in the EU-27 (*source:* Eurostat (tec00009)). This consumption of different types of goods and services has varying impacts on the economy, the society and the environment.

Although the environmental impact of each household is relatively small compared with that of production activities, as a whole, the millions of households in Europe are a major contributor to environmental pressures. The choices made by individuals concerning purchases of consumer items, means of transport and decisions on how to run their homes can significantly influence the related environmental impacts. Household consumption can, for example, have an impact on the environment through increased water and energy consumption or through amplified air emissions, wastewater and waste generation. These cause changes in environmental conditions which in turn lead to impacts on human beings, ecosystems and infrastructures.

Sustainable consumption on the international agenda

Sustainable consumption can be described as the use of goods and services that respond to basic needs and bring a better quality of life, while at the same time minimising the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle of the goods and services so as not to jeopardise the needs of future generations (UN-CSD 1995).

In 1992, Agenda 21, the first global political agreement to refer to the need for sustainable consumption (¹), identified unsustainable patterns of production and consumption as one of the major causes of the continued deterioration of the global environment and stressed that 'action is needed to promote patterns of consumption and production that reduce environmental stress and will meet the basic needs of humanity' (UN, 1992). Ten years later, the declaration known as the Johannesburg Declaration on Sustainable Development (²) stressed the need for developing 'a framework of programmes in support of national and regional initiatives to accelerate the shift towards sustainable consumption and production' (UN, 2002).

Reflecting this renewed policy focus, sustainable consumption features on the agenda in EU policy-making. The Europe 2020 strategy (³), the sustainable development strategy (EC, 2001 and renewed in 2006), the sustainable consumption and production and sustainable industrial policy (SCP/SIP) action plan (⁴), the integrated product policy (⁵) (EC, 2003) and the sixth environmental action programme (⁶) (including its thematic strategies) provide the broad framework for promoting sustainable consumption. Also, on a national level in Europe, a number of countries have developed strategies for sustainable development, in which concepts of sustainable consumption are included.

The trend in European households

Household size

A tendency towards smaller households …

The average number of persons per household in the EU-27 has fallen from 2.5 in 2005 to 2.4 in 2008 demonstrating a tendency towards smaller households. The average in the EU-15 was 2.4 in 2005 and 2.3 in 2008 (*source:* Eurostat (lfst_hhanwhtc)). An increase in the number of single person households and single parent households partially explains this change.

… is leading to an increase in the total number of households

In northern Europe the number of one-person households is relatively high, while it is generally much lower in southern Europe and in most new Member States. Although regional differences exist, the trend all over Europe is towards smaller households thus leading to an increase in the total number of households (4 % in the EU-27 and 5 % in the EU-15 between 2003 and 2006: see Figure 1.1).

This tendency means that each household will consume resources (energy for heating, electric and electronic equipment, etc.) that will be shared and used by fewer people as households contain fewer members.

Household consumption

The environmental impact of changes in lifestyles can be important for a shift towards more sustainable consumption. It is therefore of interest to look into the composition of consumption and its distributional aspects. The evolution of household expenditure by category of goods or services provides an indication of consumption patterns.

(¹) Chapter 4 of *Agenda 21*, the United Nations (UN) Conference on Environment and Development report agreed in Rio de Janeiro in 1992.

(²) World Summit on Sustainable Development in Johannesburg in 2002.

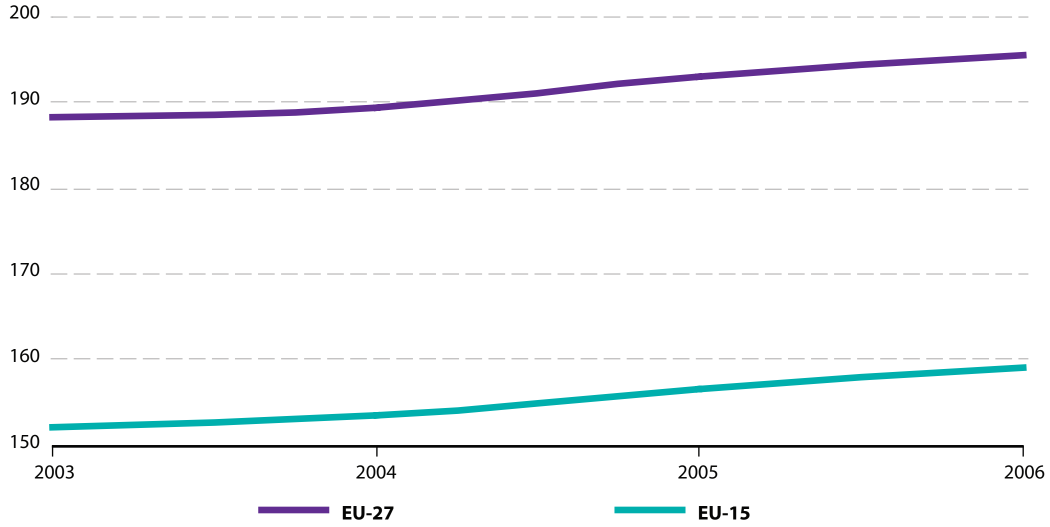
(³) Following calls for the Lisbon strategy to be updated, a European Council meeting in March 2010 announced that the Europe 2020 strategy would replace the Lisbon strategy (EC, 2000). EU leaders will discuss the new strategy further before it is launched in June 2010, followed by the submission on EU states' 'national reform programmes' on how they will meet the strategy's targets.

(⁴) The European Commission Sustainable consumption and production and sustainable industrial policy (SCP/SIP) action plan, adopted in 2008, includes a series of proposals on sustainable consumption and production that will contribute to improving the environmental performance of products and increase the demand for more sustainable goods and production technologies. It also seeks to encourage EU industry to take advantage of opportunities to innovate.

(⁵) Communication from the Commission to the Council and the European Parliament 'Integrated product policy — Building on environmental life-cycle thinking' (COM(2003) 302 final).

(⁶) Decision No 1600/2002/EC of the European Parliament and of the Council laying down the sixth Community environment action programme (OJ L 242, 10.9.2002).

Figure 1.1: Number of households, EU-27 and EU-15 *(million)*



Source: Eurostat (tsdpc510)

Household expenditure is growing rapidly …

In all countries, household expenditure exceeds government expenditure and is growing rapidly (*source:* Eurostat (nama_gdp_k)). Consumption expenditure in Europe by household currently exceeds 1990 consumption expenditure levels both in absolute terms and in euro per inhabitant at constant prices (*source:* Eurostat (nama_co3_k) and (tsdpc520)).

Figure 1.2 shows the growth of household expenditure per inhabitant and per country from 2000 to 2008 taking the year 2000 as the index 100.

Household expenditure per inhabitant has steadily grown in the new Member States over the last decade (every person spends almost double in 2008 compared with 2000). However, the level of expenditure in absolute terms is smaller than in the EU-15.

… reflecting some changes in consumption patterns

From 1998 to 2008, income increased in the EU-15 (from EUR 17 700 to EUR 24 600 per inhabitant of net national disposable income) and savings have remained relatively stable (from EUR 1 600 to EUR 1 800 per inhabitant of net savings), so EU-15 households have spent most of the increase in income on consumption (*source:* Eurostat (nama_inc_c)).

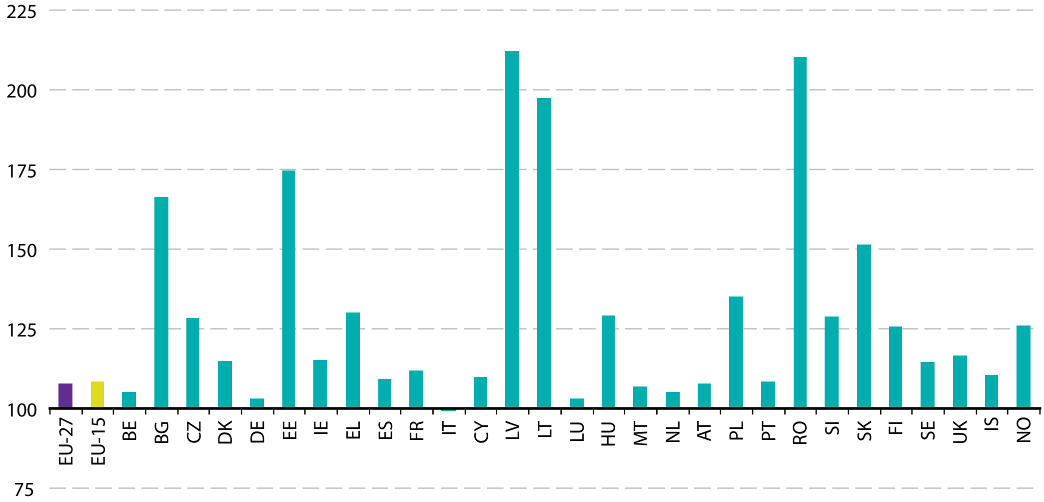
Figure 1.3 shows the evolution of EU-27 household expenditure in billion (1 000 million) euro (at 2000 exchange rates) by category.

In relative terms (see Figure 1.4), EU-27 households spent 16 % of total expenditure on housing, 15 % on food and beverages and 13 % on transport in 2008. Recreation and culture as well as restaurants and hotels represented 11 % and 9 % of total expenditure respectively, and health services not covered by public health schemes represented 4 % of total expenditure in 2008.

A shift from basic needs to leisure activities and communications

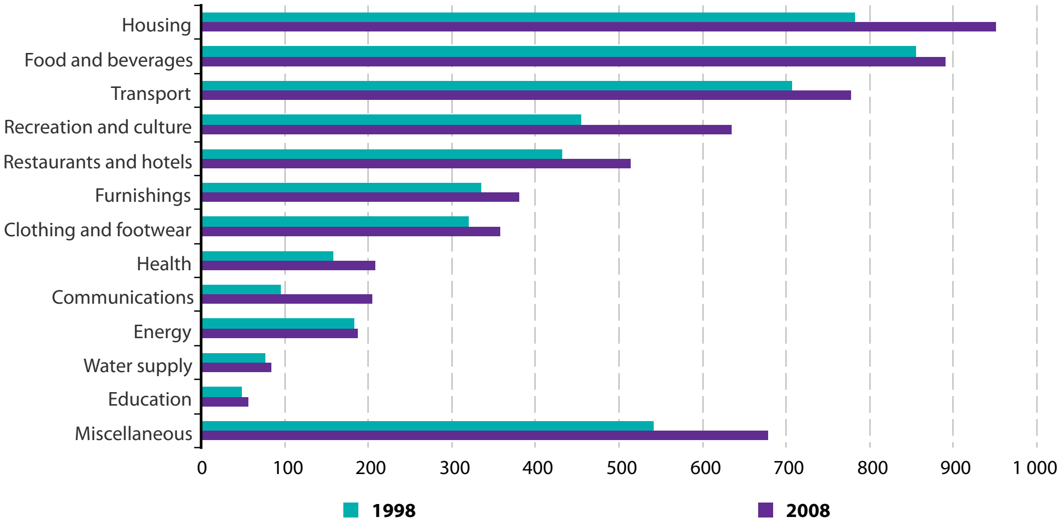
While housing, food and beverages, and transport dominate household expenditures across the

Figure 1.2 : Growth of household expenditure per inhabitant in European countries from 2000 to 2008 *(volume index 2000 = 100)*



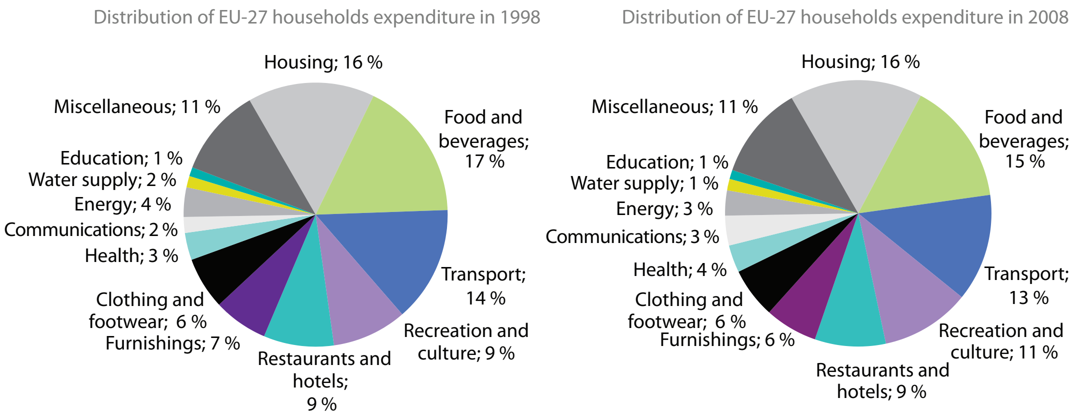
Source: Eurostat (tsdpc520)

Figure 1.3 : Household expenditure by category, EU-27 *(billion EUR)*



Source: Eurostat (nama_co3_k)

Figure 1.4 : Household expenditure by category, EU-27 *(%)*



Source: Eurostat (nama_co3_k)

EU-27, the consumption of food and beverages decreased from 17 % to 15 % of overall household consumption expenditure between 1998 and 2008. In contrast, the share for recreation and culture, communications and health has increased.

Spending on recreation and culture increased (7) from 9 % to 11 % of overall household consumption expenditure from 1998 to 2008.

Spending on communications (postal, telephone and telefax equipment and services), which doubled in absolute terms from 1998 to 2008, increased from 2 % to 3 % of overall household consumption expenditure over the same period, but still remains a relatively small consumption category.

Household consumption from a life-cycle perspective

The level and type of environmental pressures associated with household consumption depend both on absolute levels of consumption (how much is consumed) and on patterns of consumption (what goods and services are consumed) as well as on the various pressure intensities of these goods and services (i.e. environmental pressures per unit of consumption).

For some goods and services, environmental pressures dominate during the use phase of the life cycle and can be directly attributed to households (e.g. energy use of some electronic equipment). For other goods, such as food, the main pressures can be associated with production, transport, distribution or disposal, and indirectly attributed to households through their demand on these goods.

Economic and social factors drive household consumption. The increase of household incomes and globalisation provide households with access to goods from all over the world. Due to the increase in trade and globalisation, many environmental impacts connected to European household consumption occur outside of Europe. These impacts are related to resource extraction, production, processing and transportation of the goods consumed in Europe. These are considered indirect environmental effects of household consumption. For example, by importing goods and services, European households are

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(7) Maslow's theory of a pyramid of needs (1970) can provide an explanation. We never want to compose music if our stomachs are empty and we would never invest a high proportion of our budget on recreation and culture if we did not have enough to eat. Household priorities thus reflect their socioeconomic conditions.

increasingly using resources extracted abroad (see the chapter on materials flows which shows that resource extraction in Europe has decreased, while imports of resources have increased). Many goods are also manufactured in Europe from raw materials extracted abroad.

Demand for food and drink, housing and infrastructures, and mobility is found to cause around 60–70 % of total environmental pressures over their life cycle in terms of emissions of greenhouse gases and ozone-depleting substances, acidification and resource use ([8]).

Household consumption of food and beverages

The share of food and beverages in household budget decreases

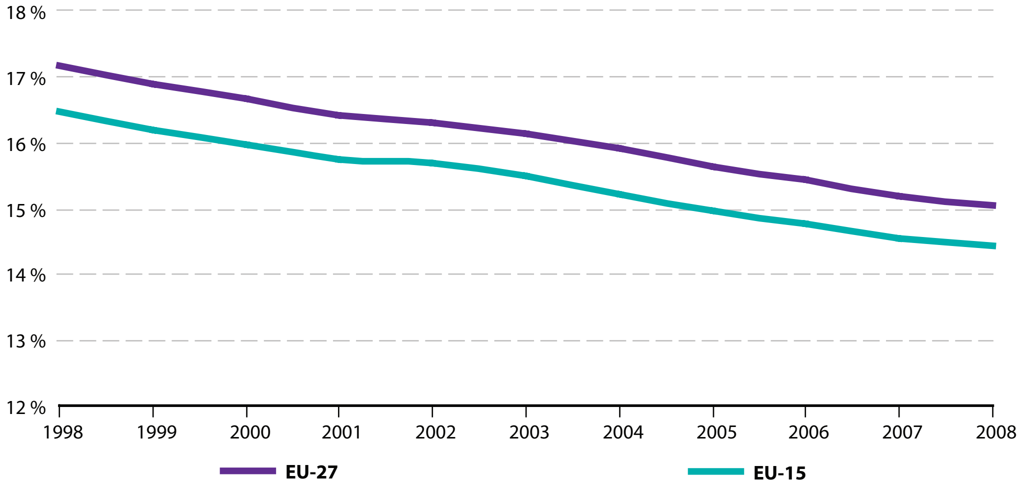
Consumption of food and beverages represented on average 14 % of total consumption expenditure in the EU-15 countries and 15 % in the EU-27 in 2008 (see Figure 1.5).

Household expenditure on food and beverages ranged from 12 % to 38 % of total household consumption expenditure in European countries in 2008, with the smaller shares in the EU-15 Member States and larger shares in the new Member States.

As incomes increase, the share of food and beverages in household total expenditure decreases. The proportion of household consumption spent on food and beverages is highest in Member States where household incomes are lowest. Since food consumption is a basic necessity, low income households spend a higher proportion of their budget on food. In Romania, for example, food and beverages make up 38 % of the total consumption expenditure of households, compared with 12–15 % in the United Kingdom, Austria, Germany, the Netherlands and Luxembourg in 2008.

Economic development is normally accompanied by improvements in food supply and the gradual elimination of dietary deficiencies, thus improving the nutritional status of the population. Europeans have generally become wealthier and the increase in food prices has been lower

Figure 1.5 : 'Food and beverages' component in total household expenditure, EU-27 and EU-15 *(%)*



Source: Eurostat (nama_co3_k)

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[8] 'Environmental pressures from European consumption and production. — A study in integrated environmental and economic analysis', ETC/SCP working paper 1/2009.

than that of income. In some cases, food prices have even fallen, partly due to agricultural subsidies in Europe.

Many Europeans eat out more frequently

Figure 1.6 shows the evolution of expenditure in catering services (which includes expenditure in restaurants, cafés and canteens) in EU-27 and EU-15 from 1998 to 2008 in billion euro (at 2000 exchange rates) demonstrating that many Europeans eat out more frequently.

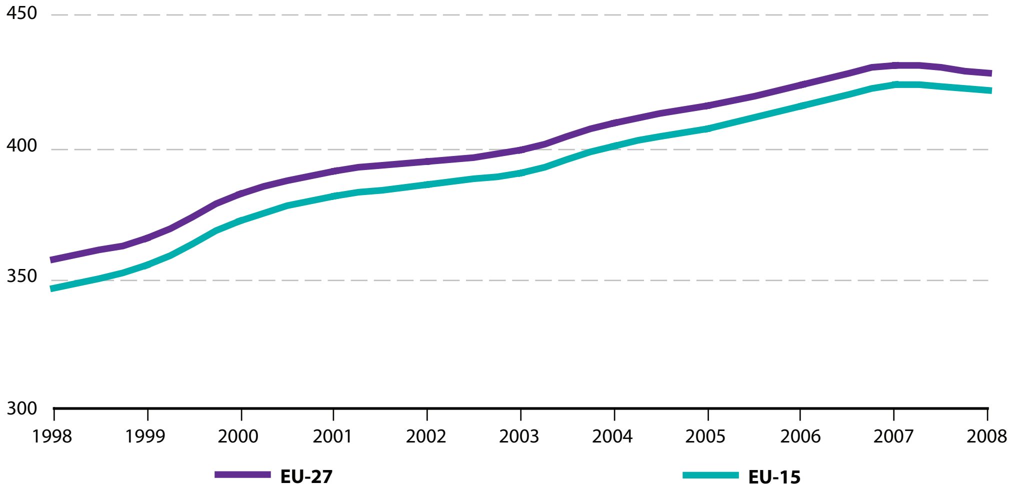
Expenditure in catering services has increased steadily over the last decade in both the EU-15 and EU-27. Simultaneously, the time spent on food preparation in households has changed dramatically. Many Europeans buy pre-cut vegetables and frozen dinners and eat more frequently at restaurants or in cafeterias at work or in school (9).

Packaging waste from food and beverages

A large part of household waste in European countries is related to the consumption of food and beverages. Consumption of food generates both organic waste (which is the wettest and most dense component of household waste) and, increasingly, non-organic waste such as plastic, paper and cardboard from food and beverages packaging.

European households buy food and drinks with more packaging and which have been transported longer distances (for example, exotic and out-of-season fruits and vegetables). With adults often working outside the home, receiving higher incomes and having less free time, convenience has become a major factor in determining food choice and an increase in the consumption of packaged pre-prepared food can be observed. At the same time, there has been an increase in the purchase of fresh food all year round from all over the world which has to be packaged in order to be transported. These patterns have resulted in large streams of packaging waste over the last decade. Increasing packaging has helped to reduce waste from spoilage but has significantly increased

Figure 1.6 : Household expenditure in catering services, EU-27 and EU-15 *(billion EUR)*



Source: Eurostat (nama_co3_k)

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(9) Laurie Michaelis and Sylvia Lorek, 'Consumption and the environment in Europe — Trends and futures', Danish Environmental Protection Agency, Copenhagen, 2004.

the amount of non-organic wastes entering the waste stream from household food consumption. Also, mineral water and soft drinks consumption involves the generation of increasing amounts of glass and plastic packaging waste.

Environmental impacts from household waste result primarily from their disposal. Paper and cardboard is generally the largest fraction of household packaging waste but with high recycling rates (see the chapter on waste which shows that packaging accounts for 166 kg/capita of waste per year with an average rate of packaging recycling in the EU-27 close to 60 % in 2007). Although recycling rates for many packaging materials have increased in the EU-27, big differences exist between European countries: 17 out of 27 countries have recycling rates lower than 60 %, with the lowest down to 10 % in 2007 (*source:* Eurostat (env_wasgen)).

The majority of household and similar waste generated in European countries ends up in landfill (*source:* Eurostat (env_wasgen)) resulting in a loss of potential resources. In addition, placing organic food waste in landfill leads to the generation of methane, which is a potent greenhouse gas.

The indirect environmental pressures of food and beverages consumption

In Europe, there is an increasing demand for non-seasonal foods, or foods which cannot be produced domestically due to climatic and/or soil conditions.

Every stage of the production–consumption chain (from growing crops, raising livestock or fisheries to transportation and storage, manufacturing, distribution, purchasing, consumption and dealing with wastes) has environmental effects.

The indirect environmental effects of food and beverages consumption come from the production, processing and transportation of the food consumed and handling of waste; and the indirect environmental pressures of food and beverages consumption are more significant than the direct environmental effects [10].

Among the agricultural products, studies have consistently found that meat [11] and dairy products require considerably higher inputs of energy, water and land and lead to greater environmental pressures than equivalent amounts of vegetables, cereals and other crops [12].

At the same time, impacts from food produced by intensive agriculture can be greater than food produced using organic methods.

Organic farming is a method of production that puts the highest emphasis on environmental protection and, with regard to livestock production, animal welfare considerations. It avoids or largely reduces the use of synthetic chemical inputs such as fertilisers, pesticides, additives and medical products. Farming is only considered to be organic at EU level if it complies with Council Regulation (EEC) No 2092/91 and its amendments, which have set up a framework for the organic production of crops and livestock and for the labelling, processing and marketing of organic products, while also governing imports of organic products into the EU.

The choice of diet is therefore a key in determining the environmental pressures resulting from food consumption. However, the country of origin of the food is also critical as the energy used to transport food between countries can be high when compared to the energy content of the food itself.

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(10) Laurie Michaelis and Sylvia Lorek, 'Consumption and the environment in Europe —Trends and futures', Danish Environmental Protection Agency, Copenhagen, 2004.

(11) Food products vary widely in terms of the environmental pressures they create along their full production chain. The full production chain for beef, for example, includes all inputs invested in the growing of grain for animal feed, energy used in producing artificial fertilisers and pesticides which are applied to the grain during its growth, energy used for transporting animal feed to the livestock farms, fertiliser and water inputs into pastures, and energy and water used in farms and during the slaughter and processing of the cows.

(12) European Commission, 2006, 'Environmental impact of products (EIPRO) — Analysis of the life cycle environmental impacts related to the final consumption of the EU-25', Technical Report EUR 22284 EN (http://www.jrc.es/home/pages/detail.cfm?prs=1429).

Organic farming generally uses less indirect energy than conventional farming, as energy-intensive chemical fertilisers and pesticides are not used. However, if organic food is imported in place of local conventional food, the lower energy consumption for production may be offset by higher energy consumption for transportation. The production of organic food is growing, but is currently still small. This is reflected by the area occupied by organic farming in the EU-15, which has seen an estimated increase from 3 % in 2000 to 4.7 % in 2007 (*source:* Eurostat (tsdpc440)) (see the chapter on agri-environmental indicators devoted to the surfaces allocated in the different countries to organic farming). In consequence, if organic food is not available locally, buying local non-organic food may in some cases have lower overall environmental implications than buying organic food imported from another continent.

Food consumption trends in Europe include increasing food consumption in general, increasing meat and dairy consumption (*source:* Eurostat (hbs_exp_t121)), more frozen and prepared food consumption, year-round consumption of fresh fruits and vegetables, and increasing food imports (*source:* Eurostat Comext database). These trends result in increasing long-distance refrigerated transport, including air transport, increasing the indirect energy consumption and air emissions related to food.

Concerning beverages, for example, the consumption of bottled water per person has increased in all European countries (13), replacing the drinking of tap water. The indirect environmental effects of mineral water consumption include the effects of transporting the water over long distances. Tap water is more energy efficient as it is provided through underground pipes, compared with the fuel and energy needed for filling bottles and transport.

European housing

Household expenditure in housing

Figure 1.7 presents the evolution of expenditure in the EU-27 and EU-15 for housing, which includes actual and imputed rentals for housing and the

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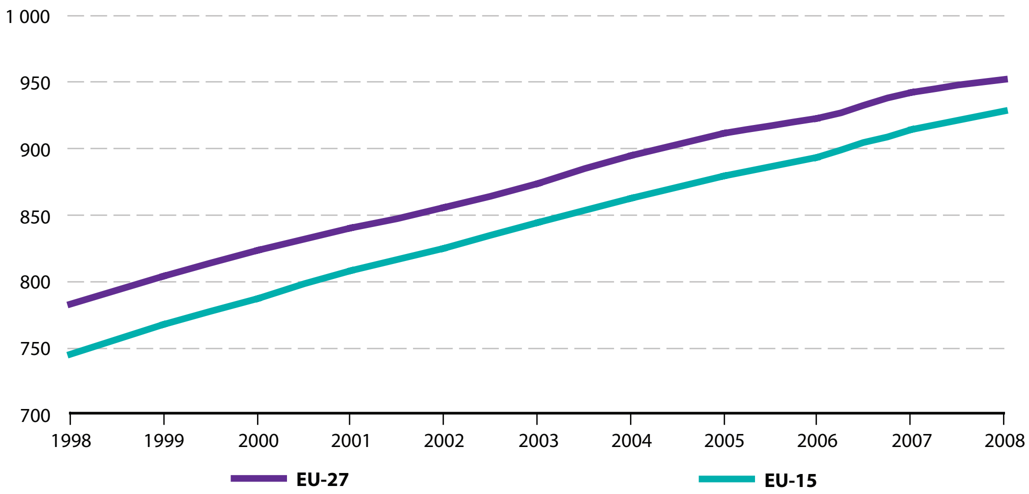
(13) According to the Beverage Marketing Corporation, in 2004 Europe was the greatest consumer of bottled water worldwide. European consumption of bottled water increased by nearly 60 % from 34 328 m³ in 1997 to 53 661 m³ in 2004.

Figure 1.7 : Household expenditure for housing, EU-27 and EU-15 *(billion EUR)*



Source: Eurostat (nama_co3_k)

maintenance and repair of dwellings in billion euro (at 2000 exchange rates) from 1998 to 2008.

Housing expenditure represents on average 16 % of total consumption expenditure both in the EU-15 countries and in the EU-27 in 2008.

House prices in some EU countries have changed by more than 10 % annually in either direction in consecutive years, a situation labelled as a 'boom' or a 'bust'.

Since 1980, booms have been more frequent than busts and have typically been followed by prolonged periods of very low growth or even of decline in house prices. House price booms and busts have been observed more frequently in the three Nordic countries and in the United Kingdom, but they have not been altogether absent from other EU countries. Spain, Ireland, the Netherlands and also the United Kingdom have been among the EU countries that have experienced two-digit growth rates in house prices. Greece and Italy have also experienced a rapid increase of house prices since 2001–02 (14).

The increase in house prices is mainly correlated with the rising cost of land for construction use. Land is a scarce resource, so its cost is expected to rise as demand for space suitable for construction purposes rises with the increasing number of households and with higher income.

A recent and growing European trend is the purchase of second homes (15) for holiday and/or weekend use. Many are in highly environmentally sensitive areas, on coastal zones and in mountainous areas.

Behaviour can be pre-determined by building infrastructure

In terms of energy consumption, household behaviour is often pre-determined by existing building infrastructure. For example, if the level of heating cannot be controlled, households may need to resort to wasteful practices such as opening windows to reduce temperatures on milder winter days.

Directive 2002/91/EC requires Member States to comply with Article 7 (energy performance certificates), Article 8 (inspection of boilers) and Article 9 (inspection of air conditioning systems) before 4 January 2009. Energy performance certificates present the energy efficiency of dwellings on a scale of A–G. The most efficient homes — which should have the lowest fuel bills — are in Band A. The certificate uses the same scale to define the impact a home has on the environment. Better-rated homes should have less impact through carbon dioxide (CO_2) emissions.

Improved designs and standards for housing, particularly for construction, can substantially reduce energy consumption for space heating. Various design elements affect energy efficiency. For example, insulation, sealing joints and the orientation and shape of the building (which influence the heat gain from sunlight) all contribute to the energy efficiency of the building. Sustainable building design thus includes elements such as high levels of thermal insulation in walls, roofs and windows, efficient heating, design of the building to fit a specific location, use of passive lighting and active shading or solar water heating.

Increased amounts of demolition waste

The supply of new housing has led to the dismantling of existing housing stock, generating increasing amounts of construction and demolition waste.

Construction and demolition waste makes up approximately 33 % of all waste generated in the EU (*source:* Eurostat (env_wasgen)) with a large proportion arising from the demolition and

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(14) European Central Bank. EU housing statistics: Residential property prices for EU countries.

(15) United Nations, Economic and Social Council, Economic Commission for Europe, Conference of European Statisticians, Group of Experts on National Accounts, 10th session, 'Second homes — Vacation home ownership in a globalised world — Note by the United Nations World Tourism Organisation (ECE/CES/GE.20/2010/15).

renovation of old buildings ([16]). It is made up of numerous materials including concrete, bricks, wood, glass, metals, plastic, solvents, asbestos and excavated soil. Due to its composition, there is a significant potential to reuse and/or recycle construction and demolition waste, but practical procedures are not yet widely known or practised in the construction industry in many countries. The main methods currently used to treat and dispose of construction and demolition waste include landfill and incineration.

Construction activity in Europe has increased substantially in the past decade. Equally, there has been an increase in the generation of construction and demolition waste. Although some European countries obtain recycling rates as high as 80 % ([17]), the rate of recycling and reuse of this type of waste is still quite low in many European countries. This has engendered an environmental problem and a motivation to develop strategies and management plans to solve it.

The European Community strategy for waste management to the year 2000 (SEC(89) 934 final), endorsed by the European Council resolution of 7 May 1990 on waste policy, includes a hierarchy of waste management options in which the primary emphasis is laid on waste prevention, followed by promotion of recycling and reuse, and then by the optimisation of final disposal methods for those wastes which are not reused. In 1991, the European Commission initiated the priority waste streams programme for six waste streams. One of these was construction and demolition waste. The recent waste framework directive ([18]) indicates that specifications and criteria should be developed for construction and demolition 'end-of-waste' and requires of the Member States an increase in the reuse and recycling of non-hazardous construction and demolition waste to a minimum of 70 % by weight by 2020.

Consumption of resources and occupation of land

The most significant indirect environmental pressures of housing are the consumption of resources and the occupation of land.

The construction boom over the last decade in Europe has required the consumption of significant quantities of raw materials and energy. The construction of new houses and apartment buildings and the replacement of existing houses with new and larger houses have thus put additional pressures on the use of natural resources such as sand, gravel and wood but especially on land use (see the chapter on biodiversity and land use which shows that as Europe's population continues to increase, the various demands for land in and around cities are becoming increasingly acute, generating increasing pressures on the environment).

Household use of electric appliances and electronic devices

An increase in the number of powered appliances and devices in homes

Figure 1.8 presents the evolution of expenditure in household appliances from 1998 to 2008 in the EU-27 and EU-15 in billion euro.

Expenditure as well as the number of powered appliances and devices in homes has increased rapidly in recent decades ([19]). Examples include conventional appliances such as washing machines, dishwashers, microwave ovens, refrigerators and freezers, and audio-visual devices such as TV sets, DVD players, mobile phones and personal computers. One of the latest trends has been the introduction of MP3 players and video games and the replacement of cathode ray tube TV sets with flat screens (LCD and plasma).

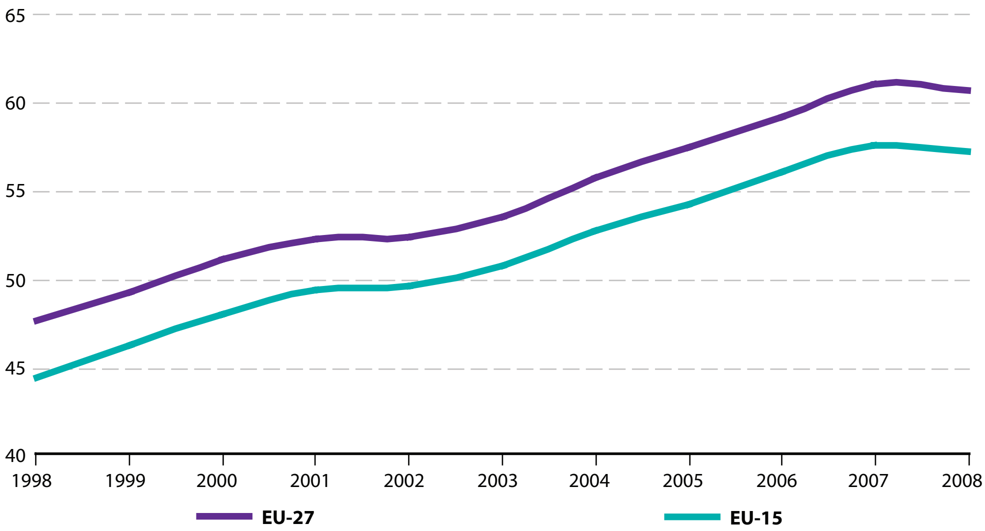
([16]) Eionet — European Topic Centre on Sustainable Consumption and Production.

([17]) Eionet — European Topic Centre on Sustainable Consumption and Production.

([18]) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives.

([19]) Eurostat, 2003, Theme 4: Industry, trade and services. *Statistics in Focus* 34/2003, DVD and video statistics, Sectorial profiles and detailed tables, cinema, TV and radio in the EU, statistics on audiovisual services, data 1980–2002.

Figure 1.8 : Expenditure in household appliances, EU-27 and EU-15 *(billion EUR)*



Source: Eurostat (nama_co3_k)

Household expenditure in appliances in the EU-27 grew by 27 % and in the EU-15 by 29 % between 1998 and 2008.

Penetration patterns of powered appliances vary across Europe with generally higher penetration in the EU-15 than in the new Member States.

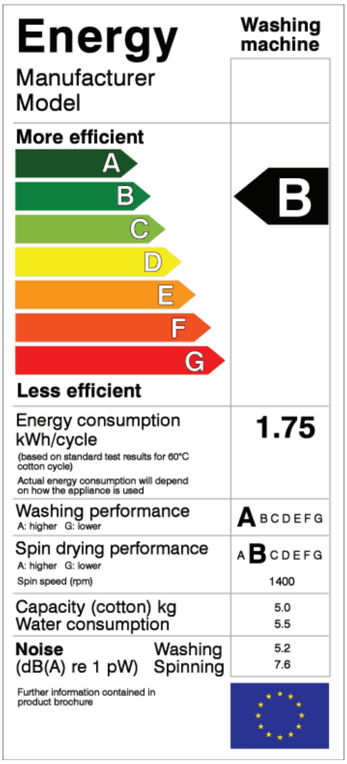
The increase in the number of appliances and devices has created additional pressures on the environment in terms of energy and water use and waste generation.

Electric power for appliances is growing

Many appliances such as refrigerators, air conditioners, lighting and other energy-using appliances consume much more energy during the use phase of their life cycle than in their production.

The energy rating label enables consumers to compare the energy efficiency of appliances.

According to several different EU directives (92/75/EEC, 94/2/EC, 95/12/EC, 96/89/EC, 2003/66/EC, et al.) selected white goods, light bulb packaging and cars must have an EU energy label clearly



displayed when offered for sale or rent. The energy efficiency of the appliance is rated in terms of a set of energy efficiency classes from A to G on the label, A being the most energy efficient, G the least efficient. The labels also give other useful information to the customer (such as the consumption of energy and of other essential resources) as they choose between various models. The information should also be given in catalogues and included by Internet retailers on their websites. In an attempt to keep up with advances in energy efficiency, A+ and A++ grades were later introduced for refrigeration products.

The EU legislation on energy labelling has effectively shifted consumer buying behaviour towards the purchase of more energy and water-efficient large household appliances. Energy-efficiency labels for appliances and equipment are currently used in many European countries and the range of appliances to which they are being applied is expanding. The EU energy labelling framework directive makes labelling compulsory for refrigerators and freezers, dishwashers, light bulbs, washing machines and dryers. Energy labels are in preparation for a number of other appliances, including boilers and hot water heaters.

However, despite improvements in the energy efficiency of the average new electronic appliance, the total energy use by electronic appliances in the average home increases because the number of electronic appliances (for example, TV sets, DVD players or personal computers) in each household increases. For example, many European households now have two or three TV sets and personal computers. The average energy consumption per unit for large conventional appliances such as washing machines, dishwashers and cold appliances such as refrigerators and freezers has fallen during last decade, but not the total energy consumption as a result of the increasing number of appliances and the growing energy use in consumer electronics.

Electric power for appliances and consumer electronics, including stand-by power when appliances are not being used, is the fastest growing form of energy consumed within households.

Some electronic appliances spend most of their lives in standby mode

A small but growing cause of inconspicuous energy use is the increasing number of electrical appliances that consume electricity when they are not in use. In some cases this is because of built-in clocks or computers that require power to run; or because the appliance is on 'stand-by', ready to be powered up by a remote control handset. Many appliances consume electricity even when they appear to be turned off, because they contain transformers that are still connected to the power supply.

Currently, in European households, a significant number of electronic appliances spend most of their lives in standby mode. In some cases, standby energy use is several times larger than the active energy use over the lifetime of the appliance. An example of this is the VCR, which on average consumes more electricity in total in standby mode than while actively recording or playing. Electricity consumption of TV sets in the EU-27 was estimated at 60 TWh in 2007, of which 54 TWh was on-mode power consumption and 6 TWh (or 10 %) was stand-by/off-mode power consumption (20). A TV set that is switched on for 3 hours a day (the average time Europeans spend watching TV) and in stand-by mode during the remaining 21 hours uses about 40 % of its energy in standby mode (21). A microwave oven that is only used occasionally, for example, may use more energy in running the clock when it is not in use than for heating food.

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(20) European Commission. Joint Research Centre, Institute of Energy Electricity, *Consumption and efficiency trends in European Union — Status report 2009.*

(21) http://ec.europa.eu/environment/climat/campaign/control/switchoff_en.htm

Increasing amounts of electrical and electronic equipment waste

As a result of the increased number and variety of appliances found in households, even though the resource-efficiency of each appliance is improving, households are generating increasing amounts of waste. Another contributing factor is that these appliances, when broken, tend to be replaced rather than repaired. Due to a reduced durability of goods and low prices of new units compared with the cost of repairs, households replace their electronic and communications tools and household appliances (washing machines, dishwashers, ovens, microwave ovens, refrigerators, freezers and air conditioners) more often.

The replacement occurs even more frequently in the case of some of the 'non-mature' products whose technologies have been constantly developing over the last decades — most notably ICT equipment. An average personal computer in Europe remains in use for three years. Together with cameras, cellular phones, notebook computers and many other small electronic devices and electric appliances, they resulted in more than 910 000 tonnes of discarded equipment by households in the EU-15 in 2006 (*source:* Eurostat (env_wasgen)).

In the EU-27, the total weight of electrical and electronic equipment put on the market in 2005 was estimated at 10.3 million tonnes and estimates of the electrical and electronic equipment waste arising across the EU-27 is between 8.3 million and 9.1 million tonnes per year for 2005 (22). In the EU-27 only between 25 % (for medium-sized appliances) and 40 % (for larger appliances) of electrical and electronic waste is reported as separately collected and appropriately treated. The rest is potentially still going to landfills and to sub-standard treatment sites. Illegal trade of electrical and electronic waste as second-hand goods to non-EU countries continues to be identified at EU borders.

EU legislation restricting the use of hazardous substances in electrical and electronic equipment (Directive 2002/95/EC) and promoting the collection and recycling of such equipment (Directive 2002/96/EC) has been in force since February 2003. The former requires the phase-out of heavy metals (lead, mercury, cadmium and hexavalent chromium) and flame retardants (polybrominated biphenyls or polybrominated diphenyl ethers). The latter legislation requires, among others, the creation of collection schemes where consumers return their used waste free of charge. The objectives of the legislation are waste prevention in terms of both quality and quantity, as well as an increase in the recycling and/or reuse of such products and an improvement in the quality of these operations. In December 2008, the European Commission proposed a revision of the directives on electrical and electronic equipment in order to increase the amount of waste that is appropriately treated and to reduce the volume that goes to disposal. The collection target of 4 kg per person per year does not properly reflect the amount of electrical and electronic equipment waste arising in individual Member States. The Commission proposes to set mandatory collection targets in percentages to appropriately reflect the consumption rate of different Member States.

The overall composition of electric and electronic equipment scrap is characterised by a high content of metal, plastics and glass. Although the fraction of this waste that is collected is mostly recovered in European countries (see the chapter on waste, which shows that in most European countries the recovery rates of large and small household appliances, IT and telecommunication appliances and lighting equipment separately collected is well above 75 %), collection rates are low and disposal of electric and electronic waste can present serious hazards (for example, uncontrolled landfilling can release contaminants over time and leach carcinogenic substances into soil and groundwater over the medium and long term, and incineration or co-incineration with no prior treatment or sophisticated flue gas purification can pose a major risk of generating and

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(22) J. Huisman et al. '2008 review of Directive 2002/96 on waste electrical and electronic equipment (WEEE)', United Nations University, Bonn, 2007.

dispersing contaminants and toxic substances such as heavy metals).

Household use of transport

Household transport expenditure

Figure 1.9 shows the evolution of expenditure in transport in the EU-27 and EU-15.

Travel by European citizens is mainly for commuting to and from work or school, for leisure activities (including tourism), shopping or visiting family and friends.

Transport represented on average approximately 13 % of total consumption expenditure in both the EU-15 and the new Member States in 2008.

Figure 1.10 shows the evolution of expenditure in transport services (as a proxy for public transport) and in the purchase of vehicles and the operation of personal transport equipment (proxy for private transport) in the EU-27 and EU-15.

Expenditure in public transport increased by 25 % and 30 % while expenditure in personal transport increased by 7 % and 8 % in the EU-27 and EU-15 respectively from 1998 to 2008. However, European households spend on average 2 % of their total expenditure on public transport and 11 % on personal transport, which means that Europeans spend six times more on personal transport than on public transport.

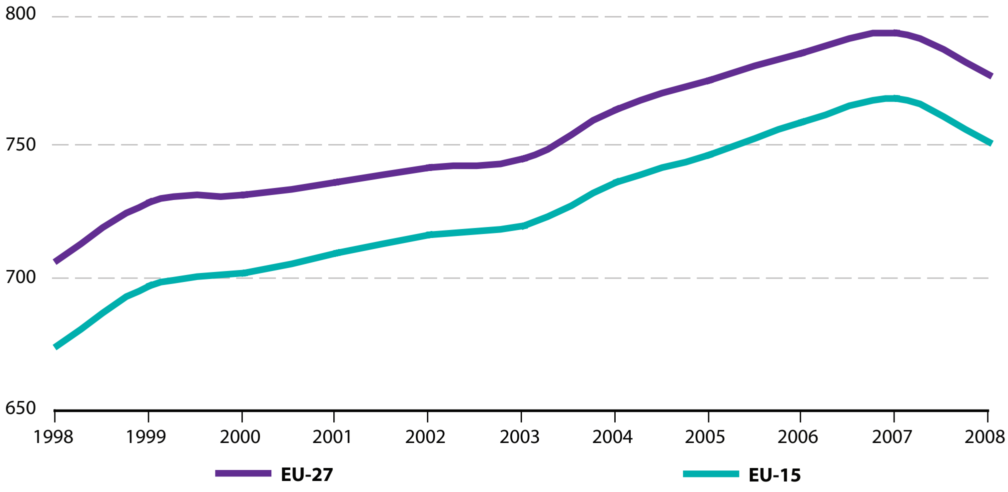
A shift from the use of public transport towards the private car

Despite the increased expenditure on public transport, among different means of transport, the proportion of public transport used by households is on the decline, while car ownership and use increases.

Figure 1.11 shows the number of passenger cars per 1 000 inhabitants (the motorisation rate) in the European countries from 1995 to 2006.

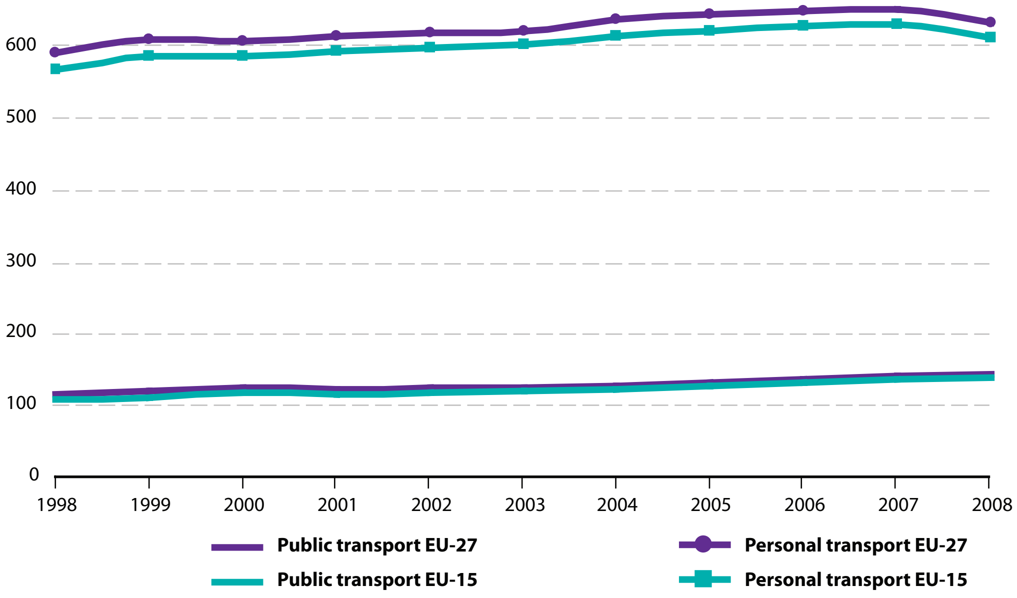
The highest numbers of passenger cars per inhabitant are registered in west European countries, with a significant difference compared with some countries in eastern Europe. However, the number of passenger cars per inhabitant increased by 19 % and 25 % in the EU-15 and EU-27 from 1995 to 2006 with the highest shares in the new Member States. Latvia registered the highest growth over this period

Figure 1.9 : Household expenditure in transport, EU-27 and EU-15 *(billion EUR)*



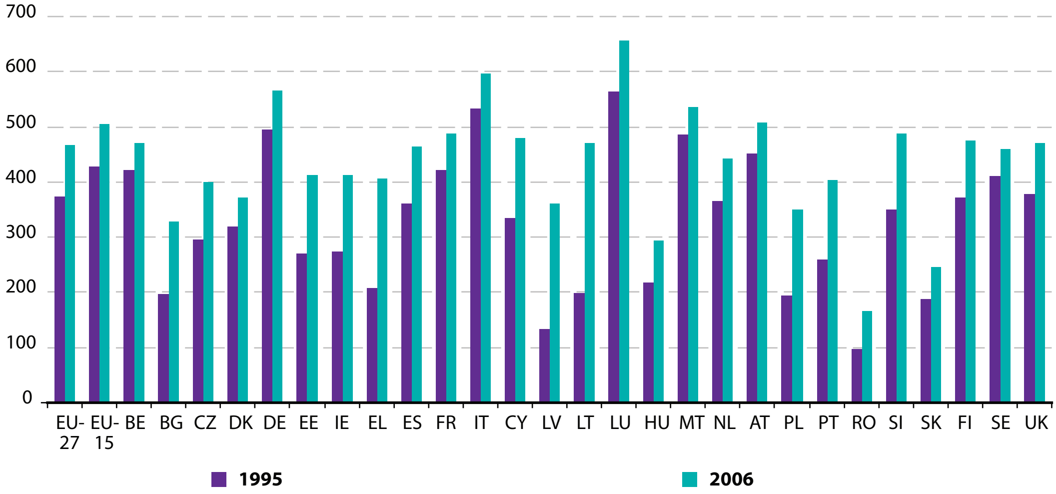
Source: Eurostat (nama_co3_k)

Figure 1.10 : Household expenditure in public and private transport, EU-27 and EU-15 *(billion EUR)*



Source: Eurostat (nama_co3_k)

Figure 1.11 : Motorisation rate in the European countries *(number of passenger cars per 1 000 inhabitants)*



Source: Eurostat (tsdpc340)

among the EU-27 Member States (nearly three times higher), followed by Lithuania (more than two times) and Poland, Romania and Bulgaria (almost two times). The lowest growth rates are observed in countries that already have relatively high numbers of cars per capita, which can be explained by the fact that households may need one or two cars, but generally not more.

The car is the most widely used mode of transport by road

Table 1.1 presents the different modes of transport by road in passenger kilometres in % in 1995 and 2007 for the EU-27.

The car is by far the most widely used mode of transport in every Member State and its use has expanded at a rapid pace across the European Union. The total number of passenger kilometres travelled by car increases, on average, by 2 % per year.

EU citizens are generally very car-dependant and the personal travel and action radius is high. Trends in the new Member States show that kilometres travelled by car are currently increasing, giving rise to significant pressures on the environment and human health.

In Hasselt (Belgium) people can make use of free public transport by bus. This opportunity has been offered since 1997. Since these measures were implemented, the use of public transport in the city has increased significantly.

London (United Kingdom), introduced a 'congestion charge' of GBP 16 in 2003, along with improved public transport, to discourage the use of private cars in central London during the day. As a result, many commuters switched to public transportation, traffic delays were reduced, average speeds increased and bus services improved. The zone subject to the charge was extended into parts of west London in early 2007 (23). Although not the first scheme of its kind in the United Kingdom, it was the largest when it was introduced and it remains one of the largest in the world.

Worldwide, several cities have referenced the London scheme when considering their own possible schemes. Central city congestion charges have also been used successfully in Norway and Sweden.

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(23) Transport for London (http://www.tfl.gov.uk/roadusers/congestioncharging/).

Table 1.1 : Passenger-km by mode of transport, EU-27 and EU-15 (%)

	Year	Passenger cars	Bus and coach	Railway	Tram and metro
EU-27	1995	80.7	10.5	7.3	1.5
EU-27	2007	82.1	9.4	6.9	1.5
EU-15	2007	83.1	8.7	7.0	1.3

Source: *EU energy and transport in figures — Statistical Pocketbook*, 2009.

There has been a shift from the use of public transport towards the private car in the EU-15 in recent decades. In the new Member States, car travel has increased its share while the share of public transport by bus and rail decreased. An explanatory factor for these trends is the fact that the fares for public transport have increased faster than the costs of private car use.

The increased number of cars leads to an increase of end-of-life vehicles

At the end of their useful life large numbers of vehicles are discarded. Some are left abandoned, others are cannibalised for parts, while a significant proportion is recycled (see the chapter on waste which shows that end-of-life vehicles represent 1.5 to 30 kg per capita in European countries in 2006).

Transport vehicles are an attractive proposition for recycling since vehicles are in general made largely out of steel, and it is generally economical to recycle them even without special requirements to do so. Due to the high metal content, recovery and reuse rates of end-of-life vehicles in European countries by weight is high (*see* the chapter on waste which shows that reuse and recycling (recovery) rates for end-of-life vehicles are above 80 % for most of the European countries in 2006).

However, the remaining materials constituting cars — plastics, laminated compounds, glass and other materials in passenger cars are more difficult to recycle. The non-metal components of cars can present difficulties in implementing the end-of-life vehicles directive. In addition, some toxic substances including heavy metals are used in vehicle construction and need to be disposed of with due care.

An explosion in demand for certain transport services

The end of the 20th century has seen an explosion in demand for certain transport services. Air transport has recorded an even faster growth than car transport, with the number of passenger kilometres increasing at an average annual rate of 5 % (*sources:* European Commission Directorate-General for Energy and Transport, *Energy and transport in figures* and *SiF Transport 42/2009*).

Growth in air transport, which is mostly for business and leisure travel, is particularly rapid in the EU-15.

Hierarchy of transport modes based on their energy-efficiency

The most energy-efficient and affordable transport modes are walking and cycling as they consume no fuel and are, in this respect, the most desirable means of transport for short journeys. Some types of mechanised transport, most obviously water transport and to a lesser extent rail (when heavily used), are, generally speaking, significantly more energy efficient than motorised road transport or aviation.

However, within each mode there is a considerable variation between the energy efficiency of different types of vehicles. For example, large public transport vehicles tend to be more energy efficient per passenger kilometre than small individual vehicles, provided that they are well utilised. Electric trains are usually appreciably more fuel-efficient than diesel trains, while diesel cars and trucks tend to be more efficient than petrol ones. There is an enormous variation between fuel consumption for car travel according to the size, age and type of construction of the vehicles. Newer vehicles tend to be more energy efficient than older ones, but often this benefit is overshadowed by their greater size, weight or power, and they might actually use more fuel than older cars.

The number of passengers travelling together is also important. For example, public transport vehicles do not make efficient use of resources if they carry few passengers. A small car with three or four passengers is a very fuel-efficient means of transportation, while a large vehicle with one passenger is the least fuel-efficient means (per passenger-km). For long-distance travel, such as a family vacation, the family car is more fuel efficient than flying. The passenger car is relatively efficient if it carries four or more passengers.

In general, the sustainable use of transport promotes walking and cycling wherever possible for short journeys and encourages most forms of public transport rather than private cars wherever it is sensible to do so. Consequently, where public transport facilities exist and where fixed infrastructures, such as railways or trams, are in place, it makes good sense to make maximum use of them. It has to be recognised, however, that these modes are not suitable for all journeys and that more affluent households tend to demand greater flexibility in individual transport, at least for certain purposes.

There are many and various policy options for reducing the negative environmental effects of transport. Road pricing, traffic-calming schemes, better provision for pedestrians and cyclists, public transport investment, telecommunications, car sharing, etc. have all been put in place in various parts of Europe; some with success.

Transport infrastructure consumes a significant proportion of land

In urban areas, transport infrastructure in particular consumes a significant proportion of the available land. The competition for land with residential, commercial and recreational demands, as well as between transport modes, can be fierce.

In this context, it is worth noting that roads require significantly more land area to provide the same capacity as railway lines, while air and water transport make far smaller demands upon land area.

The expansion of transport infrastructure is resulting in the fragmentation of natural habitats and affects air quality and biodiversity (see the chapter on biodiversity and land use). Noise is also a problem.

Household energy consumption

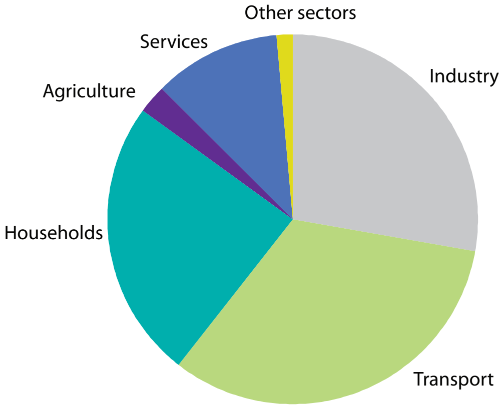
Households are one of the major energy consumers of the economy

Households are one of the major final energy consumers in the EU.

Without taking into account energy consumed by households for transport, the energy consumed by households at home accounts for 25 % of total energy consumption in the EU-27 in 2007 (which can be compared to 28 % for industrial use). In addition, over half of the energy consumed for transport in Europe is consumed by households in the form of petrol or diesel fuel for household vehicles.

The household share of total energy consumption has increased in the past 10 years in almost all the EU-15 countries and in some new Member States.

Figure 1.12 : Final energy consumption by sector, EU-27, 2007 *(%)*



Source: Eurostat (tsdpc320)

The largest household direct use of energy is heating

Without taking into account household transportation, energy consumed by households is used for space heating, hot water, appliances, lighting and air conditioning. This energy is consumed in various forms: fossil fuels for space heating and hot water in most European countries, and electricity for lighting and appliances.

The largest energy-using activity in households is space heating, which is provided mainly by the burning of natural gas, oil or solid fuels in central heating systems, stoves and fireplaces. Households also use gas and oil for water heating, and gas and electricity are used as a cooking fuel. Most other energy applications are based on electricity. Although growing, the role of renewable energy is still limited.

Household energy consumption for heating depends on factors such as the space, the age of the dwellings (thermal efficiency) and the outdoor temperatures.

Energy is being used more efficiently by European households

The annual average energy consumption (from 1996 to 2007) by European households was 297 million toe (24) in the EU-27 and 248 million toe in the EU-15.

In many European countries, the housing space per capita is increasing. More space per person typically leads to higher energy use. Larger households require less energy per person, due to increased sharing of resources and higher density in housing. However, the trend in many countries is towards more numerous but smaller households resulting in increased energy consumption per capita. Although such development leads to increased energy required for heating, the final consumption of energy by households in the EU-15 and EU-27 remained almost stable from 1996 to 2007.

This stabilisation in the energy consumed by European households can be explained by a

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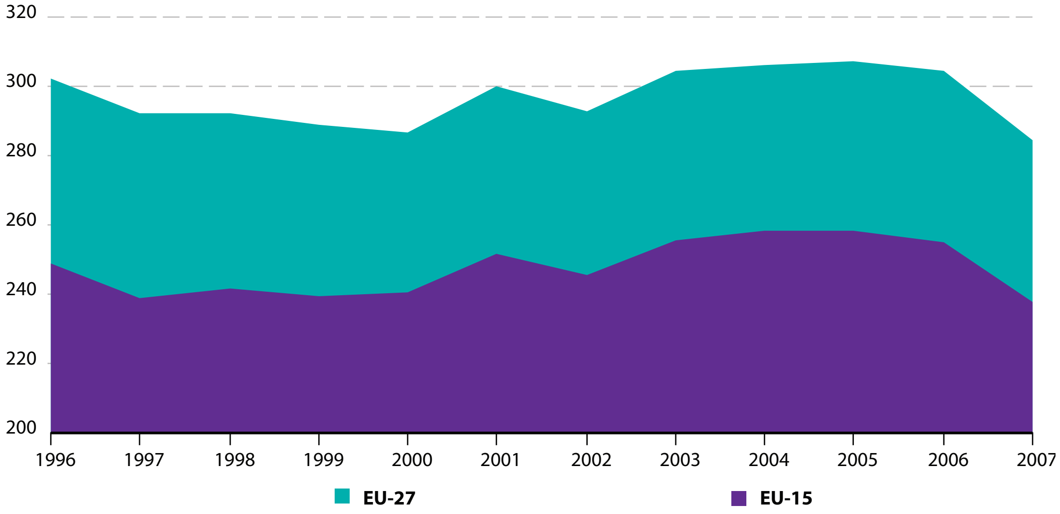
(24) The tonne of oil equivalent (toe) is a unit of energy representing the amount of energy released by burning one tonne of crude oil.

Figure 1.13 : Final energy consumption by households, EU-27 and EU-15 *(million toe)*



Source: Eurostat (tsdpc320)

more efficient energy use due to improvements in the thermal properties of residential buildings.

Another factor that influences household energy consumption is saturation in the ownership and use of conventional appliances as well as increased efficiency of these appliances. Although still increasing in absolute terms, the rate of growth in household energy use due to increases in conventional appliances ownership is slowing because of this saturation.

Figure 1.12 shows the evolution of household expenditure in electricity, gas, liquid fuels, solid fuels and heat energy in the EU-27 and EU-15 from 1998 to 2008.

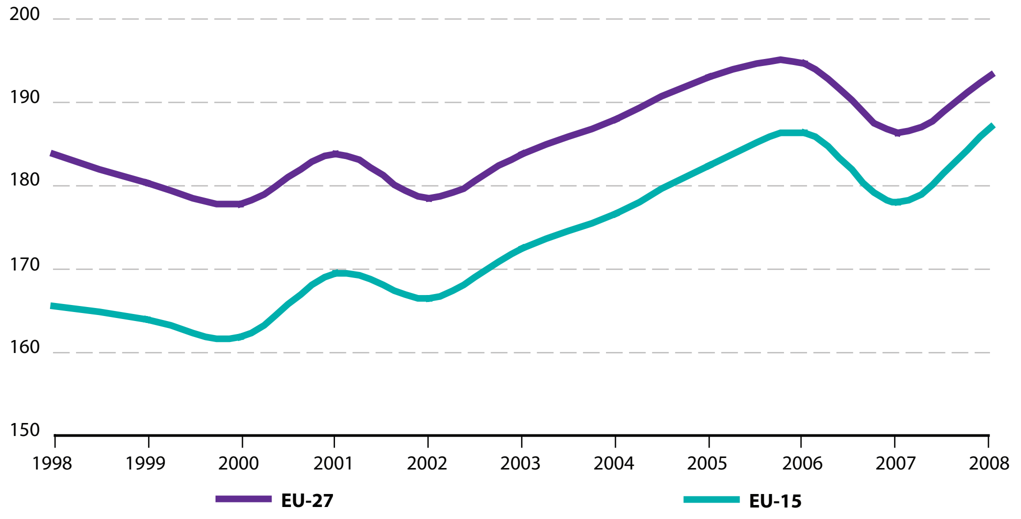
The share of household spending on energy remained almost stable from 1998 to 2008, both in the EU-15 and EU-27, at 3 % of overall household expenditure.

With increasing income, the proportion of expenditure devoted to energy tends to decrease, because energy consumption does not increase significantly once certain needs are covered in housing.

For households, EU-27 electricity prices expressed in euro per kWh increased by 9 % between 2006 and 2007. Among Member States, these prices went up in 23 countries, remained stable in Bulgaria and decreased in Latvia, Cyprus and Slovakia. The largest price increases were observed in the United Kingdom (25 %) and Sweden (16 %). In 2007, electricity prices were highest in Denmark, Italy and the Netherlands, and the lowest prices were in Bulgaria, Latvia and Greece (*source:* 'Electricity prices for EU households and industrial consumers on 1 January 2007', *Statistics in Focus, Environment and energy* 80/2007).

Energy prices have an impact on energy consumption in some countries. In times of increasing energy prices, electricity can make up a substantial part of this expenditure, especially in Nordic countries with climatic conditions that drive up heating bills in winter but also in southern countries with high electricity consumption

Figure 1.14 : Household expenditure in energy, EU-27 and EU-15 *(billion EUR)*



Source: Eurostat (nama_co3_k)

for the operation of air conditioning equipment in summer. Currently, Sweden and Norway have the least reaction to higher household energy prices due to the availability of low-priced electricity and substantial quantities of free firewood.

Directives 2003/54/EC and 2003/55/EC are the key European legislation to establish the internal market for electricity and gas. Since July 2007, all consumers have been free to choose their electricity and gas suppliers.

The source of energy depends on national circumstances

Figure 1.15 shows the final electricity consumption of households per inhabitant in each country in 1996 and 2007 (expressed in toe per 1 000 inhabitants).

At EU-27 level, a consumption of 139 toe of electricity per 1 000 inhabitants was calculated for 2007 (EU-15: 192 toe). Norway, Sweden and Finland show a consumption that is two to three times higher than the EU average, explained by the fact that the most common form of heating in detached houses in these countries is electricity (relatively cheap to install and simple to run). In apartment buildings, district heating systems are increasingly common. Moreover, the climatic conditions in the Nordic countries push consumption up to high levels. Conversely, consumption in Poland, Lithuania, Latvia, Romania and Turkey reached only one third of the EU-27 average.

The largest electricity consumers in EU-27 households are electric heating systems (18.8 %), cold (refrigerator, refrigerator freezer and freezer) appliances (15.3 %), lighting (10.8 %) and water heating systems (8.6 %). Home appliance stand-by consumption accounts for 5.9 % or 47.5 TWh/yr and is the eighth main consumer, consuming more than air conditioning and almost the same share as home computers and dishwashers together (25).

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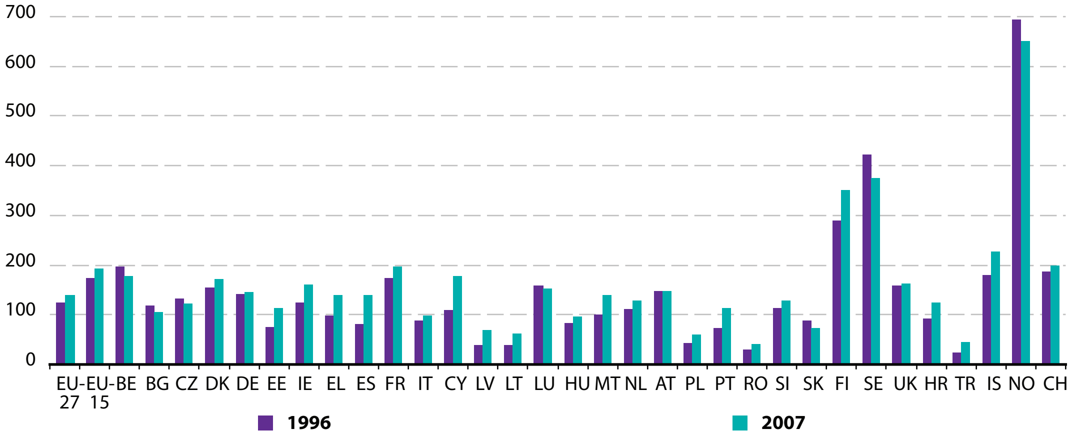
(25) 'Electricity consumption and efficiency trends in European Union — Status report 2009', European Commission. Joint Research Centre, Institute of Energy.

Figure 1.15 : Final electricity consumption of households in European countries
(toe per 1 000 inhabitants)



Source: Eurostat (tsdpc310) and (demo_pjan)

Technological improvements may contribute to increased energy consumption

The breakthrough of the Internet (26) over the last decade has provided opportunities to reduce household energy use for transportation by allowing access to online shopping, telecommuting and teleconferencing. However, there appears to be little evidence to date of such an effect. While some travel has undoubtedly been avoided through such technologies, it also seems that the increased long-range interactions facilitated by new electronic technologies encourage more travel. Globalisation seems to imply both more electronic interactions and more physical exchanges of both people and goods.

Although European households have bought increasing numbers of TV sets, DVD players, PCs, laptops, mobile phones and stereos, many of these goods are produced using fewer resources and in a way that they will consume less energy during their lifetime. However, energy consumption by consumer electronics and new media such as the Internet is steadily growing in Europe (27). While resource and energy efficiency per unit of products is improving in the new manufactured goods and services offered, growth in the total levels of consumption has been so high that in many cases it has outweighed these technological improvements.

In recent years, reductions in particular forms of energy consumption often tend to cause an increase in other forms of energy consumption, resulting in a volume of consumption that outweighs any gains made through the improved energy efficiency. The increase in consumption is caused in these cases by an increase in the use of goods due to their higher efficiency; or, because energy efficiency results in financial savings for a household, money is available for other consumption and can involve some additional (direct or indirect) energy consumption, offsetting the initial reduction to some extent. For example, a consumer shift to smaller and more fuel-efficient vehicles will reduce household expenditures on both vehicles and fuels, making money available for, among other things, more or larger appliances, leisure travel and a larger or second house. Consumers may also respond to greater efficiency by reducing conservation efforts, such as leaving energy-efficient light bulbs on rather than turning them off whenever they are not needed, using more energy by increasing the temperature for heating, or using energy-efficient air conditioners more often. However, in these examples, much also depends on how far lower energy prices are passed on to consumers, which is, in turn, a function of market structure and regulation.

Household emissions

The role of households in climate change

Figure 1.16 shows the direct greenhouse gas emissions released by EU-27 households for heating, transport and other uses in 2006.

As shown above, in almost all countries, people travel more than ever before, and increasingly by private car. One of the main impacts of increasing transport levels, particularly the use of private vehicles, is increased fuel use and therefore increased emissions of carbon dioxide, a greenhouse gas that contributes significantly to climate change. Over half of the energy consumed for transportation in Europe is consumed by households in the form of petrol or diesel fuel for private vehicles. These forms of energy release considerable amounts of greenhouse gases and made household transport responsible for more than 51 % of total EU-27 household aggregated greenhouse gas emissions in 2006.

An alternative fuel being developed in Europe to replace petroleum-based diesel fuel is biodiesel, produced from plant oil, most commonly rapeseed (canola) oil, but also from soybean and palm

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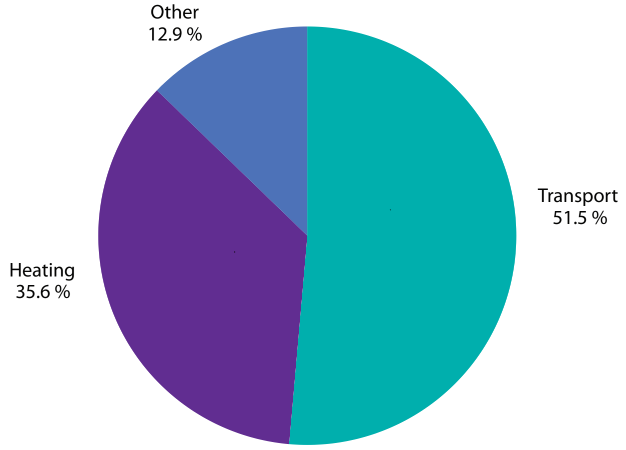
(26) For example, in the EU-27, the share of households with Internet access (be it through dial-up or broadband) increased from 49 % to 54 % from 2006 to 2007 and the percentage of households that use broadband to access the Internet increased from 30 % to 42 % over the same period. In many countries, households that do not have Internet access are a result of the lack of infrastructure in rural areas (*source:* Eurostat, ICT statistics).

(27) http://ec.europa.eu/energy/efficiency/labelling/labelling_en.htm

Figure 1.16 : Direct greenhouse gas emissions from households by consumption category, EU-27, 2006 *(CO$_2$ equivalents for three gases: CO$_2$, CH$_4$ and N$_2$O)*



Source: Eurostat (env_ac_ainacehh)

oil and biomass waste such as straw. Biodiesel, if grown sustainably, can reduce net CO$_2$ emissions compared with fossil fuel diesel, but it may compete with other uses of agricultural land. Used vegetable oil from food processing is also being used as diesel fuel and is more economical than new biodiesel, but the supply is too limited to have a substantial impact on fossil fuel consumption. Recently, concerns have been raised that increasing production of biodiesel through expansion of cultivated land could increase the release of CO$_2$ and N$_2$O (another greenhouse gas) from deforestation and peat bog degradation and that extensive monoculture biofuel production could threaten the agricultural production of food crops as well as agricultural biodiversity.

European households are contributing to greenhouse gas emissions — 36 % of the total greenhouse gas emissions in EU-27 in 2006 — also as a result of energy use for heating.

There are great differences between countries in greenhouse gas emissions related to the heating of households. This is due to the fact that CO$_2$ emissions associated with household energy consumption depend not only on the amount of energy consumed, but also on the source of this energy. In particular, if electricity is derived from renewable sources or from nuclear energy, there may be no CO$_2$ emissions resulting directly from electricity consumption (although there may be some indirect fossil fuel consumption in the energy infrastructure). The climate impact of household electricity consumption will therefore be quite different in Norway, which generates over 98 % of its electricity from hydropower, and in the Netherlands, which generates almost 90 % of its electricity from fossil fuels. Among fossil fuels, natural gas emits less CO$_2$ per unit of energy than oil, which emits less than coal. While some renewable energy is generated by households, most non-fossil fuel power, particularly nuclear and hydropower, is generated by utilities. The relationship between CO$_2$ emissions and household energy consumption is therefore complex and is, to a substantial extent, though not entirely, outside the control of the household. Impact on climate change from heating depends more on the national or local energy supply situation. Households can improve the energy

efficiency of their homes through insulation and reducing drafts, and can reduce consumption by turning off electrical appliances and lighting when not in use.

Energy gains are being offset by changes in behaviour

Energy consumption for transportation is high, and so are the associated carbon emissions, despite some improvement in the fuel-efficiency of vehicles. Almost all vehicles use fossil fuels, so CO_2 emissions are directly related to fuel consumption. Many Europeans buy heavier cars equipped with more energy-consuming features such as air conditioners and electronic devices. Although cars have generally become more energy efficient, the growth in transport demand and the increased use of heavy and relatively fuel-inefficient cars has outweighed these improvements. This has resulted in a net increase in greenhouse gas emissions from transport over the past decade.

Regulation (EC) No 443/2009 setting emission performance standards for new passenger cars requires a fleet average emission of 130 g CO_2/km for new passenger cars to be fully achieved by 2015.

The majority of Member States have introduced CO_2 emission-based vehicle taxation schemes, while others have adopted or are considering specific incentive schemes, many of them financial, to encourage consumers to opt for electric vehicles ([28]).

An increasing share of emissions from air transport

Energy consumption and the associated emissions of greenhouse gases from personal travel by air are a significant source that can contribute to climate change.

Although this energy consumption and its associated emissions are not attributed to households (but to the transport sector), the rapidly increasing number of households travelling by air and the longer distances to destinations are increasing the share of total greenhouse gas emissions from air transport. Also, because emissions from air transport are at higher altitudes, their potential impact on climate change is more severe (the IPCC has estimated that the climate change impact of air transport is 2.7 times the impact of its CO_2 emissions alone).

A recent movement to mitigate the climate impact of air travel has been the sale of CO_2 offsets, by which travellers can pay a voluntary fee or surcharge based on the distance travelled to fund measures such as afforestation to absorb the CO_2 generated by their travel, or renewable energy generation to replace fossil fuel energy.

Household air emissions are mainly associated with the combustion of fossil fuels

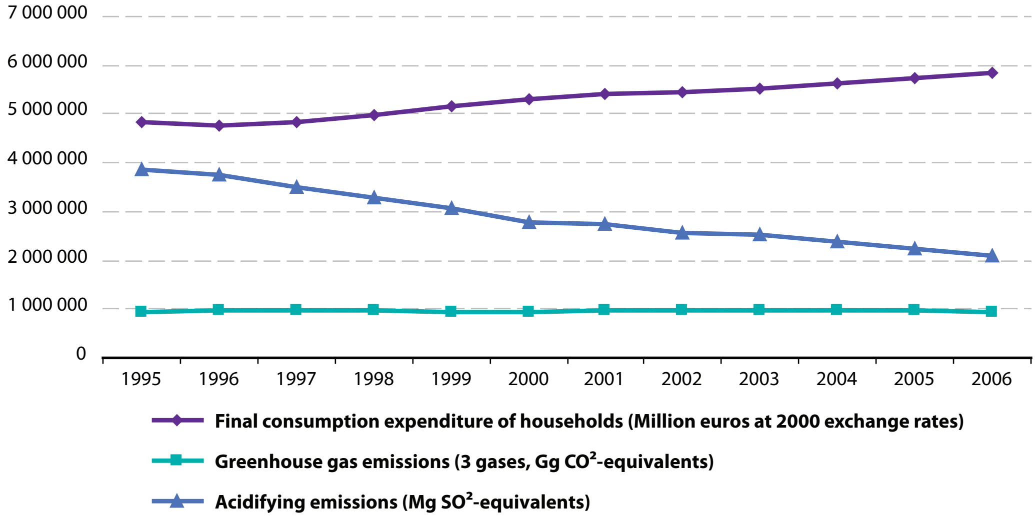
In Europe, households' share of total energy consumption has increased in the past 10 years in almost all EU-15 countries and in some new Member States. This increase is mainly because of the increases in fuel consumption for transport (*source:* Eurostat (tsdpc320)).

In terms of households' contribution to greenhouse gas emissions and acidification emissions, an increasing share of energy has come from renewable sources, offsetting the increase in energy use, so that greenhouse gas emissions from household consumption have been relatively stable between 1995 and 2006.

Emissions of other air pollutants from households are also due primarily to the use of automobiles. Vehicles that burn fossil fuels give rise to emissions, not only emissions of greenhouse gases but also air pollutants such as acidifying substances, ozone precursors and particulates which are emitted from older diesel engines.

([28]) Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee 'A European strategy on clean and energy-efficient vehicles' (COM(2010) 186 final).

Figure 1.17 : Greenhouse gas emissions and acidifying emissions from households, EU-27 *(Gg CO_2 equivalents and Mg SO_2 equivalents)*



Source: Eurostat (env_ac_ainacehh)

Generally speaking, more modern vehicles tend to be less polluting than older ones due to more sophisticated pollution control technology and the use of cleaner fuels. Mainly due to technological improvements, such as catalytic converters and other technical measures required to meet EU standards, emissions of acidifying substances from households have fallen in the EU-27 from 1995 to 2006. Fewer people per car and speed are, however, factors generating increased emissions of greenhouse gases and air-polluting substances.

Energy taxes are among the instruments used in the Member States for climate protection in the EU (see the chapter on environmental taxes which shows that in most of the EU countries for which data are available, households pay between 20 and 50 % of energy tax revenue).

Bicycles can be an effective means of reducing fuel consumption, traffic congestion and air pollution, while improving public health. Improving the attractiveness of environment-friendly, non-motorised vehicles such as bicycles has had some success in some countries, but in the majority of European towns, people use their car to go to work (29) and then continue on to a sports centre rather than using a bicycle to go to work and get exercise from that activity.

Awareness-raising campaigns are being organised throughout Europe on car-free cities, car-free days, mobility weeks, car sharing, etc. to reduce air pollution.

Household use of water

Water is a limited natural resource, a basic need, and essential to the survival of life on Earth.

Although figures vary, it is safe to say that the average use of water by someone living in the European Union is approximately 200 litres per person per day (which equals to 20 10-litre buckets of water). Though some households use rain or groundwater for some purposes like gardening, most of these

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(29) European Commission, 'State of European cities report — Adding value to the European Urban Audit', 2007.

200 litres comes from tap water use. Compared with previous decades, in many households clothes get washed more frequently, people bathe or shower more often, cars get washed, lawns are watered and swimming pools are filled.

High water abstraction rates lead to water resource depletion

Figure 1.18 shows the share of water abstracted by public water supply for urban use in European countries (latest year available) by calculating the share of water used by households and services (and some industries) of the total water abstracted.

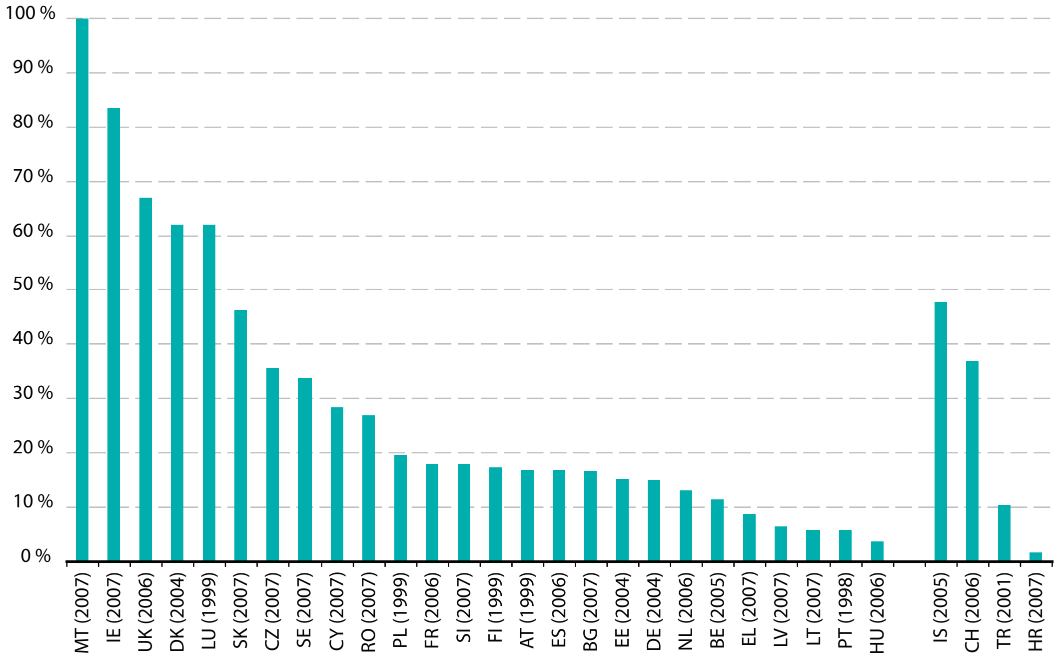
The figure shows that the proportion of water abstracted for households and services (including some industries) ranges from about 2 % to 10 % in Croatia, Hungary, Portugal, Lithuania, Latvia, Germany and Turkey to more than 60 % in Luxembourg, Denmark, the United Kingdom, Ireland and Malta.

Most of the water is used by households for bathing, showering, flushing toilets, running washing machines and dishwashing, drinking and cooking, gardening and washing cars.

Water use is not evenly distributed over time as households tend to demand more water in hot and dry periods. There are also seasonal variations, due to tourism, that influence the amount of water used at a particular time.

Population distribution and density are key factors influencing the availability of water resources. Increased urbanisation concentrates water demand and can lead to the overexploitation of local water resources. In some south European urban areas, water demand and abstraction can be very high compared to the resources available

Figure 1.18 : Water abstracted by public water supply for use in households, services and some industries in European countries, latest available year *(% of total gross abstraction)*



Source: Eurostat (ten00014)

(see the chapter on water, which shows, by means of the water exploitation index which countries put most stress on their water resources).

Basic water-using amenities are available in most European households

Higher standards of living are changing water demand patterns. This is reflected mainly in increased water use for personal hygiene. More than 90 % of the European population has showers and/or baths for daily use and indoor flushing toilets (30).

Most households also have a washing machine. In most west European Member States, the proportion is also 90 % or higher (*source:* Eurostat SILC (ilc_mddu04)).

European households rely on public water supply

Public water supplies are used by households, services and some industries. In many European countries, they rely heavily on groundwater.

The proportion of the population with access to piped water in the home supplied from a public system is presented in the chapter on water. In almost all the EU-15 countries, close to 100 % of the population have had access to public water supply since the 1990s.

In most of the new Member States access remains low (with the exception of Bulgaria), albeit rising, ranging from 49 % in Romania to 76 % in Lithuania.

The drinking water directive (80/778/EEC) and its revision (98/83/EC) specify quality standards for water intended for drinking and use in food or drink production. The standards are backed up by monitoring and legal enforcement, and regulations also govern the quality of surface water abstracted for potable supply and the extent of treatment required.

Domestic water use in west European countries is high

Water use by services and households (including some industries) per person and per year is high in several southern Member States and several Nordic countries. Southern countries all record high use whilst use in more centrally located countries and the Baltic Member States is below this level.

The use of publicly supplied water in Europe ranges from, on average, 40–50 m^3 per person per year in some new Member States to 60–80 m^3 in some central and northern EU Member States and more than 100 m^3 in some southern EU Member States and United Kingdom.

In general, west European countries use more public water per capita than the new Member States.

Data from 1996 to 2007 reflect that public water use per person has decreased in all regions of Europe in the past decade (*source:* Eurostat (ten00014)). (More details can be found in the chapter on water.)

Water expenditure varies between countries

Figure 1.19 shows the evolution of household expenditure per capita in water supply by country in 1998 and 2008 (euro per inhabitant and per year).

Households in Mediterranean countries and new Member States have below-EU-27-average expenditure per capita, as do countries with abundant water supplies. In contrast, water supply expenditure per capita is highest in north and west European countries such as Austria, Germany and Denmark.

In some countries, water is metered and households are invoiced. The use of metering and water pricing is an example of a measure that could further reduce water use in European countries.

Water use leads to water pollution

One of the most obvious environmental impacts of the household use of water is the generation of

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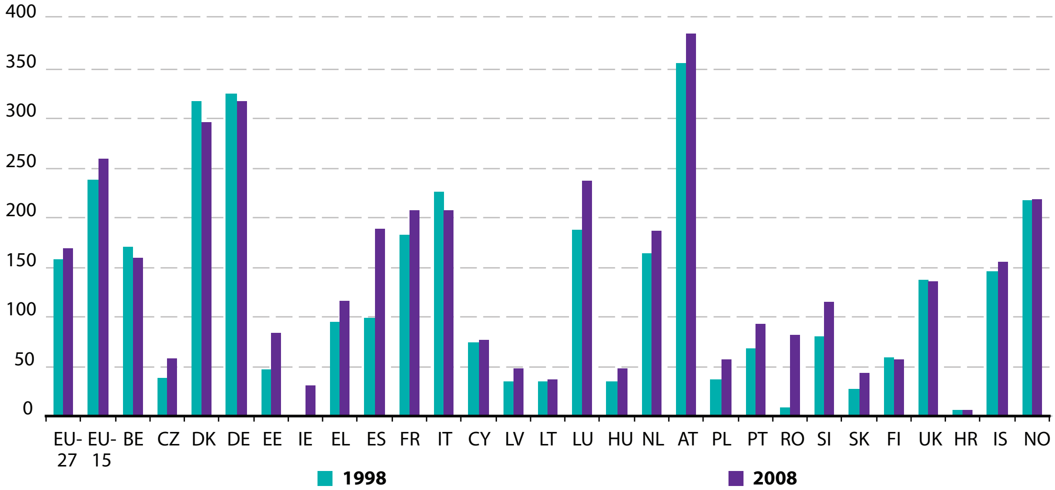
(30) 'Freshwater in Europe— Facts, figures and maps', Division of Early Warning and Assessment, Office for Europe (DEWA~Europe), of the United Nations Environment Programme (UNEP), 2004.

Figure 1.19 : Household expenditure in water supply in European countries *(euro per capita)*



Source: Eurostat (nama_co3_k) and (demo_pjan)

wastewater. To reduce the environmental burden, wastewater from households needs treatment before it is discharged to open waters. Recent decades have seen a leap forward in the development of sewage treatment plants all over Europe, but with large regional differences.

In most countries, municipalities are responsible for wastewater collection and treatment from private households and there are provisions for the construction of houses to ensure the proper discharge of wastewater into the public sewerage system.

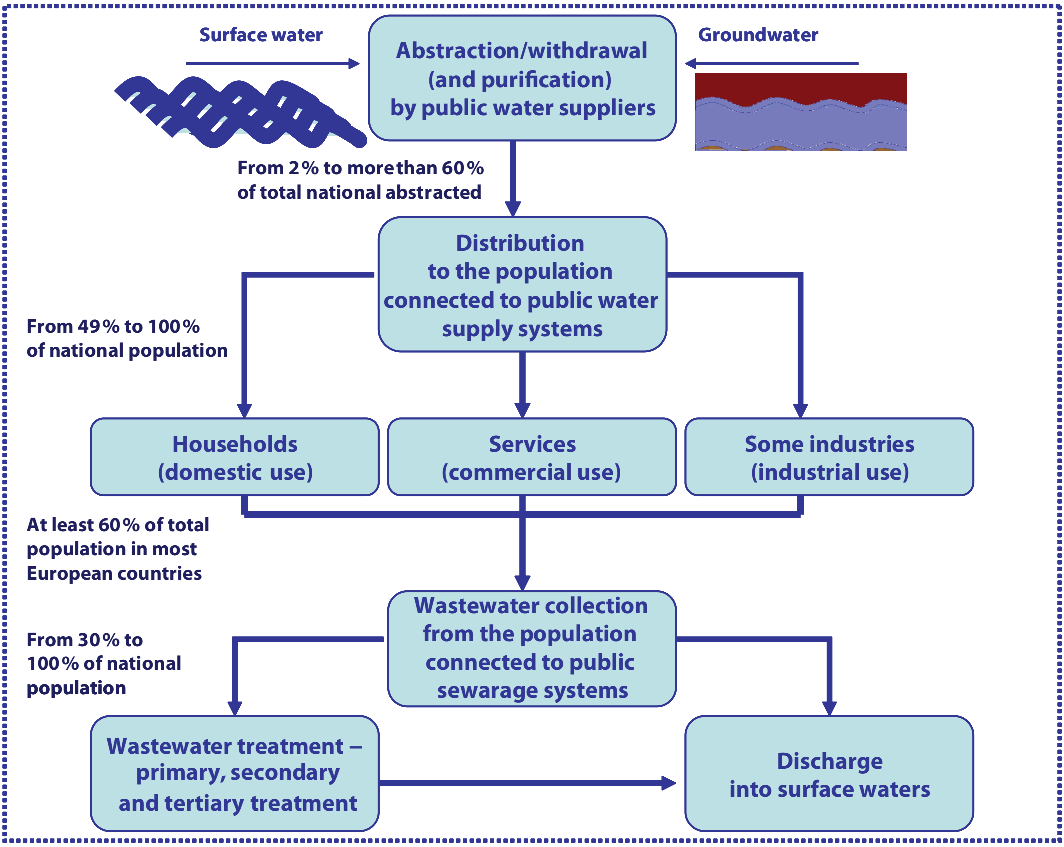
Around three quarters of the European population are connected to public sewerage systems

According to the statistical figures, in 2007, at least 60 % of the total population in most European countries were connected to the public sewage system with only Romania and Cyprus falling below this level (around 40 % and 30 % of the population, respectively). The wastewater collected in sewers is not necessarily connected to treatment plants. It is partly discharged directly into surface waters, for example through outfalls into seas, or, around cities, into rivers.

Not all collected wastewater is treated

In many European countries, the majority of public sewerage involves treatment. In these countries, (e.g. some EU-15 countries such as the United Kingdom) wastewater from households is collected by public sewage systems and almost all the wastewater collected is diverted to sewage treatment plants. At the other extreme are a few Member States like Romania and Malta, where, in 2007, almost 70 % and 90 % of the population, respectively, were connected to a public sewerage system in which wastewater was still not being treated (*source:* Eurostat (env_watq4)). However, Malta is building three treatment plants which will be in operation by 2011 and will increase the proportion of the population connected to wastewater treatment systems to 100 %.

A clear difference can be observed between the EU-15 countries and the new Member States in the proportion of the population connected to wastewater collecting systems and wastewater treatment systems. In the Accession Treaties, the



latter group of countries has been granted a clear and unambiguous transition period, staged from 2005 to 2015, so it can be expected that this difference will decrease in the near future.

The European urban waste water treatment directive (91/271/EEC) requires Member States to provide collection systems and secondary treatment (biological) for all agglomerations of more than 2000 population equivalents when discharging into freshwater, and all agglomerations of more than 10 000 population equivalents discharging into coastal waters. For smaller agglomerations that are equipped with a collection system the treated discharge has to meet the relevant quality objectives.

The chapter on water also shows the percentage of wastewater treated in European countries in 2007 or the latest year available.

In most EU-15 countries, more than 80 % of wastewater is treated in the public wastewater treatment plants, mechanically (primary treatment) and biologically (secondary treatment). Some plants are also equipped with targeted nutrient removal (tertiary treatment).

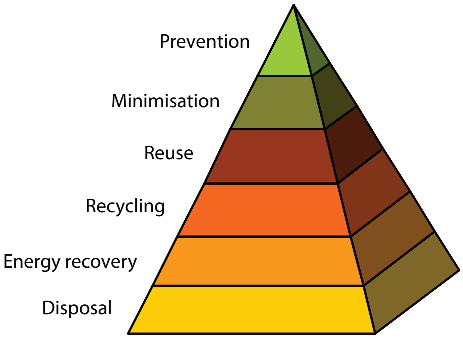
In most of the new Member States the picture is quite different. According to the available data, in the new Member States between 13 % and 74 % of wastewater is treated at least mechanically and biologically.

European water policies place great emphasis on water quality, whether for drinking or other purposes, and Community legislation in these areas dates from the 1970s and 1980s. In 2000, a long-term framework for Community action in the field of water policy was established with broader aims, including the promotion of sustainable water use. Notably, the EU water framework directive promotes a gradual implementation of the use of pricing, alongside other measures, as adequate incentives for consumers to modify their consumption patterns towards a sustainable level with the aim of using water resources efficiently and recovering the full true costs of water services in an equitable manner. These water pricing policies should be implemented by 2010. Most countries are progressing towards water pricing systems. The use of pricing to promote sustainable water use presumes that users must pay in relation to their level of consumption and pollution. It also implies that users must pay a fee that covers environmental costs and the depletion of limited resources, as well as the operation and investment costs of the distribution infrastructure.

Household waste

Waste is a material that is thrown away. In many cases what one person discards may be reused by somebody else.

At EU level, the options for dealing with waste are described in the 'waste hierarchy' — with those towards the top of the list more desirable than those towards the bottom.



Prevention, minimisation and reuse reduce the volume of waste generated and thus the volume of waste to be treated.

Recycling recovers materials and makes them into new goods; this can involve turning old material into a new version of the same thing, or materials can be recycled into something completely different.

Incineration may be carried out with or without energy recovery. With energy recovery, it is considered a recovery process. Without energy recovery it is a form of disposal, like landfill.

Waste has many impacts on the environment

Although household waste accounts for only 7 % of total EU-27 waste (*source:* Eurostat ((env_wasgen)), a high proportion is landfilled and recycling rates are low in many countries.

Waste has many impacts on the environment, including pollution of air, surface water bodies and groundwater. Moreover, valuable space is taken up by landfills, and inadequate waste management causes risks to public health. Waste generation and disposal also represent a loss of natural resources. Sound management of waste is needed to protect public health and the environment while at the same time reducing the demand for natural resources.

A big component of household waste is organic waste

Households generated about 215 million tonnes of waste in the EU-27 in 2006, which represents 438 kg per capita (*source:* Eurostat (env_wasgen)). This means that, on average, each person in European households produces 1.2 kg of waste each day.

The annual total of biodegradable (31) waste in the EU is estimated at 76.5–102 million tonnes of food and garden waste included in mixed municipal solid waste (32).

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(31) The biodegradable component of household waste includes mainly kitchen, food and garden waste, paper, card and wood.

(32) 'Green paper on the management of bio-waste in the European Union' (COM(2008) 811 final).

Biodegradable waste decomposes in landfills and produces landfill gas and leachate. One tonne of biodegradable waste produces between 200 and 400 m^3 of landfill gas. According to the Intergovernmental Panel on Climate Change (IPCC), this landfill gas, if not captured, contributes considerably to the greenhouse effect as it consists mainly of methane, which is 23 times more powerful than carbon dioxide in terms of climate change effects in the 100-year time horizon.

The diversion of biodegradable municipal waste from landfill is a key objective under the landfill directive.

The European Union landfill directive (1999/31/EC) aims to prevent or reduce the negative environmental impacts of landfilling waste. The directive requires that Member States reduce the amount of biodegradable waste going to landfill because it decays to produce methane, a potent greenhouse gas that contributes to climate change. Within the landfill directive only 75 % of the 1995 quantities of biodegradable municipal waste are allowed to be landfilled by 2010, 50 % of 1995 quantities by 2013 and 35 % of 1995 quantities by 2020. This is mainly to be achieved by reducing the quantity of organic matter deposited, through measures such as separate collection and recycling of the organic waste stream or pre-treatment of residual wastes before landfilling. Other than incineration or other thermal processes, mechanical biological treatment is playing an increasingly important role. Consequently, the importance of composting and other technologies to deal with this waste stream is growing.

The hazardous component of household waste

Hazardous waste contains substances which, even in small quantities, can be irritant, toxic, inflammable or otherwise harmful. Proper collection and handling of hazardous waste is crucial for protecting the environment and public health.

Around 2.7 million tonnes of household hazardous waste are generated in the EU-27 every year, constituting 1.2 % of total household waste (*source:* Eurostat (env_wasgen)). This is mainly waste from chemical products such as paints, cleaners, solvents, pesticides, medicines, cosmetics, products used for automotive care, etc. and batteries containing heavy metals. Only a small proportion of it is recycled. Most of the hazardous waste currently generated in EU-27 is incinerated.

From an environmental point of view it is important to collect hazardous waste separately, in order to prevent it from ending up in landfills together with the rest of the waste from households.

Waste collection from household to treatment

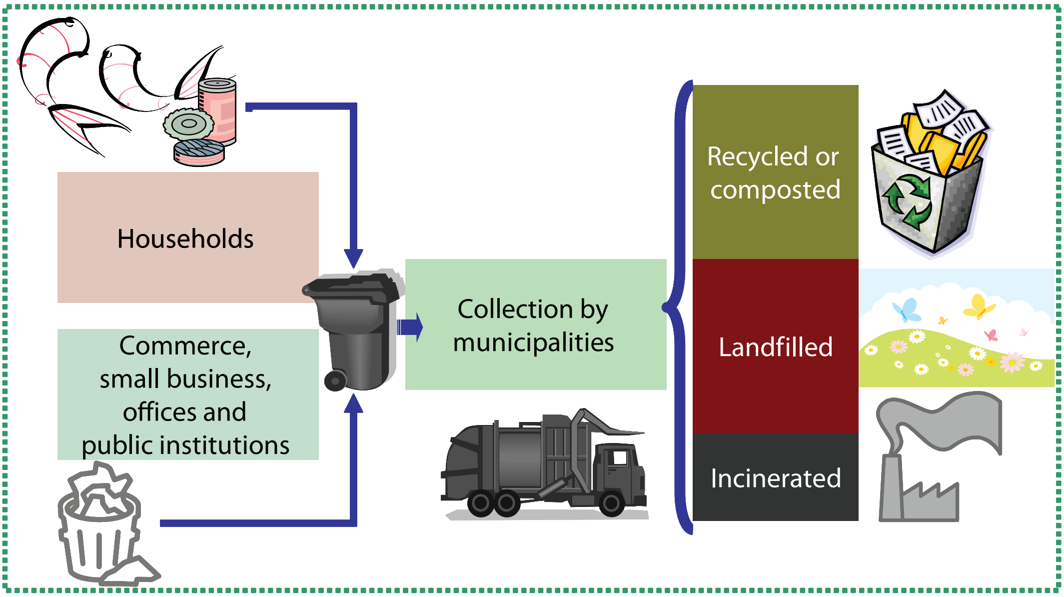
Waste from households is generally collected by local authorities, and increasing numbers of these authorities are introducing source separation systems for recyclables and hazardous waste. In addition, in most European countries households may make special trips to specific sites in order to dispose of particular waste. Local governments also often organise a kerbside collection for bulky waste.

The method used to collect household waste affects both the quality and quantity of waste produced and citizens' participation in recycling schemes. The methods most commonly used to collect waste include kerbside collection of unsorted and sorted waste streams and the 'bring' system for specific waste to local recycling stations.

The collection system for both unsorted and sorted household waste collection varies from one country, region, or city to the next.

Municipal waste is waste collected from municipalities and includes waste from households, commerce, small business, offices and public institutions. Household waste makes up the biggest portion of municipal waste.

In the EU-27, the share of municipal waste recycled has progressively grown from 10 % in 1995 to 22 % in 2008 (*source:* Eurostat (tsdpc210)).



A handful of EU directives exist that set collection and/or recycling targets for waste streams arising from specific products, such as packaging, electronics, cars, batteries and construction and demolition waste. National authorities set corresponding targets at the national level — at times, more ambitious ones than the level set by the EU — and introduce various accompanying measures to increase recycling in the future.

Waste material for recycling needs to be clean and uncontaminated, meaning not mixed with other materials. The yield of recycling can be significantly lowered when the wrong materials are put into the wrong recycling containers. Contaminating collected waste materials in this way can make the whole batch unusable for recycling.

The part of municipal waste landfilled is decreasing

Incineration is widely used for municipal waste in west European countries, while landfill is predominant in the new Member States (see the chapter on waste, which shows that landfilling prevails in many countries, accounting for more than 50 % of the municipal waste treated in 19 out of 27 countries).

By volume, 40 % of the waste collected by EU-27 municipalities (household and services waste) ends up in landfill sites, 40 % was recycled or composted and 20 % incinerated in 2008.

In 2008, EU-27 municipal waste recycling and composting rates increased to 40 % from 16 % in 1995 while waste landfilling rates decreased from 62 % to 40 % (*source:* Eurostat (tsdpc210)).

The increase in recycling rates has slowed the growth rate of waste destined for final disposal, but has not reduced the total volume of waste generated.

The cost of collection and disposal is met in many countries through fees

The cost of collection and disposal of household waste is met in many countries through fees (33). For waste streams under the producer responsibility legislation, the costs for the

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(33) 'Financing and incentive schemes for municipal waste management case studies', Final report to the Directorate-General for the Environment, European Commission.

collection of specific waste fractions are often not borne directly by the municipality (or only partially so). Some countries apply charges for waste by weight, volume or a combination of both. Examples from these countries show that variable charging reflecting the quality and quantity of mixed waste can strongly influence the behaviour of citizens in the source separation of recyclables and waste minimisation. Some European localities have introduced the possibility of fining residents who do not use their recycling facilities. Schemes whereby bins are tagged and monitored are becoming more common as localities, regions and countries seek methods to increase their recycling rates.

The influence of urbanisation on consumption patterns

Recent trends in land use for housing demonstrate that more and more area is used per person and that urban densities are decreasing. This phenomenon is called 'urban or suburban sprawl'. This concept includes a city and its suburbs spreading outwards to its outskirts. It results in a number of disadvantages, among which are long transport distances to work, school and shopping areas, higher car dependence and higher per-person infrastructure costs. It results also in environmental pressures such as loss of farmland, loss of wildlife habitat, increases in car and truck traffic, leading to major increases in air pollution and smog, increases in energy consumption per person for increased petrol, home heating and electricity use, and increases in water consumption for lawn watering and other landscape activities.

The most densely populated countries are Malta, the UK and the Netherlands and the least-populated countries in the EU are the north European countries and the new Member States.

Potential sprawl can be observed in Belgium, Denmark, Italy, France, the Netherlands and Germany.

In 2005, the distribution of households in densely, intermediate and sparsely populated areas was 50 %, 23 % and 27 % in the EU-27 and 52 %, 24.5 % and 23.5 % in the EU-15 (*source:* Eurostat (hbs_car_t315)).

Rural and suburban households are more likely to consume somewhat more energy than urban households, particularly for space heating and transportation, as urban residents are more likely to live in smaller dwellings with smaller appliances and to travel by foot or public transportation.

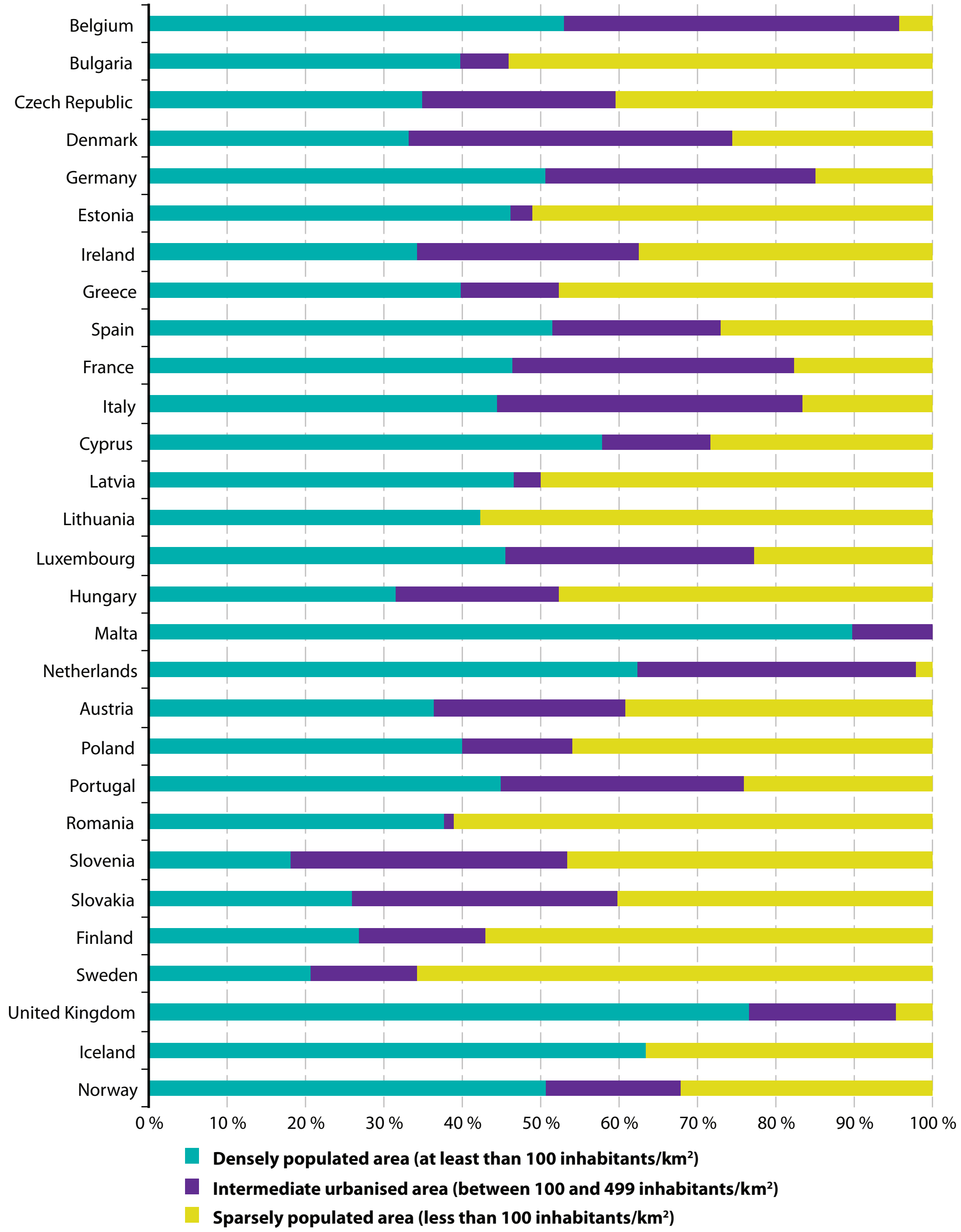
In urban areas, dependence on household cars is a consequence not only of people's lifestyles and consumption choices, but also of land use patterns, infrastructure development and alternative transportation systems.

While urbanisation has been a long-term global trend, urban growth in recent decades has been concentrated in low-density suburbs, where mass transit is not economically feasible or environmentally beneficial if ridership is low. The separation of residential areas from commercial areas has made walking or cycling less convenient.

The level of urbanisation has a strong influence on the patterns and impacts of consumption. Dense urban areas can benefit from more efficient provision of services such as multi-apartment housing, heating, collective transport, or wastewater and waste collection and treatment. On the other hand, in sprawling urban areas the demand for transport can be high and the provision of collective services can become more difficult to organise.

Efficient passenger transport implies land-use patterns that minimise the need to travel long distances. This includes maintenance of densely-populated and thriving urban centres well-served by public transport, while avoiding urban sprawl and out-of-town developments.

Figure 1.20 : Distribution of population by degree of urbanisation in European countries, 2008 *(%)*



Source: Eurostat SILC (ilc_lvho01)

The 'finger plan' or radial approach to urban development can help promote public transit and reduce the need for cars, while also promoting energy-efficient housing. High-density housing sites combined with retail stores are concentrated on axes (fingers) radiating out from the centre of the city, and particularly around stations of rapid transit lines serving the axes, whether subways, light rail or dedicated bus lanes. The land between these axes can be used for parks or other low-density uses. This approach has proven successful in reducing vehicle traffic, energy consumption and air pollution in cities such as Copenhagen.

A car-free housing project in Vienna-Floridsdorf (34) is an apartment complex (including 244 flats of different sizes from 50 to 130 m^2) which was opened in 1999 as a demonstration project for car-free housing on the periphery of Vienna. The apartment complex includes garages for bikes and car-sharing only. The money saved by not providing one parking space per flat was invested in communal areas, such as social rooms and a playground. The project includes an office for teleworkers and freelancers, a fitness room and a distribution/storage room for organic food. Solar energy is used for hot water heating. The apartment building is located near the old and the new Danube and therefore has easy access to recreational areas. It is easy to access the city centre via a nearby subway station. Only 5 % of the trips residents take are by car, 58 % are by public transport, the remainder is walking and cycling.'

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(34) Jan Scheurer, 'Urban ecology, innovations in housing policy and the future of cities: towards sustainability in neighbourhood communities', 2001, pp. 309–318

Varying environmental pressures of products

Indirect household emissions can increase with the rise of income

As shown, through the examination of the impact of households on overall energy consumption and climate change, household consumption involves substantially more energy than the energy consumed directly in households. Energy has been used for the production and distribution of everything that households consume, from appliances to food and cars. This energy 'embodied' in consumer goods, called 'indirect energy consumption' is generally greater than the energy consumed directly. Just as most economic activity is devoted ultimately to private consumption, so most of the national energy supply is devoted, directly or indirectly, to private energy consumption. The relatively small share of national energy consumption that is not associated with household consumption includes energy for government activities such as the military, street lighting, heating and air conditioning of public buildings, public vehicles, schools and hospitals. It should also be noted that, because indirect energy consumption includes energy embodied in imports, total energy consumption, direct and indirect, can be greater than the national energy supply if imported goods and services are more energy-intensive than those exported.

Indirect household energy consumption and its associated emissions increase steadily with the rise of income, with indirect energy embodied in goods and services forming the greatest share.

Households can help reduce national energy consumption, not only by reducing energy consumption in the household, but also by choosing more environmental-friendly goods and services and by recycling materials.

The ecolabel schemes can help to identify green products

Starting with Germany in 1978, a number of countries and regions in Europe have introduced the so-called Type I ecolabelling over the last 30 years. A scheme was also introduced at EU level, often referred to as the EU flower. These volun-

tary national, regional and EU ecolabelling (³⁵) schemes can help consumers to easily identify green products through a symbol of environmental quality.

Before a product is awarded an ecolabel, studies are carried out on its environmental impact over its entire life cycle — from the extraction of raw materials, through manufacturing, distribution (including packaging), use by the consumer and, finally, disposal (the 'cradle to grave' approach). Different types of environmental impacts such as energy consumption, toxicity, resource efficiency and water consumption arising from these stages are considered. A panel of experts and stakeholders representing industry, consumer groups and environmental NGOs discussed the study and came up with a set of criteria. The label is only awarded after verification by an independent body that the product meets these high environmental and performance standards. The label thus goes only to the most environmentally-friendly brands in each product group (products and services that have a reduced environmental impact during their entire life cycle).

The EU ecolabel was established in 1992. Currently it covers around 25 types of products and services, with further groups being continuously added. These include cleaning products,

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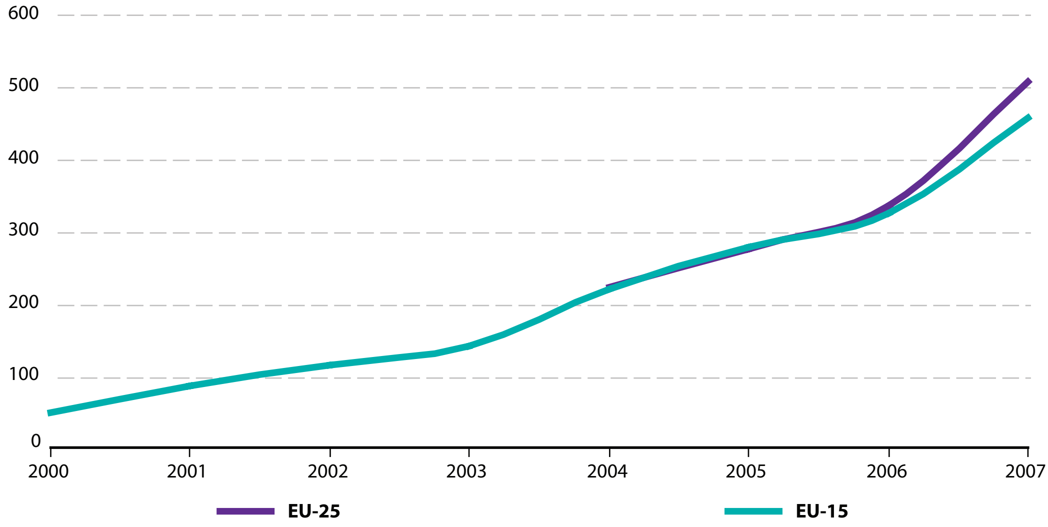
(35) For more information on ecolabels, see also: http://ec.europa.eu/environment/ecolabel/index_en.htm

Figure 1.21 : EU ecolabel awards in EU-25 and EU-15 *(total number)*



Source: Eurostat (tsdpc420)

household appliances, electronic equipment, paper products, textiles, home and garden products, lubricants, and services such as tourist accommodation. The EU ecolabel is recognised throughout the 27 EU Member States as well as in Norway, Liechtenstein and Iceland.

In 2008, 705 ecolabel or ‘EU flower’ awards were assigned in the EU-27. From 2000 to 2007, most of the EU ecolabels were awarded in EU-15 countries.

National, regional and EU ecolabels help purchasers identify products which are less harmful to the environment. They also award producers who produce environmentally friendly products.

Conclusions: The need for sustainable consumption

European households affect the environment through their day-to-day choices of which goods and services to buy and how to use them, where to live, where to work, how to use leisure time and how to travel. Such choices are made within certain boundaries conditioned by urban planning, transport infrastructure and available housing. For example, increased spending on transport has implications for energy use, air quality and climate change. Driving a car or heating the home, for example, give rise to CO_2 emissions directly. Households also contribute to the rise of CO_2 emissions indirectly by purchasing goods and services in which the CO_2 emissions of production, distribution and disposal, are embedded.

Figures show that European households are becoming smaller (fewer people per household). This means, in general, that household members are using more space, more goods and services, more energy and water, and generating more waste and emissions per person.

Most European households have progressively acquired a greater quantity and variety of food from all over the world, more vehicles and more electronic devices. Figures provide evidence of an increase in private car and second home use and ownership, in consumption of electronic consumer goods, in consumption of highly processed and packaged food, and in the increasing generation of household waste.

Household expenditures on food and beverages have increased, but not as much as the total budget. Consequently, the share of household budget spent on food and beverage consumption has decreased. Household expenditures shifted from basic needs such as food and beverages to other consumption categories such as leisure activities or communications.

Household diet choices can significantly influence the use of resources and the environmental effects of the production, retail and distribution phases of products’ life cycles. For example, consumers can choose to consume more organic food, adopt a less meat-intensive diet, or choose local fruit and vegetables in season. By choosing food products with a low environmental impact (e.g. locally grown fruits and vegetables in season rather than off-season fruits and vegetables transported over long distances) consumers can achieve a reduction in the indirect environmental impacts of their food consumption.

The energy efficiency of European houses has increased, mainly as a result of the use of improved insulation and energy efficiency of heating systems and conventional appliances. On the other hand, Europeans live in larger homes and buy and use an increasing number of electronic devices. As a result, final energy consumption from households has remained relatively stable although electricity consumption has increased in most European households.

European households are very car-dependent and travel progressively larger distances. Fuelled transport gives rise to pollution and private cars and air transportation are the most energy-intensive and fastest-growing forms of transportation used by European households. Regulations

which promote improvements in technologies and fuel efficiency have been successful in reducing emissions of certain air pollutants such as acidifying substances but much can still be done to steer mobility behaviour in a more sustainable direction.

Whether household environmental pressures are direct or indirect does not necessarily indicate whether households can have full control over them. For example, the energy required for space heating will depend largely on the construction of the dwelling, as well as on the temperature at which the space is maintained. The possibility of private citizens exerting influence on these issues varies. Energy consumed by personal travel, and the resulting CO_2 emissions, depend on the fuel, the vehicle, the distance travelled and the number of passengers travelling together. The amount of fuel consumed also depends on the driving patterns of the household, which in turn depend on urban planning, infrastructure and alternative transportation systems. In many cases, households have few alternatives to private cars for commuting, shopping, visiting and other errands. For long distance travel, energy consumption depends primarily on the destination (distance) and secondarily on whether the trip is made by car (direct household consumption) or aircraft (indirect). In the case of lighting, the number of lights, the wattage, the efficiency and the amount of time they are on are determined by the household. On the other hand, the electrical energy consumed by a refrigerator is determined primarily by the efficiency built into the appliance, not by how it is used. However, a household purchasing a new refrigerator may be able to consider energy efficiency among other characteristics if appliances have energy efficiency labels. Energy conservation measures and the associated emissions reductions that households can control include building insulation, buying fuel-efficient vehicles or using public transport, buying more efficient lighting, using fuel wood for heating, and reducing stand-by power consumption.

Wastewater from households represents a significant pressure on the environment. Many EU countries have implemented the urban waste water treatment directive, which prescribes the level of treatment required before discharge. In northern and western Europe, most of the population is now connected to wastewater treatment plants and many have tertiary treatments, which remove nutrients and organic matter. However, the percentage of the population connected to wastewater treatment is still relatively low in central and eastern Europe, although it is increasing.

European household consumption can be a major cause of increased environmental pressures affecting the environment through the use of its natural resources and through the generation of unwanted by-products such as greenhouse gas emissions, household waste or wastewater. However, household consumption can also provide the opportunity for the development of goods and services that are more ‘environmentally-friendly’ if demanded by consumers (for example, ecolabelled products, more energy-efficient appliances and less packaging). Organic food labelling is a policy measure that helps consumers to take informed decisions about what to buy to enable more sustainable food consumption. Also, the Energy Rating label enables consumers to compare the energy efficiency of appliances. Products that meet defined ecological and performance criteria are awarded with ecolabels at national, regional or EU levels and can be identified according to the logos used on packaging. These logos provide consumers with simple and straightforward information on the environmental quality of products to help them make informed environmental choices in their purchases.

In the EU-15, the rise in income levels and household expenditure tend to lead to an overall rise in environmental impacts related to household consumption. Households become smaller with the increasing per capita living area and more and more resources to fulfil daily needs.

Further information

Eurostat main tables and database

Consumption expenditure of private households (hbs), see

Mean consumption expenditure of private households (hbs_exp)

Structure of mean consumption expenditure (hbs_struc)

National accounts (including GDP) (t_na), see:

Annual national accounts (t_nama)

National accounts detailed breakdowns (by industry, by product, by consumption purpose) (t_nama_brk)

Final consumption expenditure of households by consumption purpose (COICOP) (t_nama_co)

Household expenditure per inhabitant, by category (tsdpc520)

Final consumption expenditure of households by consumption purpose — COICOP 2 digit — aggregates at current prices (nama_co2_c)

Final consumption expenditure of households by consumption purpose — COICOP 2 digit — volumes (nama_co2_k)

Final consumption expenditure of households by consumption purpose — COICOP 2 digit — price indices (nama_co2_p)

Final consumption expenditure of households by consumption purpose — COICOP 3 digit — aggregates at current prices (nama_co3_c)

Final consumption expenditure of households by consumption purpose — COICOP 3 digit — volumes (nama_co3_k)

Final consumption expenditure of households by consumption purpose — COICOP 3 digit — price indices (nama_co3_p)

Living conditions and welfare (livcon), see:

Income and living conditions (ilc)

Living conditions (ilc_lv)

Housing conditions (ilc_lvho)

Distribution of population by degree of urbanisation, dwelling type and income group (Source: SILC) (ilc_lvho01)

Eurostat dedicated section

Living conditions and social protection, see:

Household budget surveys

Income, social inclusion and living conditions

Eurostat publications

Statistics explained: Household consumption patterns, August 2009

Statistics explained: Household consumption expenditure, September 2008

Statistics explained: Living conditions statistics, September 2009

Statistics explained: Housing indicators, June 2009

Statistics explained: Housing statistics, September 2009

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Methodological notes

Household expenditure is the value of goods and services used for household needs and classified by 12 main headings of COICOP (Classification of Individual Consumption by Purpose, see also Commission Regulation (EC No 113/2002 of 23 January 2002).

COICOP categories presented are as follows:

Food and beverages: 01 — Food and non-alcoholic beverages plus 02 — Alcoholic beverages, tobacco and narcotics.

Clothing: 03 — Clothing and footwear.

Housing: 04.1 — Actual rentals for housing plus 04.2 — Imputed rentals for housing plus 04.3 — Maintenance and repair of the dwelling.

Water supply: 04.4 — Water supply and miscellaneous services relating to the dwelling.

Energy: 04.5 — Electricity, gas and other fuels.

Furnishings: 05 — Furnishings, household equipment and routine household maintenance.

Household appliances: 05.3 — Household appliances.

Health: 06 — Health.

Transport: 07 — Transport.

Personal transport: 07.1 — Purchase of vehicles plus 07.2 — Operation of personal transport equipment.

Public transport: 07.3 — Transport services.

Communication: 08 — Communication.

Recreation and culture: 09 — Recreation and culture.

Education: 10 — Education.

Restaurants and hotels: 11 — Restaurants and hotels.

Catering services: 11.1 — Catering services.

Miscellaneous: 12 — Miscellaneous goods and services.

2

Economy-wide material flows

Understanding material flows in Europe

A great deal is known about the way in which money flows through economies by using economic data from the national accounts — but this does not provide information about the physical flows of materials. Using material flow analysis (MFA) techniques, a better understanding of the physical materials needed in economies can be obtained. The basic idea behind the material flows approach is 'what goes in, comes out.'

MFA can have different levels of focus. Sometimes the focus is on individual substances or groups of substances which are known to be particularly dangerous to human health or eco-systems. One example of this type of analysis is the chemicals index (see the chapter on chemicals). Another focus is on the economy as a whole.

When looking at a national economy as a whole, MFA enhances understanding of the material basis of the economy and can help to identify inefficient uses of natural resources.

Typically, as economies grow, more materials such as energy, construction materials, and metals are needed. By using materials more efficiently and getting more economic value out of each unit used, the growth rate of the use of materials can be less than the economic growth rate. When the growth rate of material use is less than the economic growth rate, this is called 'decoupling' material use from economic growth.

Decoupling economic growth from environmental degradation is one of the main objectives of the EU sustainable development strategy (European Commission 2001) under the key challenge 'sustainable consumption and production'. Additionally, under the key challenge 'conservation and management of natural resources' the strategy calls for 'improving resource efficiency, to reduce the overall use of non-renewable natural resources and the related environmental impacts of raw materials use'. The European Union's strategy for smart, sustainable and inclusive growth (COM(2010)

2020) calls for seven flagship initiatives, one of which is a 'resource-efficient Europe' to help decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernise the transport sector and promote energy efficiency. One of the most pressing objectives for the new Commissioner for the Environment is to develop good indicators for resource efficiency (Potočnik, 2010).

Domestic material consumption (DMC) measures the total amount of materials directly used by an economy and is defined as the annual quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports. The DMC indicator provides an assessment of the absolute level of the use of resources. The basic idea of material flow analysis is what goes in equals what comes out. In other words, accumulated materials (i.e. physical stocks) will eventually turn into emissions and wastes. Using this reasoning, DMC also indicates the waste potential of a given region.

This chapter on economy-wide material flows describes trends for the EU-27 over time, and, for resource productivity for the EU-27 and the productivity for industries responsible for domestic extraction, includes analysis of the influence of climate factors on domestic biomass harvest, studies the role of foreign and domestic resources and draws conclusions with regard to further development of the accounts to improve interpretability.

At the end of the chapter further information is provided on methodology, main tables, data availability and key publications of Eurostat and at EU level as well as links to related international activities.

Material flows trends

Europe requires more materials

From 2000 to 2003, the domestic material consumption (DMC) (36), a measure of the total amount of materials directly used by an economy, of the EU-27 declined slightly from 7.6 billion to 7.4 billion tonnes but rose again to 8.2 billion tonnes by 2007, a 7.8 % increase from 2000 (Figure 2.1). Domestic extraction used (DEU) makes up the larger part of DMC, 85 %, with the physical trade balance (PTB) (imports less exports) accounting for roughly 15 %.

From 2000 to 2003, the DEU decreased from 6.6 billion to 6.3 billion tonnes but then increased to 6.9 billion tonnes by 2007, which is 4.9 % higher than in 2000.

In contrast, the PTB rose constantly over 2000 to 2007 from 1.0 billion to 1.3 billion tonnes, an increase of 26.5 %. This means that the EU-27 is a net importing region from the rest of the world.

Since domestic extraction is increasing it can be interesting to see what the major components of this extraction are. Figure 2.2 shows that in 2007, the main materials extracted from the national territories of the EU-27 were biomass (24 %) including grazed biomass (4 %), non-metallic minerals including sand and gravel (61 %), metal ores (2 %) and fossil energy materials/carriers (13 %). Please note that water flows are excluded from economy-wide material flow analyses. The flows of water would be so large that all other materials would not be seen.

From this breakdown, the importance of the construction industry — which uses much of the sand, gravel and other non-metallic minerals — can be seen. Thus when there are large construction projects, such as building new airports, tun-

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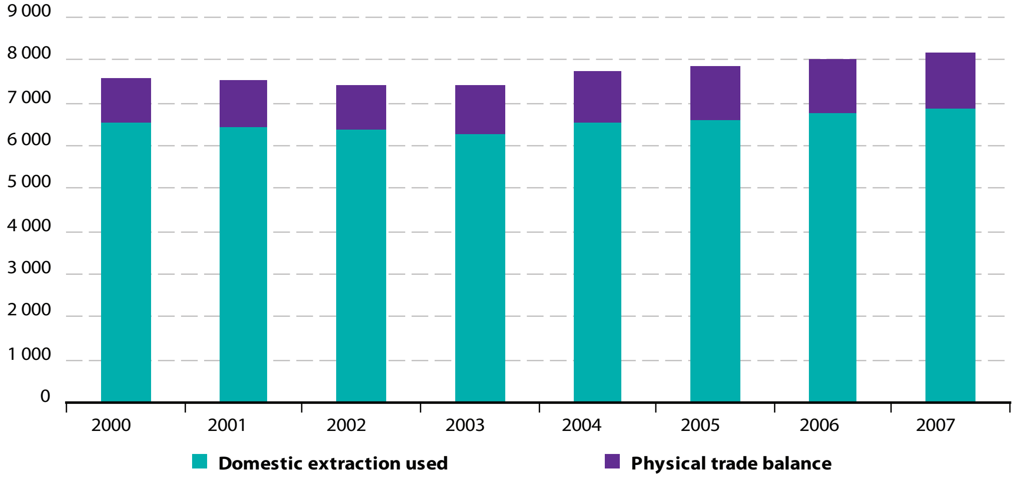
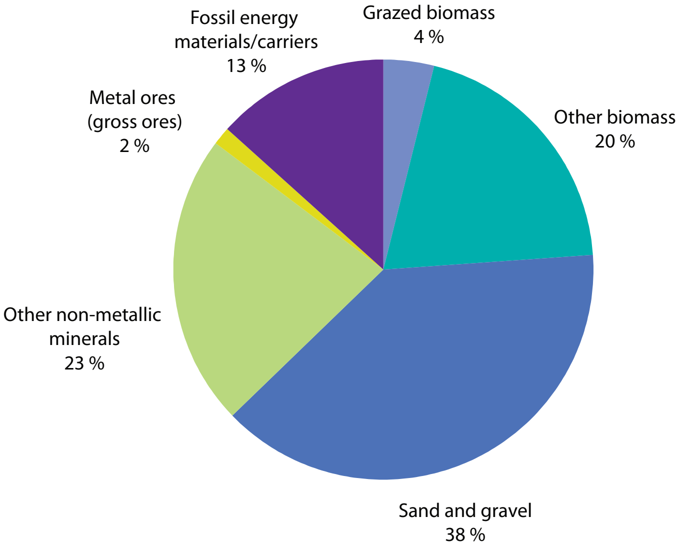
(36) Domestic material consumption (DMC) is made up of domestic extraction used (DEU) plus the physical trade balance (PTB = imports minus exports).

Figure 2.1: Domestic material consumption (DMC) by components — domestic extraction used (DEU) and physical trade balance (PTB), EU-27 *(million tonnes)*



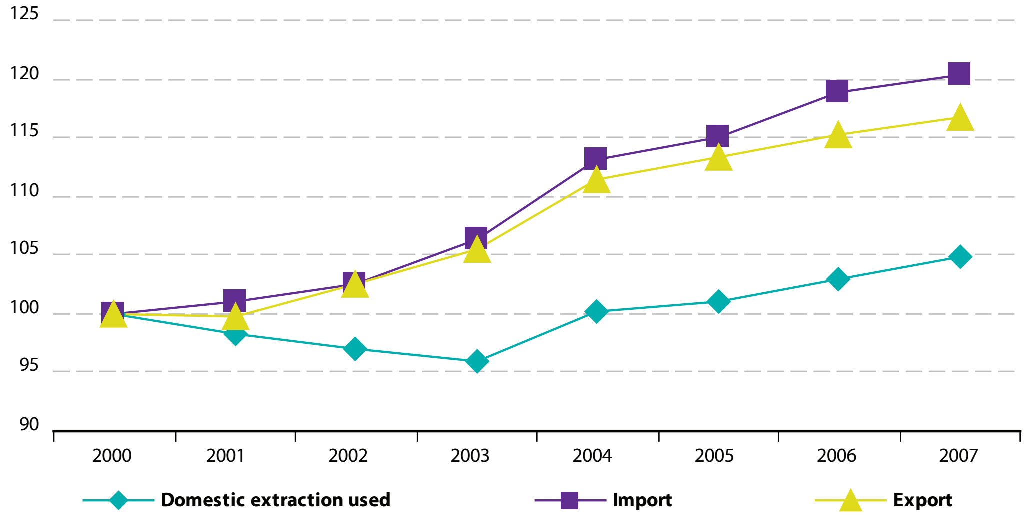
Source: Eurostat (env_ac_mfa)

Figure 2.2: Domestic extraction used (DEU) by major components, EU-27, 2007 *(%)*



Source: Eurostat (env_ac_mfa)

Figure 2.3: Domestic extraction used (DEU), imports (IMP) and exports (EXP), EU-27 *(index 2000 = 100)*



Source: Eurostat (env_ac_mfa)

nels, dykes, highways and large buildings, there can be a visible impact on the figures.

Relationships between domestic extraction and foreign trade

From 2000 to 2007, the domestic extraction used (DEU) in the EU-27 increased a moderate 5 % (Figure 2.3). By contrast, international trade of the EU-27 increased substantially, with imports increasing by 20 % and exports increasing by 17 %.

Big differences between countries

Direct material input (DMI) measures the direct input of materials for use into the economy, i.e. all materials which are of economic value and are used in production and consumption activities (excluding water flows). DMI equals domestic (used) extraction plus imports. The relation of domestic material consumption (DMC), which equals DMI less exports, to DMI indicates to what extent material resource inputs are used for own domestic consumption or are exported for consumption in other economies.

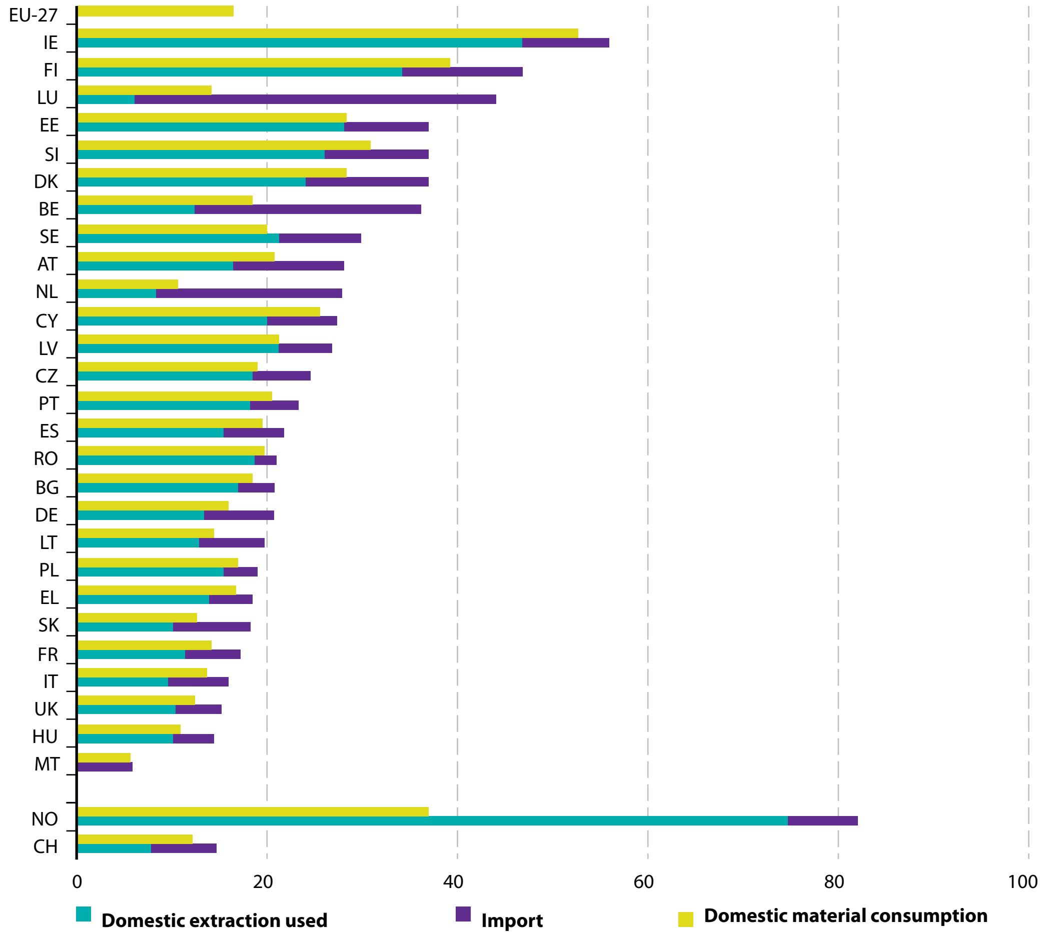
By making a side-by-side DMI and DMC comparison, different types of economies can be characterised, such as (a) through-transport countries with both high imports and exports (Belgium and the Netherlands), (b) extraction used mostly at home (in particular Bulgaria, Cyprus, Finland, Ireland, Hungary, Poland and Romania), and (c) extraction exporting countries (especially Norway).

Ten of the countries (nine EU countries and Switzerland) had direct material requirements, shown using the indicator DMI, between 6 and 20 tonnes per capita in 2007 (Figure 2.4). Their share of DMI that was used for DMC ranged from two thirds for Slovakia to 90 % for Greece and Malta.

A second group of 11 EU countries had a DMI between 20 and 30 tonnes per capita. Their share of direct material used for own domestic consumption ranged from 38 % for the Netherlands to 95 % for Romania.

Another group of seven EU countries and Norway had a DMI higher than 30 tonnes per capita. The reasons for DMI being higher than DMC

Figure 2.4: Domestic material inputs (DMI) by domestic extraction used plus imports and domestic material consumption (DMC) in European countries, 2007 *(metric tonnes per capita)*



Sources: Eurostat material flow accounts (env_ac_mfa) and average population (demo_gind)
All data are estimated for BE and CY; trade data are estimated for EL, FI, MT, NO using COMEXT.

are very different in the different countries. Belgium, like the Netherlands, is an economy with high DMI but significantly lower DMC due to high throughput of resources from abroad to the rest of Europe. In contrast, the economy of Ireland is characterised by high resource requirements (DMI is second highest per capita) which are predominantly for domestic use in manufacturing and construction. Finland shows a similar pattern also due to a high use of extracted natural resources in their own economy. On the other hand, Norway shows a unique pattern with the highest DMI per capita of all European countries at 82 tonnes in 2007. Norway has a high resource extraction-based economy which is largely exported. This is seen with DMC being only 45 % of DMI. Only Norway is a net exporter of natural resources in the EU and EFTA region. Due to data availability only the DMC of the EU-27 can be derived, which was at 16.5 tonnes per capita in 2007.

Resource productivity

Resource productivity is a measure of the total amount of materials directly used by an economy (measured as domestic material consumption (DMC)) in relation to economic activity (GDP is typically used). It provides insights into whether decoupling between the use of natural resources and economic growth is taking place.

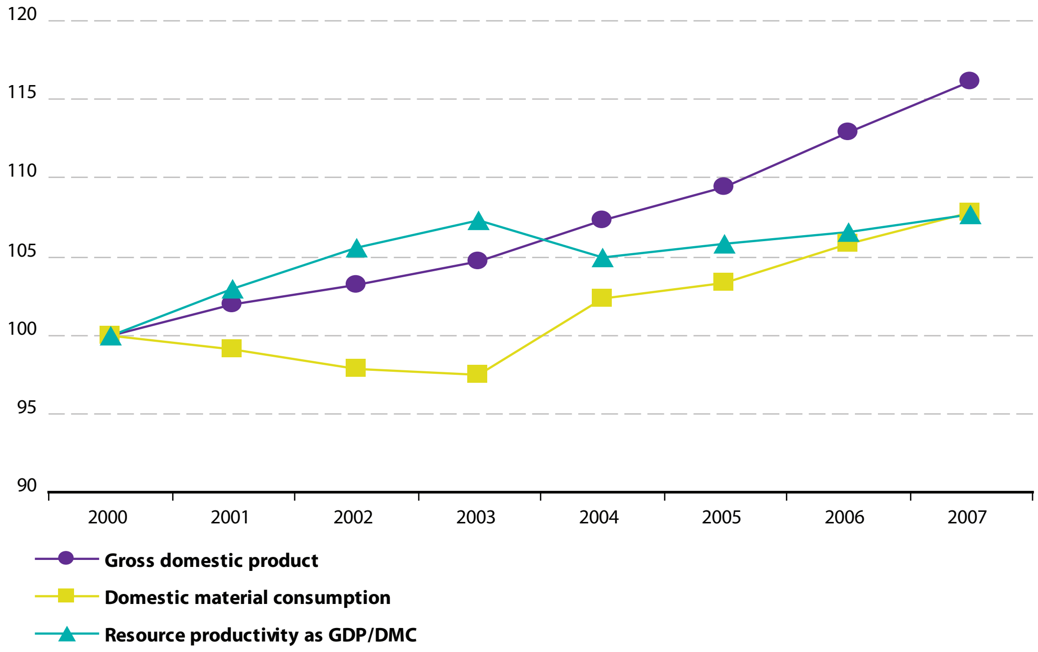
Resource productivity of the EU is expressed by the amount of GDP generated per unit of direct material consumed, i.e. GDP/DMC in euro per kg. When making comparisons over time or between countries it is important to use the correct GDP units so that the figures are comparable and changes are not due to changes from inflation or in prices. See the methodological notes at the end of the chapter for further discussion of this point.

Resource productivity in Europe

Resource productivity in the EU-27 rose 7 % from 2000 to 2003, then decreased in 2004 but increased to slightly above the 2003 level by 2007 (Figure 2.5). Over the entire period 2000–07 an increase of resource productivity of almost 8 % was observed.

While the EU-27 GDP continuously increased during the period 2000–07, the DMC declined in the first four years until 2003. When economic growth increases, while at the same time DMC is decreasing, this is called 'absolute decoupling' of resource use from economic growth. We observe this type of situation for 2000–03. From 2003 to 2007, however, the DMC again increased together with economic growth, showing only a slightly lower growth level (10.6 % vs 11 % for GDP).

Figure 2.5: DMC, GDP and GDP/DMC, EU-27 *(index 2000 = 100)*



Sources: Eurostat material flow accounts (env_ac_mfa) and GDP in chain-linked volumes to reference year 2000 (at 2000 exchange rates) (nama_gdp_k)

Resource productivity (GDP/DMC) is the EU sustainable development indicator for policy evaluation. But much of the growth of the GDP was from services industries, so this apparent decoupling needs to be investigated more closely before any definitive conclusions can be made about making progress in this area.

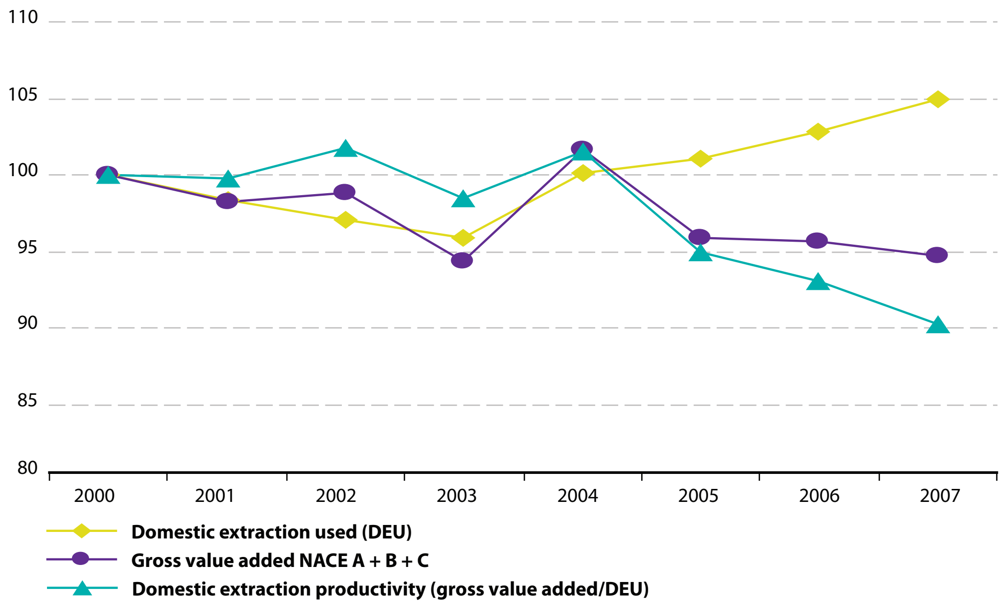
Productivity of domestic extraction

These overall EU trends look good but should be interpreted with care. DMC treats extracted materials differently to imports and exports. Also, in quantitative terms, domestic extraction dominates DMI and DMC. Therefore, a closer look at domestic extraction industries is useful. In making this comparison, gross value added (GVA) and domestic extraction of the extracting industries will be used. GVA is a measure in economics of the profit from goods and services produced in an area, industry or sector of an economy. From this comparison we can answer the following questions: are these natural resource-based industries more profitable per unit of materials extracted, and are they producing products extracted from nature more efficiently?

From 2000 to 2003, domestic extraction in the EU-27 declined, then the trend changed and extraction increased for the rest of the period. The 2007 level was 5 % above the level of 2000 (Figure 2.6).

GVA of the extracting industries in the EU-27 (agriculture, forestry, fishing, mining and quarrying — NACE rev. 1.1 A, B, C) also declined from 2000 to 2003, but rose in 2004 before the downward trend continued from 2005 onwards. Compared to 2000, the gross value added of the extracting industries (NACE rev. 1.1 A, B, C) of the EU-27 was 5 % lower in 2007.

Figure 2.6: Domestic extraction used (DEU), gross value added of the extracting industries and domestic extraction productivity as gross value added/DEU, EU-27 *(index 2000 = 100)*



Sources: Eurostat material flow accounts (env_ac_mfa) and gross value added (nama_nace60_k)

The trends show that for the EU-27 as a whole, more and more materials are extracted for use in the economies but there is less and less value added to the overall performance of the economy from these activities. This is the exact opposite of what is desired when looking at the productivity.

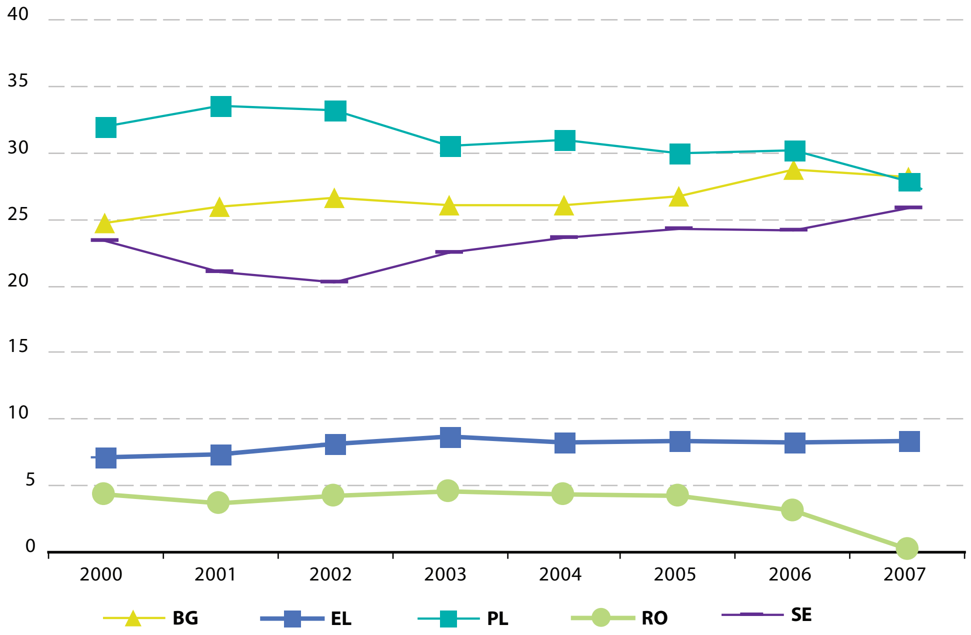
Domestic extraction productivity can be expressed by the ratio of GVA to materials extracted. Domestic extraction productivity in the EU-27 has been declining in particular since 2004 and in 2007 was almost 10 % lower than in 2000.

The positive trend for overall resource productivity as GDP/DMC (Figure 2.5) is obviously not reflected in a positive productivity development of the domestic extracting industries. An important issue in this context seems to be increasing net imports (Figure 2.1), which are not counted the same way (i.e. as raw materials), as domestic extraction and thus resulting in a distorted picture which is getting worse over time with increasing net imports. This issue is further discussed below.

While total minerals extraction in the EU-27 increased from 2000 to 2007 by about 7 %, metallic minerals extraction decreased in many countries (Figure 2.7). In only 8 out of 18 countries extracting metal ores is an increase in extraction observed — the two countries with the largest absolute increase were Sweden, followed by Bulgaria. The overall result for the EU-27 was a slight decrease of metal ore extraction from 2000 to 2003 followed by a slight increase until 2006 and another decrease in 2007. As a result, in 2007, 0.5 % less metallic minerals were extracted from EU-27 territory than in 2000.

Extraction of metallic minerals makes up only about 3 % of total minerals extraction from the EU-27 territory while the bigger portion of domestic minerals is for construction

Figure 2.7: Domestic extraction used of metallic minerals in selected countries *(million tonnes)*



Source: Eurostat (env_ac_mfa)

purposes (sand and gravel, limestone, etc.) and industrial use (salt, potash, etc.). Metals are increasingly sourced from countries outside the EU at medium to high manufacturing level. Due to the changing pattern from national mineral extraction towards imports of raw, semi-manufactured and finished mineral-based products, the importance of how the traded products are included in the material flow accounts is increasing. This topic is discussed in more detail below and some ideas on how to correct for this problem are suggested.

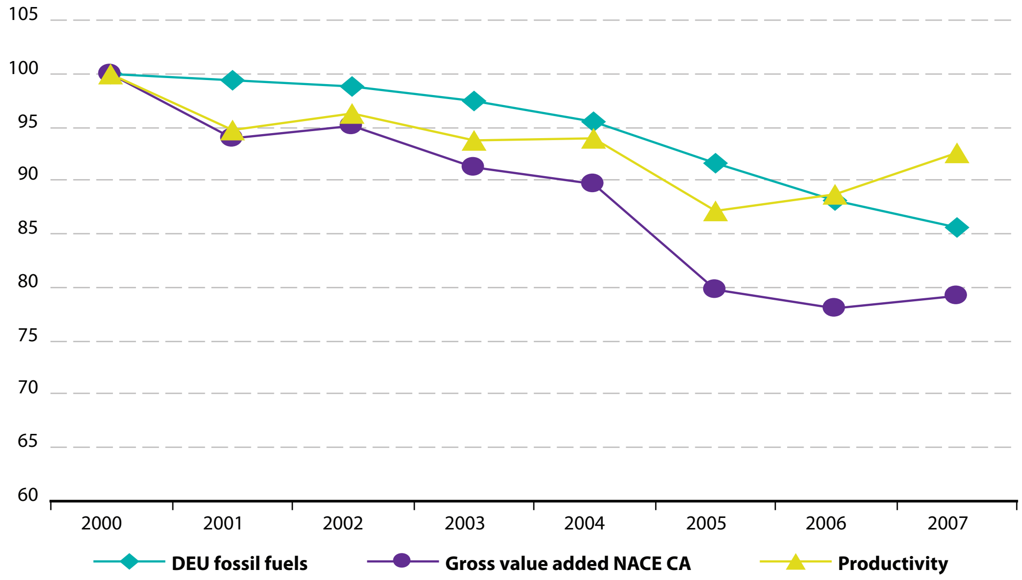
A closer look at the domestic extraction industries for fossil fuels follows (NACE rev. 1.1 CA). Domestic extraction of fossil fuels in the EU-27 declined continuously over the period 2000–07 (Figure 2.8). The DEU of fossil fuels in 2007 was 14 % lower than in 2000.

The GVA of the fossil fuel extracting industries in the EU-27 also declined from 2000 to 2006, and then rose slightly in 2007. In 2007 the GVA was almost 21 % lower than in 2000.

The ratio of GVA to materials extracted ('productivity') was declining from 2000 to 2005 and recovered slightly in 2007. In 2007 the productivity of fossil fuels extraction in the EU-27 was 7.5 % lower than in 2000. This does not appear to be a favourable development as the productivity does not even return to the 2000 level. Apart from that, it should be ensured that the decline of domestic fossil fuels extraction is not counterbalanced by rising imports (there are currently no extra-EU import data available to check for this). Sustainable development should rather see decreasing overall use of non-renewable energy resources and significant increases of renewable energies which is the target of the EU directive on renewable energy (Directive 2009/28/EC).

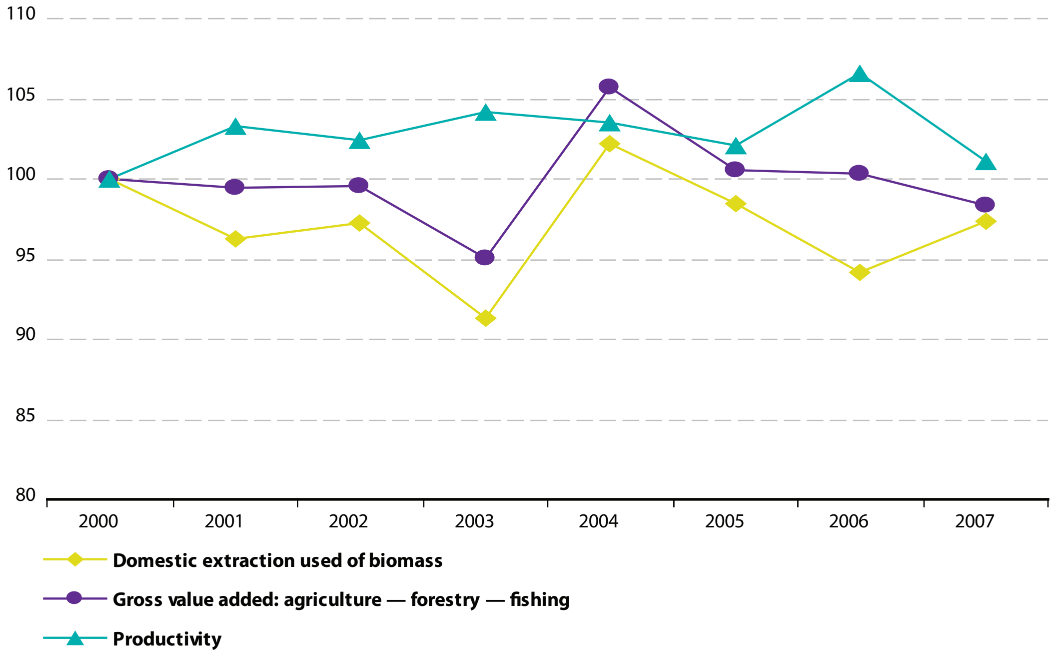
Taking a closer look at domestic extraction of biomass and the related gross value added of the

Figure 2.8: Domestic extraction used of fossil fuels, gross value added of NACE rev. 1.1 CA, and derived 'productivity' , EU-27 *(index 2000 = 100)*



Sources: Eurostat material flow accounts (env_ac_mfa) and gross value added (nama_nace60_k)

Figure 2.9: Domestic extraction used of biomass, gross value added in agriculture, forestry and fishing, and derived 'productivity' (GVA/DEU), EU-27 *(index 2000 = 100)*



Sources: Eurostat material flow accounts (env_ac_mfa) and gross value added (nama_nace60_k)

agriculture, forestry and fishing industries (NACE rev. 1.1 A and B), it appears that there are a similar trends for both DEU and GVA (Figure 2.9). As a result, the 'productivity' of renewable materials extraction in the EU-27 increased from 2000 to 2003, decreased in 2004 and 2005, increased again in 2006, and finally declined again in 2007. In 2007, the productivity of renewable materials extraction in the EU-27 was only 1 % higher than in 2000.

No consistent picture is observed for biomass and the industries related to the harvesting of these types of materials. One reason could be the influence of climatic factors such as rain and temperature especially during the growing season. In the next section, the effects of these two factors on agricultural production will be investigated.

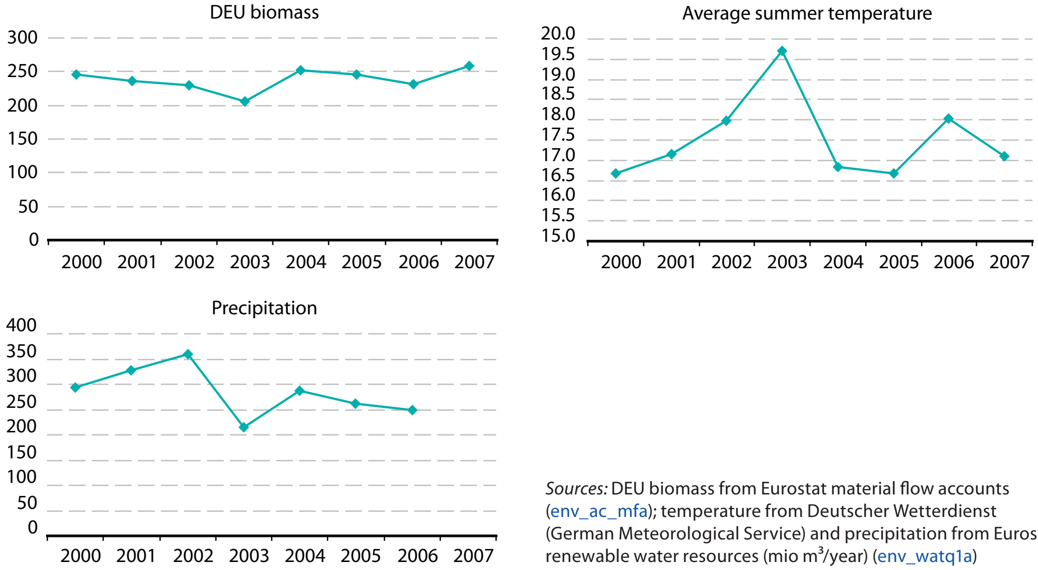
The influence of climate factors on domestic biomass extraction

As regards biomass it can be assumed that climate factors have a significant influence on the amount of domestic harvest. This was investigated in the case of Germany using data for temperature and precipitation and in the case of Romania using data for precipitation.

Indeed, domestic extraction of biomass in Germany between 2000 and 2007 was negatively correlated ($R^2 = 0.83$) with average growing season (summer) temperatures (Figure 2.10a). In other words, the cooler the summer, the more biomass was harvested.

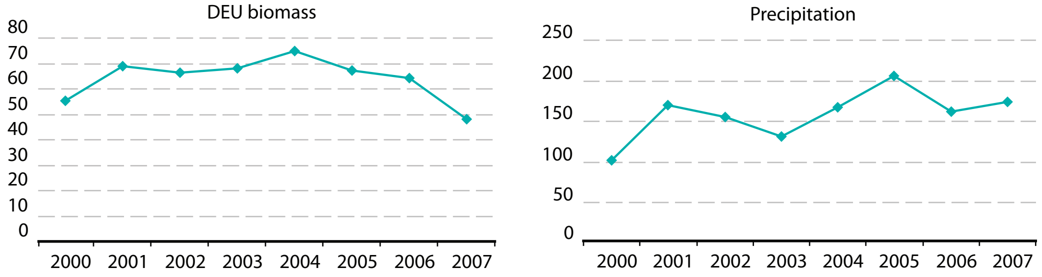
On the other hand, there seems to be no obvious influence of precipitation on the domestic harvest of biomass in Germany (Figure 2.10a) or in Romania (Figure 2.10b). It appears that precipi-

Figure 2.10a: Domestic extraction used of biomass *(million tonnes)*, average growing season temperature *(° C)*, average growing season precipitation *(billion m^3/yr)*, Germany



Sources: DEU biomass from Eurostat material flow accounts (env_ac_mfa); temperature from Deutscher Wetterdienst (German Meteorological Service) and precipitation from Eurostat renewable water resources (mio m^3/year) (env_watq1a)

Figure 2.10b: Domestic extraction used of biomass *(in million tonnes)* and average growing season precipitation *(billion m^3/yr)*, Romania



Sources: DEU biomass from Eurostat Material flow accounts (env_ac_mfa) and precipitation from Eurostat Renewable water resources (mio m^3/year) (env_watq1a)

tation of around 150 billion m^3/yr in Romania provides an average growing year. Below that amount — as in 2000, when there were drought conditions — the harvested biomass is lower. Also, when the precipitation is significantly greater — as in 2005, when there was widespread flooding — the additional rainfall did not result in greater harvests.

It is difficult to use national-level figures to draw sophisticated conclusions between climatic factors and biomass harvests. Regional differences within a country can play a large role depending on where droughts, floods, wind storms and other extreme weather events occur and where the main agricultural activities are located.

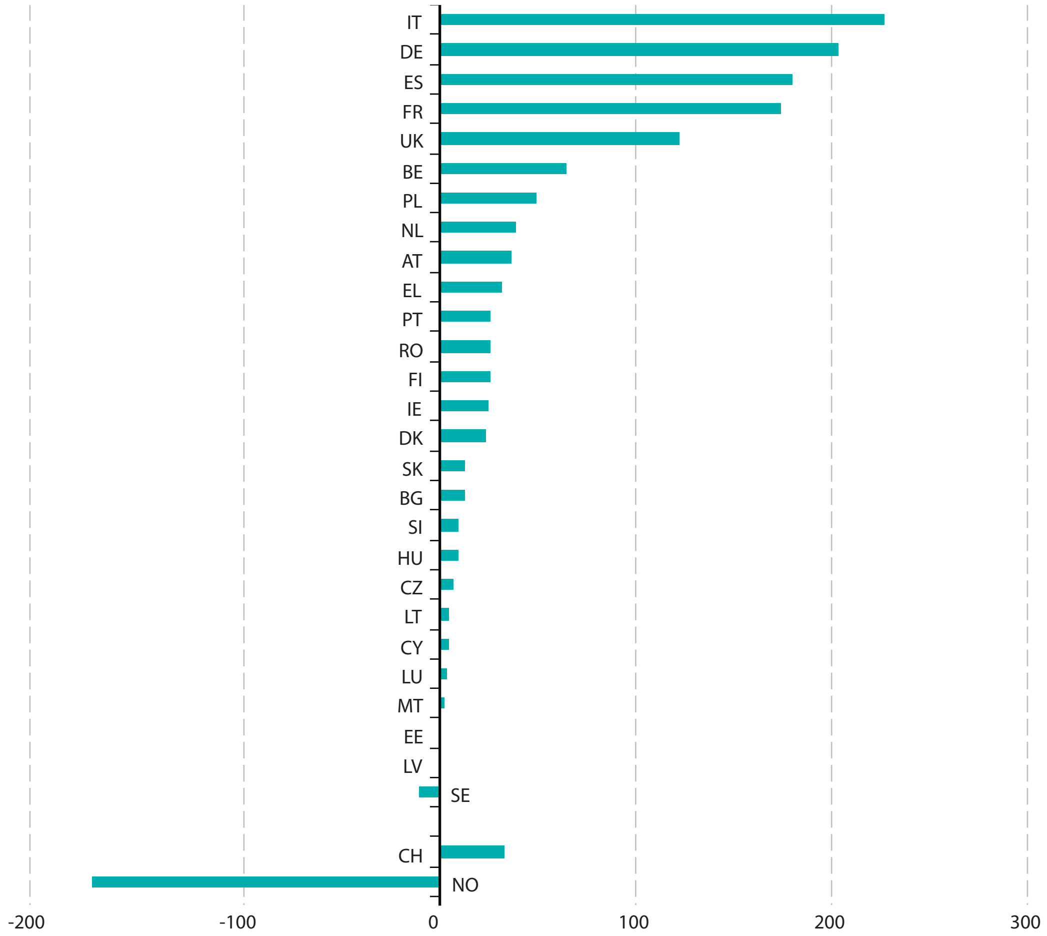
Domestic and foreign resources

Physical trade balances

For most countries, the material requirements for a country's economy are dominated by domestic raw material extraction, but the EU is no longer self-sufficient for all the materials needed. Materials that are not available or are too expensive to produce nationally are typically obtained through international trade. The material requirements for a country are augmented by net foreign trade (physical trade balance = PTB).

Most European countries are net importers and require more resources from the rest of the world than they provide to the rest of the world (Figure 2.11). Among the EU countries in 2007 only Latvia and Sweden were net exporters of materials though at relatively low absolute amounts.

Figure 2.11: Physical trade balances (PTB) in European countries, 2007 *(million tonnes)*



Source: Eurostat (env_ac_mfa)
Trade data are estimated for EL, FI, MT, NO using COMEXT.

Norway, on the other hand, is at the other extreme to Italy and Germany and is the largest net exporter of the EU and EFTA countries. Norway has a largely natural resource-based economy due to its high extraction and export of domestic oil and gas, fish and timber.

What countries move versus what they use?

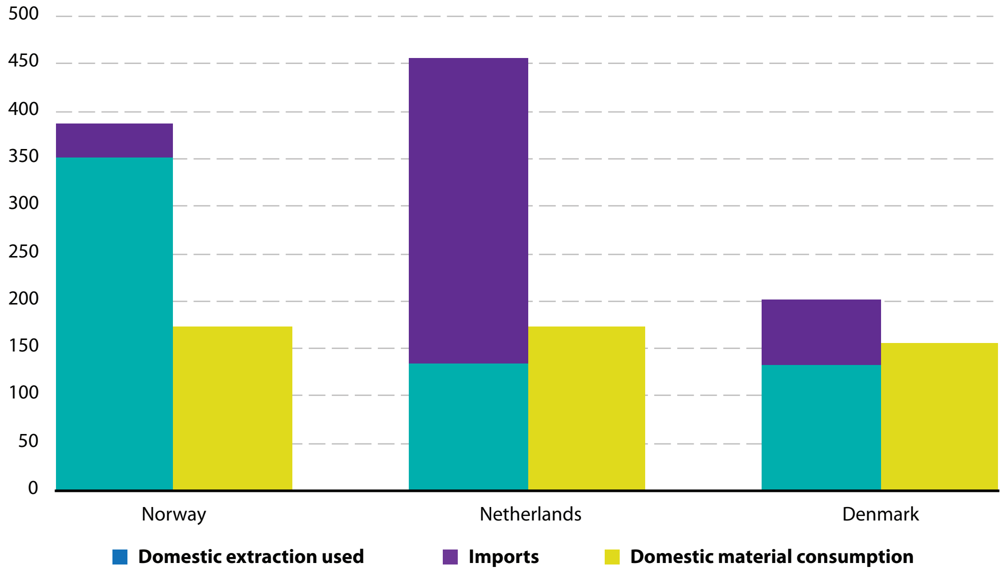
Domestic material input (DMI) shows all of the materials that enter into a country's economic activity, whereas domestic material consumption (DMC) is connected to the amounts of materials actually consumed. Looking at the patterns for these two indicators, and showing DMC by its underlying components of domestic extraction used and the trade balance, can show some special characteristics of these economies. Three examples of countries of roughly similar size (Figure 2.12) illustrate these differences.

Norway is a resource-rich country which exports much of its extracted natural resources and which, from a material flow perspective, requires few direct imports in addition to this. This means that only a small part of its direct material requirements is used for its own domestic consumption.

In contrast, the Netherlands is a country with high levels of imports. But not all of the goods imported to the Netherlands are consumed nationally because the country also acts as an entry point for foreign goods to other European countries. This phenomenon is sometimes called the 'Rotterdam' effect. As a result the Dutch DMC per capita is the second lowest of all EU countries.

Denmark is more of a 'typical' EU country because it takes most of its direct material requirements from the domestic environment but still imports a significant portion and uses

Figure 2.12: DMI by components (DEU and IMP) and DMC, Norway, the Netherlands and Denmark, 2007 *(million tonnes)*



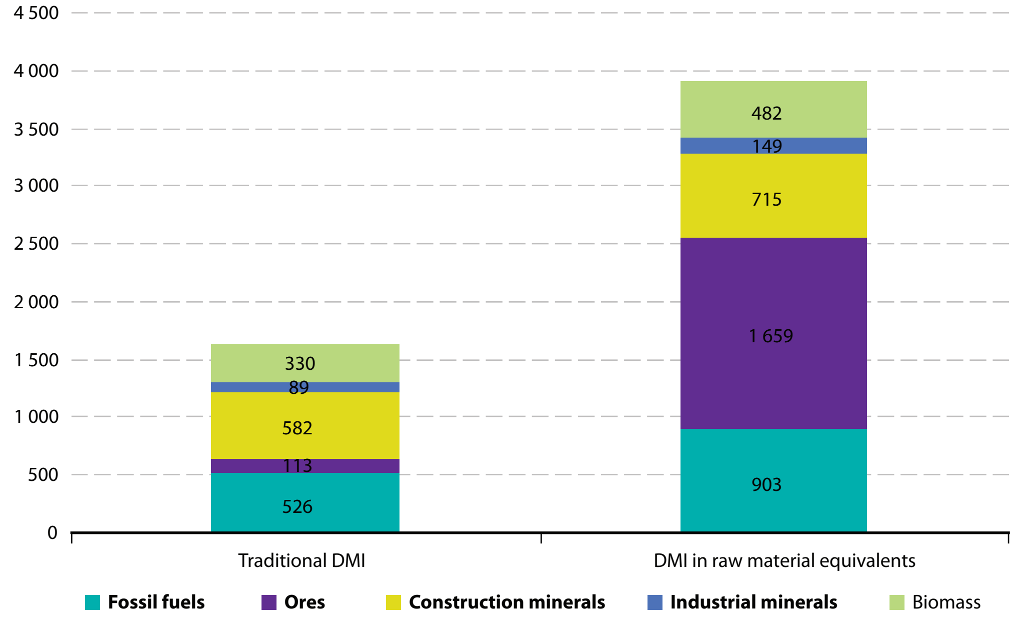
Source: Eurostat (env_ac_mfa)
Trade data are estimated for NO using COMEXT.

the major portion of this direct input for its own domestic consumption.

The data sources used for compiling domestic extraction used include primarily agriculture, fishing, forestry, mining and energy statistics. We are measuring raw materials. Domestic extraction is then combined with trade data to compile the input side of economy-wide material flow accounts. This approach has an inherent asymmetry — domestic extraction is looking at raw materials whereas trade is looking at products at various stages of manufacturing — for example, raw products, semi-manufactured and final products. When these two pieces are added together to make indicators such as DMC the national production is counted differently from the traded products. For the traded products, a large portion of the raw material that was required in foreign countries to produce these goods is left out of the account. This results in a distorted picture of the total global raw material requirement of economies.

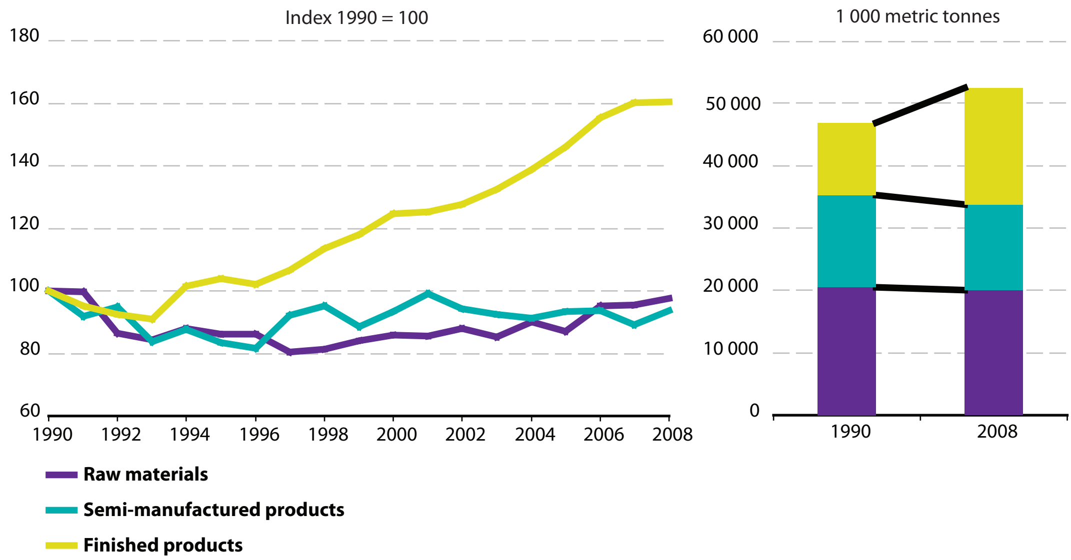
One way to overcome this problem is to find a way to include the raw materials extracted abroad that were needed to make the imported products. Germany and the Czech Republic have tried to develop ways to correct this asymmetry of accounting. In Germany, the Federal Statistical Office is developing an indicator for the German national sustainability strategy that converts imports into the associated raw material equivalents — RME (Buyny et al., 2009). The DMI in raw material equivalents for Germany in 2005 was about 2.4 times higher than the DMI derived using the traditional approach (Figure 2.13). The most obvious difference was for metals, which are often

Figure 2.13: Relation between traditional DMI and DMI in raw material equivalents, Germany, 2005 *(million tonnes)*



Source: Buyny et al., 2009

Figure 2.14: Imports by raw materials, semi-manufactured products, and finished products, Switzerland *(index 1990 = 100)*



Sources: BfS 2008 and 2010

imported in a highly concentrated form or as pure metal, and therefore enormous amounts of raw materials extracted in the countries of origin are left out.

The example of Germany shows that the current approach where domestic extraction and trade are treated similarly may not be the best way of looking at the material requirements of European economies. Using the idea of converting the mass of traded products into mass of raw materials needed for producing the products provides a good example of how this methodology can be adapted to give a more balanced picture. Eurostat is supporting this type of development work to try to improve these indicators.

It was previously shown that total imports are increasing (Figure 2.3) but the types of imported products that are making the largest contribution to this increase are not known. If the traded products are classified into rough processing stages, some interesting information about imports can be obtained.

Switzerland has differentiated its imports into raw products, semi-manufactured products, and finished products, and Figure 2.14 shows that the country is increasingly importing finished products (BfS 2008 and personal communication BfS, Mr Florian Kohler, 2010). This indicates a tendency towards purchasing imported products which may also imply that producing those products nationally is not profitable and it may also lead to shifting the associated environmental burden abroad.

The economy-wide MFA statistics allow for some analyses at an aggregated level, but sand, gravel and grazed biomass typically dominate the picture. The data for these materials have a high level of uncertainty so other types of material flow analyses that focus on particularly toxic materials are also needed (See the chapter on chemicals for these types of statistics).

Conclusions: Economy-wide material flows

Economic data and the national accounts show how money flows through our economies — but this does not provide information about the physical flows of materials. Material flow analysis (MFA) techniques provide a better understanding of the physical materials needed in our economies. Typically, as economies grow, more materials such as energy, construction materials and metals are needed. By using materials more efficiently and getting more economic value out of each unit used, the growth rate of the use of materials can be less than the economic growth rate. When the growth rate of material use is less than the economic growth rate, this is called 'decoupling' material use from economic growth.

Domestic material consumption (DMC) measures the total amount of materials directly used by an economy and is defined as the annual quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports. The DMC indicator provides an assessment of the absolute level of the use of resources. From 2000 to 2007 the DMC of the EU-27 increased by 7.8 %. Domestic extraction used (DEU) makes up the larger part of DMC, 85 %, with the physical trade balance (imports less exports) accounting for roughly 15 %. After some variation, DEU in 2007 was 4.9 % higher than in 2000. In contrast, Physical Trade Balance (PTB) rose constantly over 2000 to 2007 by 26.5 %. This means that the EU-27 is a net importing region from the rest of the world.

In 2007, the main materials extracted from the national territories of the EU-27 were non-metallic minerals including sand and gravel (61 %), biomass (24 %), fossil energy materials/carriers (13 %) and metal ores (2 %).

For most countries, the material requirements for a country's economy are dominated by domestic raw material extraction but the EU-27 as a whole is no longer self-sufficient for all materials it needs. Materials that are not available or are too expensive to produce nationally are obtained from foreign countries. Most European countries are thus net importers and require more resources from the rest of the world than they provide to them. Among the EU countries in 2007 only Latvia and Sweden were net exporters of materials though at relatively low absolute amounts. Norway, on the other hand, is the largest net exporter of the EU and EFTA countries. Norway has a largely natural resource-based economy due to its high extraction and export of domestic oil and gas as well as fish and timber.

Direct material input (DMI) measures the direct input of materials for use into the economy, i.e. all materials which are of economic value and are used in production and consumption activities. DMI equals domestic (used) extraction plus imports. The relation of DMC (which equals DMI less exports) to DMI indicates to which extent material resource inputs are used for own domestic consumption or are exported for consumption in other economies.

By making a side-by-side DMI and DMC comparison, different types of economies can be characterised, like (a) through-transport countries with both high imports and exports (Belgium and the Netherlands), (b) extraction used mostly at home (in particular Bulgaria, Cyprus, Finland, Ireland, Hungary, Poland and Romania), and (c) extraction exporting countries (especially Norway). Norway is a resource-rich country which exports much of its extracted natural resources and that requires little direct imports. This means that only a small part of its direct material requirements is used for its own domestic consumption. In contrast, the Netherlands is a country with high levels of imports. But all of the imported goods to the Netherlands are not consumed nationally because the country is also acting as an entry point for foreign goods to other European countries. This phenomenon is sometimes called the 'Rotterdam' effect. As a result the Dutch DMC per capita is the second lowest of all EU countries. Denmark is more

of a 'typical' country of the EU because it takes most of its direct material requirements from the domestic environment but still imports a significant part and uses the major part of this direct input for its own domestic consumption.

Resource productivity (GDP/DMC) is the EU sustainable development indicator for policy evaluation. Over the entire period 2000–07 an increase of resource productivity for EU-27 of almost 8 % was observed. But DMC treats extracted materials differently than imports and exports. And, in quantitative terms, domestic extraction dominates DMI and DMC. Therefore, a closer look at domestic extraction industries is useful. In making this comparison, domestic extraction productivity (gross value added (GVA)/DEU) is used. The trends show that for the EU-27 as a whole, more and more materials are extracted for using in the economies but there is less and less value added to the overall performance of the economy from these activities. The positive trend for overall resource productivity as GDP/DMC is obviously not reflected in a positive productivity development of the domestic extracting industries. An important issue in this context appears to be increasing net imports which are not counted the same way, i.e. as raw materials, like domestic extraction and thus result in a distorted picture which is getting worse over time with increasing net imports. Using the idea of converting the mass of traded products into mass of raw materials needed for producing the products provides a good example of how this methodology can be adapted to give a more balanced picture. Eurostat is supporting this type of development work to try to improve these indicators.

Further information

Eurostat database

Environment and Energy > Environment (env) > Environmental accounts (env_acc) > Physical flow and hybrid accounts (env_acp) > Material flow accounts (env_ac_mfa).

http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

Eurostat dedicated section

Environmental accounts > Physical environmental accounts: This section includes publications dealing with physical environmental accounts including NAMEA, MFA and Input / Output tables.

http://epp.eurostat.ec.europa.eu/portal/page/portal/environmental_accounts/publications/physical_environmental_accounts

Eurostat publications

Eurostat, *Economy-wide material flow accounts and derived indicators — A methodological guide*, Luxembourg, 2001.

Eurostat, *Measuring progress towards a more sustainable Europe — 2007 monitoring report of the EU sustainable development strategy*, *Eurostat Statistical Books*, Luxembourg, 2007.

Eurostat, Economy-wide Material Flow Accounts: Compilation Guidelines for reporting to the 2009 Eurostat questionnaire. 2009a. Luxembourg.

Eurostat, Sustainable development in the European Union — 2009 monitoring report of the EU sustainable development strategy, Luxembourg, 2009b.

Further reading

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Buyny, S., Klink, S. and Lauber U., *Weiterentwicklung des direkten Materialinputindikators*, Statistisches Bundesamt, Wiesbaden, 2009.

OECD, *Work on material flows and resource productivity* (http://www.oecd.org/document/51/0,3343,en_2649_34441_34808435_1_1_1_1,00.html).

United Nations Statistics Division, *Integrated Environmental and Economic Accounting 2003* (SEEA 2003) (http://unstats.un.org/unsd/envaccounting/seea.asp).

See also

European Commission, 'European governance — A White Paper' (COM(2001) 428), Brussels, 2001.

Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (OJ L 140, 5.6.2009, p. 16).

European Commission, 'Europe 2020 — A strategy for smart, sustainable and inclusive growth' (COM(2010) 2020) Brussels, 2010.

Potočnik, J., European Commissioner for the Environment, 'Resource efficiency as a driver for growth and jobs', 2010 Jean Jacques Rousseau Lecture, The Lisbon Council, Silken Berlaymont Hotel, 23 March 2010.

Methodological notes

MFA uses already available production, consumption and trade data in combination with environment statistics. Eurostat is currently developing economy-wide material flow accounts which take a very aggregated approach at tracking materials.

Eurostat data on material flows in Europe are available by country, material category, indicator and year. Data are published for the EU-27 (partly) and each of its Member States and for Norway and Switzerland in units of 1 000 tonnes.

If no data are available for a certain country, material and/or year, estimations are made by Eurostat. These Eurostat estimates are presented at national level. Complete gap-filled data are available for 2000–07. The data are available by material category: biomass, metallic minerals, non-metallic minerals and fossil energy materials/carriers and by domestic extraction used, total imports and exports, for all 27 EU Member States plus Switzerland and Norway. EU aggregates are calculated by summing up the national figures. Some countries have reported figures before 2000 and are available in the database but full gap-filling/ estimations have not been performed for these data.

Since the figures for the materials sand and gravel and grazed biomass are estimated by countries using a number of different inputs to arrive at these estimates, there can be a fair amount of uncertainty in the figures and totals in this methodology. Also please note that water is excluded from this methodology.

These data resulted from the second Eurostat EW-MFA questionnaire launched in 2009 and represent data closest to quality standards set by the Eurostat compilation guide (Eurostat 2009a). Any confidential data are not published and the EU aggregates are only published at the aggregated material levels to preserve the detail in country data and respect confidentiality.

Domestic material consumption (DMC) is defined as the total amount of material directly used in an economy. It is important to note that the term 'consumption' as used in DMC denotes apparent consumption and not final consumption. DMC does not include upstream hidden flows related to imports and exports of raw materials and products

DMI is not additive across countries. For example, for EU totals of DMI the intra-EU foreign trade flows must be subtracted from the DMIs of Member States. Theoretically, the exports from country A to country B should equal the imports to country B from country A and can be netted out. The data for doing this are available; however, the quality of these EU aggregate calculations needs to be evaluated before the indicator DMI for EU aggregates can be published with confidence.

Resource productivity is calculated by the ratio of DMC and gross domestic product (GDP). Since GDP is a monetary variable, comparisons over time and between countries need to be done using the correct GDP variables. GDP is provided by Eurostat in a number of different ways. For comparing one geographic area over time the GDP which excludes inflation needs to be used or, more precisely, the chained volume series for GDP is used, which is a series of economic data from successive years, put in real (or constant, i.e. inflation- and deflation-adjusted) terms by computing the production volume for each year in the prices of the preceding year, and then 'chain-linking' the data together to obtain a time-series of production

figures from which the effects of price changes (i.e. monetary inflation or deflation) have been removed.

When comparisons of resource productivity between countries are going to be made, the GDP that removes the differences between countries needs to be used. The level of GDP in different countries may be compared by converting their value in national currency according to either the current currency exchange rate or the purchasing power parity exchange rate. The purchasing power parity exchange rate is the exchange rate based on the purchasing power parity (PPP) of a currency relative to a selected standard (often the United States dollar) but the unit purchasing power standards (PPS) is the one available on the Eurostat website. The purchasing power parity method accounts for the relative effective domestic purchasing power of the average producer or consumer within an economy. The method can provide a better indicator of the living standards of less-developed countries, because it compensates for the weakness of local currencies in the international markets.

There is a clear pattern of the purchasing power parity method decreasing the disparity in GDP between high and low income (GDP) countries, as compared to the current exchange rate method. This finding is called the Penn effect. GDP in PPS is proposed by some experts to compare resource productivity across countries.

All data presented in this publication are available from the Eurostat database in the environment section. The data set also includes the EU headline indicator ‘Resource productivity’ calculated by GDP divided by DMC (Eurostat, 2007; Eurostat, 2009b).

PR

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Waste

Defining waste

Waste includes all the items that people no longer have any use for, which they either intend to get rid of or they have already discarded. Additionally, wastes are also all the items which people are required to discard, for example because of their hazardous properties.

All daily activities, therefore, can give rise to a large variety of different waste flows from different sources. These sources include, for instance, waste coming from households (e.g. plastic packaging waste), commercial activities (e.g. cardboard packaging waste from shops, food waste from restaurants and medical waste from hospitals), industry (e.g. fly ashes from thermal processes of energy generation, textile waste and tanning liquor from clothes manufacturers), agriculture (e.g. slurr), construction and demolition projects. A small part of the waste which is generated is hazardous; that is, it poses substantial or potential threats to human health or to the environment.

Significant concerns over the environmental impact of waste have emerged in recent decades. Managing waste has a wide range of potential environmental impacts, since natural processes act to disperse pollutants and toxic substances throughout all environmental media. The nature and dimension of these impacts depend upon the amount and composition of waste streams as well as on the method adopted for treating them. Improper management of waste has caused numerous cases of contamination of soil and groundwater, threatening the natural functioning of ecosystems and the health of the exposed population.

The generation of waste also represents an inefficient use of valuable resources. Europe is the largest net importer of natural resources in the world and a large share of semi-manufactured input materials are imported as well (EEA, forthcoming). Thus, sound waste management, and, in particular, recycling are a strategic economic challenge for securing the supply of materials critical to the European economy (EEA, forthcoming).

WASTE PREVENTION AND RECYCLING: THE CORE TARGETS OF EU WASTE POLICY

The EU's sustainable development strategy (37) identifies waste prevention and management as one of its top priorities. The objective is to decouple the generation of waste from economic growth to reduce the pressures of waste on the environment.

The EU's strategy for coping with waste is based on four cornerstones: waste prevention and reuse, waste recycling, turning waste into a greenhouse-neutral energy source, and improving final waste disposal. Waste prevention can be achieved through the use of cleaner technologies, eco-design, or more eco-efficient production and consumption patterns. Waste recycling can also reduce the environmental impact of resources through limiting raw material extraction and transformation. Where possible, waste that cannot be recycled or reused should be safely incinerated. Landfilling should only be used as a last resort.

In practice, overseeing the safe and environmentally sound management of waste is a complex task which requires different strategies depending on the products and according to each specific waste stream, including the redesigning of manufacturing processes.

Waste policies both in the EU and in individual Member States have been put in place progressively since the 1970s. The EU's current waste policy based on the 'waste hierarchy' has been strengthened by the thematic strategy on the prevention and recycling of waste (38) and by the revised waste framework directive (39) (WFD), which establishes waste prevention programmes by the Member States (Article 29) and outlines the time schedule for the action at EU level (Article 9).

The European Union's waste legislation comprises three main elements. A horizontal legislation establishes the overall framework for the management of waste, including definitions and principles. Legislation on treatment operations, such as landfill or incineration, sets technical standards for the operation of waste facilities (e.g. the landfill directive (40) and the waste incineration directive (41)). Legislation on specific waste streams (42), such as batteries (43), packaging waste (44), end-of-life vehicles (45) and waste electrical and electronic equipment (46), includes measures directed towards increasing recycling or reducing hazardousness. These directives clearly place responsibility on producers to bear the costs of collection, sorting or treatment, and recycling or recovery.

Producer responsibility is an extension of the 'polluter pays' principle, and is aimed at ensuring that businesses that place products on the market take responsibility for those products once they have reached the end of their life.

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(37) The sustainable development strategy of the European Union (EU SDS), as revised in 2006, is a framework for a long-term vision of sustainability in which economic growth, social cohesion and environmental protection go hand in hand and are mutually supporting. See the communication from the Commission to the Council and the European Parliament 'On the review of the sustainable development strategy — A platform for action' (COM(2005) 658 final).

(38) Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions 'Taking sustainable use of resources forward: A thematic strategy on the prevention and recycling of waste' (COM(2005) 666 final).

(39) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives.

(40) Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste.

(41) Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste.

(42) For some special waste streams, the principle of the waste hierarchy has evolved, for example by the introduction of concrete targets for recycling. EU legislation now requires Member States to introduce legislation on waste collection, reuse, recycling and disposal of these waste streams.

(43) Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators.

(44) European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste.

(45) Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of-life vehicles.

(46) Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE).

Other problems are linked to waste management. Existing disposal facilities are reaching saturation and difficulties emerge in the setting up of new facilities: protests over the localisation of landfills and incineration facilities due to their potential environmental and health impacts are common all over Europe. Increased movement of waste, both within and outside the EU, needs to be carefully monitored for the risk posed to human health and to the environment by some waste stream shipments.

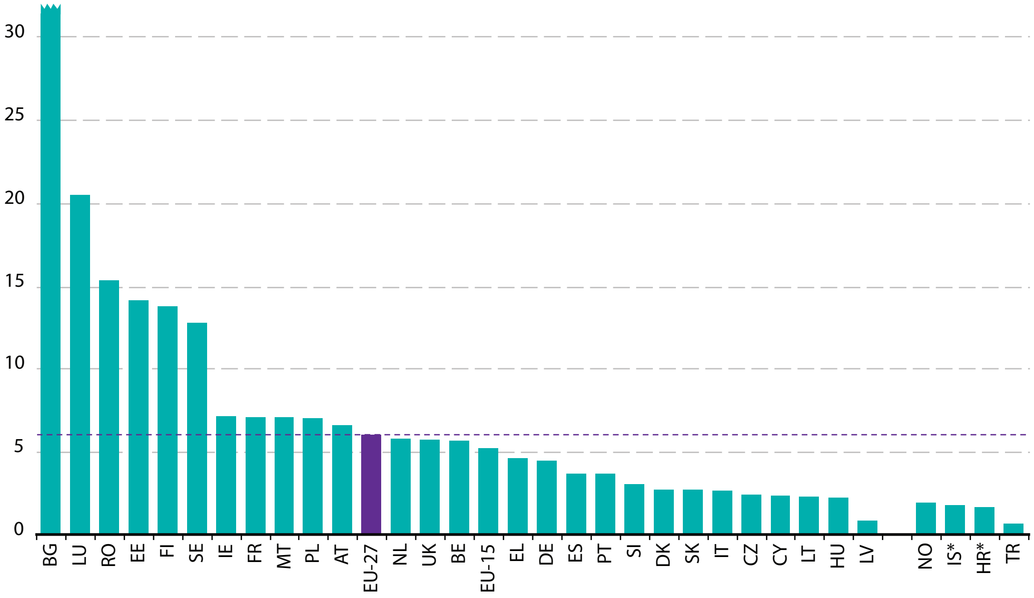
Thus, it is of paramount importance that waste is managed in such a way that it does not cause any harm either to human health or to the environment and so that it reduces the inefficient use of resources.

Waste generated in European countries

Almost 3 billion tonnes of waste were generated in the EU-27 in 2006, which is 6 tonnes per capita. The quantity of waste generated in European countries reflects differences in the economic structure and consumption patterns as well the different degree of implementation of waste prevention policy. However, differences between countries should be regarded with caution since these could also be caused by the methodologies used for the collection of data so far.

Bulgaria produced over 30 tonnes of waste per capita in 2006, which is five times the EU-27 average: most of the waste generated is mineral waste from mining and quarrying activities. Luxembourg (20 t per capita), Romania (20 t per capita), Estonia (15 t per capita), Finland (14 t per capita) and Sweden (14 t per capita) also generated considerably higher quantities of waste with regard to the EU-27 average. For these countries this is also due to the generation of large quantities of mineral waste

Figure 3.1: Waste generated, 2006 *(tonnes per capita)*



* 2004

Source: Eurostat (env_wasgen)

Waste streams in Europe

Waste includes many different types of items and substances. Each kind of waste stream has its own characteristics which have different pressures on the environment and on human health.

Sixty eight per cent of the waste generated in the EU-27 in 2006, or almost 2 billion tonnes, was mineral and solidified waste, which comes mainly from mining/quarrying activities and construction/demolition activities. This type of waste also includes combustion waste, mainly from the production of energy (158 million tonnes), which alone accounts for 5 % of waste generated in the EU-27 in 2006.

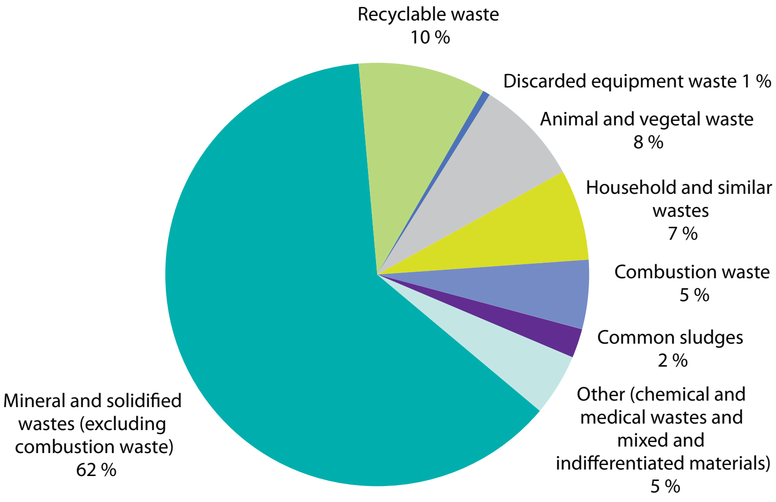
Recyclable waste and discarded equipment waste accounted for 11 % of the waste generated in the EU-27 in 2006. This waste category includes two main groups of items: recyclable waste (e.g. metal waste as well as paper, rubber, wood, glass, plastic and textile materials), which accounted for 288 million tonnes, and equipment waste (e.g. discarded equipment and batteries), which accounted for 19 million tonnes. These two waste streams come from all sectors of the economy and households. A high fraction of these waste materials can be recycled/reused.

Animal and vegetal waste, which includes biodegradable waste and other waste from agriculture, waste from food preparation and products, sludge from washing and cleaning, slurry and manure, accounted in 2006 for 8 % of waste generated in the EU-27, that is to say 233 million tonnes.

In the same period household waste accounted for 7 % of total waste, or 205 million tonnes. This waste category includes mixed waste, bulky waste, kitchen waste and household equipment but excludes the separately collected fractions of waste.

Common sludges, which accounted for 65 million tonnes and 2 % of total waste, are made by wastewater: treatment sludges from municipal sewerage water, organic sludges from food preparation and processing, and dredging spoils.

Figure 3.2: Waste generated by type, EU-27, 2006 *(% of total waste)*



Source: Eurostat (env_wasgen)

The main types of waste streams generated vary a lot across European countries. This is mainly due to the economic structure of each country, for example the existence of a large mining sector. Mineral and solidified waste is the largest waste stream in most European countries (Figure 3.3). This is due to the large amount of waste arising from mining and quarrying, construction and demolition, and to a lesser extent electricity generation activities. Mixed and ordinary waste includes household and similar wastes, street-cleaning residues, mixed and undifferentiated packaging and sorting residues.

Not all waste poses the same problems. Due to the fact that it can present a potential risk both to human health and to the environment, hazardous waste is subject to stricter legislations and controls. Wastes are classified as being hazardous if they exhibit particular characteristics (47).

For example, waste containing heavy metals, halogenated solvents, acids, asbestos, organohalogen compounds, organophosphate compounds, cyanides or phenols is regarded as hazardous waste. Redundant or broken electrical equipment with potentially harmful components such as cathode ray tubes or lead solder are hazardous wastes. Waste refrigerators contain ozone-depleting substances. Sewage sludge from the treatment of industrial wastewater and dredged spoils from harbours and rivers generally concentrate heavy metals and synthetic organic

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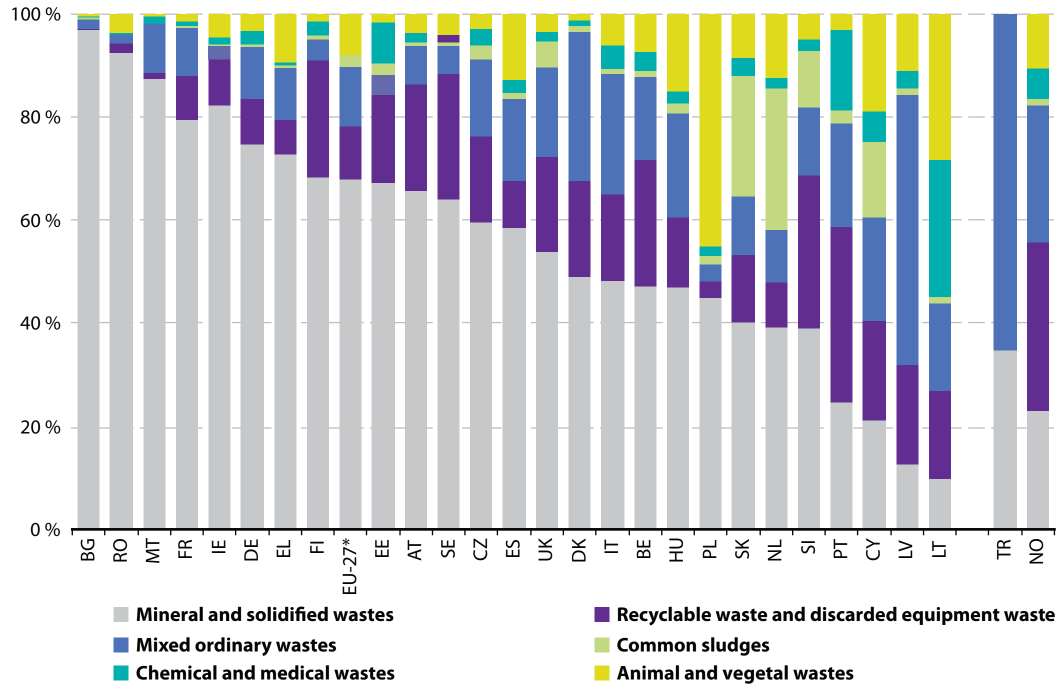
(47) For a list of these characteristics see Annex III to Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste.

Figure 3.3: Waste generated by type, 2006 *(% of total waste)*

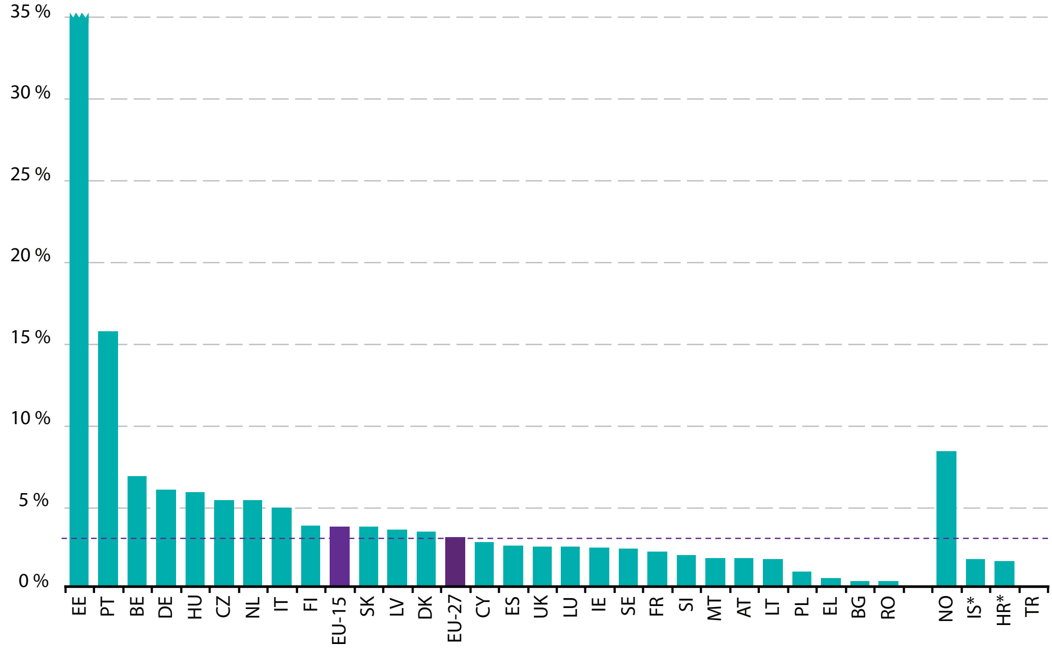


LU: the breakdown by type of waste is not available due to confidential data.

* EU-27: mixed ordinary waste (which includes households' waste) summed up under chemical and medical waste.

Source: Eurostat (env_wasgen)

Figure 3.4: Hazardous waste generated in European countries, 2006 *(% of total waste generated)*



* IS and HR: 2004

Source: Eurostat (env_wasgen)

compounds. Demolition waste, including asphalt and concrete, steel, timber and cement, may also contain relevant concentrations of toxic substances such as asbestos. Hospital wastes contain contaminated materials and are generally required to be segregated from other waste. Household wastes commonly include hazardous items, such as batteries, fluorescent lamp tubes, used oils, some types of paints and resins, and out-of-date medicines.

Three per cent of the total waste generated in the EU-27 in 2006, or 88 million tonnes, was hazardous. The proportion of hazardous waste in European countries varies between 1 % and 8 % of total waste. In Estonia the high share of hazardous waste is due to energy production from shale oil (48).

In 2006 most of the hazardous waste in the EU-27 was mineral and solidified waste (42 %): combustion wastes accounted for 14 % of total hazardous waste generated and contaminated soils and polluted dredging spoils 11 %. Chemical and medical wastes represented the second biggest item, constituting 39 % of hazardous waste. The main types of hazardous chemical wastes are chemical deposits and residues, used oils, acid, alkaline or saline wastes and chemical preparation wastes. Recyclable waste and discarded equipment waste contributed up to 17 % of hazardous waste generation, mainly with discarded vehicles, batteries and accumulators, and hazardous wood waste (Figure 3.5).

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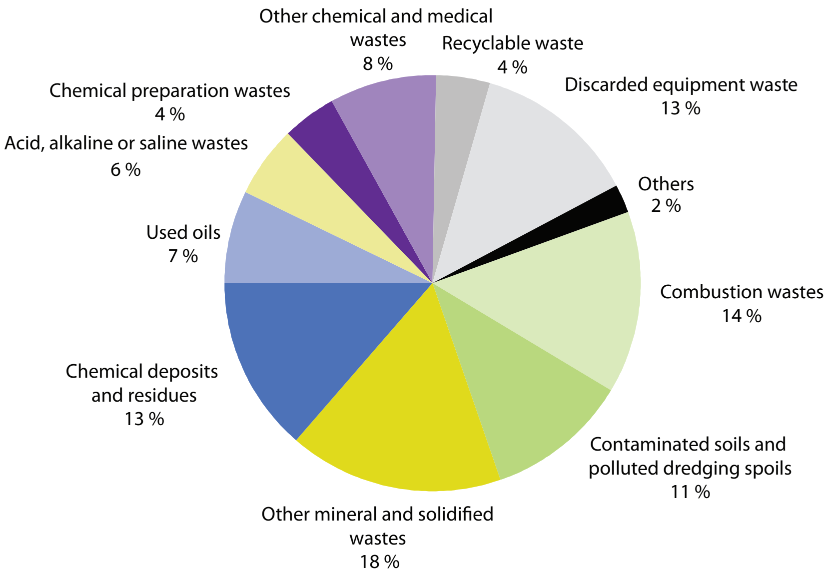
(48) Shale oil is an organic-rich fine-grained sedimentary rock from which liquid hydrocarbons can be extracted. Its processing and use as fuel produces hazardous combustion waste.

Figure 3.5: Hazardous waste by type, EU-27, 2006 *(% of total hazardous waste)*



* Excluding spent chemical catalysts (ewc 014).

Source: Eurostat (env_wasgen)

The generation of waste

Waste generation by source

All human activities are potential sources of waste: during extraction, production, distribution and final consumption of goods and services, as well as during waste collection and treatment (e.g. sorting residues in recycling facilities and incinerator slag).

Figure 3.6 shows the generation of waste by economic sector in the EU-27 in 2006. Construction, mining and quarrying, and manufacturing activities are, in order of importance according to quantity, the major sources of waste in the European Union. A third of all waste generated in the EU-27, 970 million tonnes, comes from the construction sector. A quarter (741 million tonnes) is waste from mining and quarrying. Manufacturing activities generated 364 million tonnes of waste. Households account for 215 million tonnes, or 7 %, of the waste generated in 2006 in the EU-27.

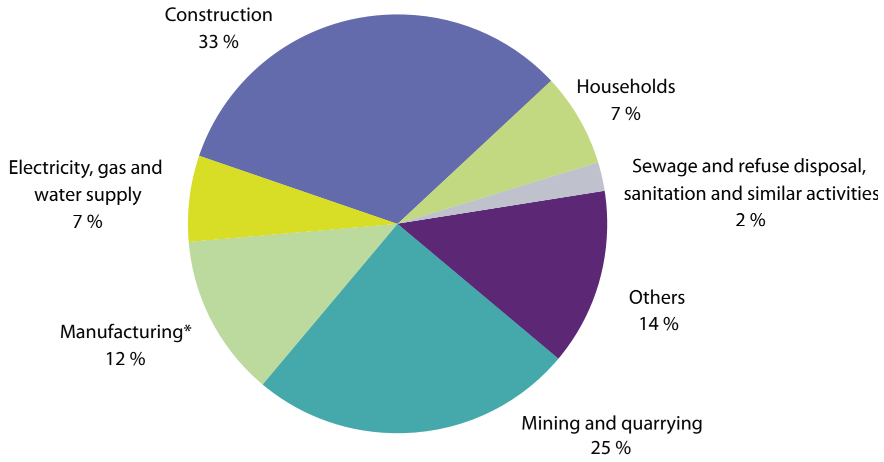
The relative importance of the various sources of waste varies between countries and according to their own economic structure. This is evident from comparing waste arising by economic sector in European countries, as in Figure 3.7.

Industry, which includes mining and quarrying, and electricity, gas and water supply, as well as manufacturing activities and construction, is the main waste generator in all the EU countries except Latvia where households are the principle generators of waste.

Hazardous waste

Hazardous waste can arise from all human activities. As Figure 3.8 shows, 29 % of EU-27 hazardous waste comes from the manufacturing sector. Figure 3.9 compares the hazardous waste generated to the total quantity of waste arising in each economic sector. The sectors producing the

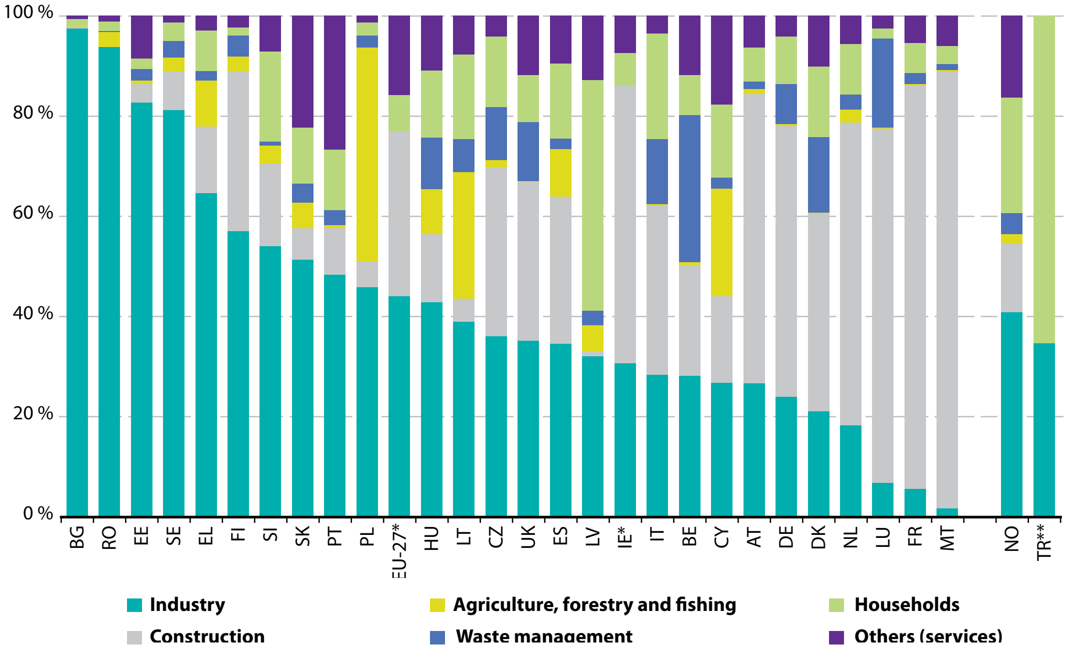
Figure 3.6: Waste generation by economic sector, EU-27, 2006 *(% of total waste)*



* Excluding recycling activities (NACE Rev. 1.1. division DN37).

Source: Eurostat (env_wasgen)

Figure 3.7: Waste generation by economic sector, 2006 *(% of total waste)*

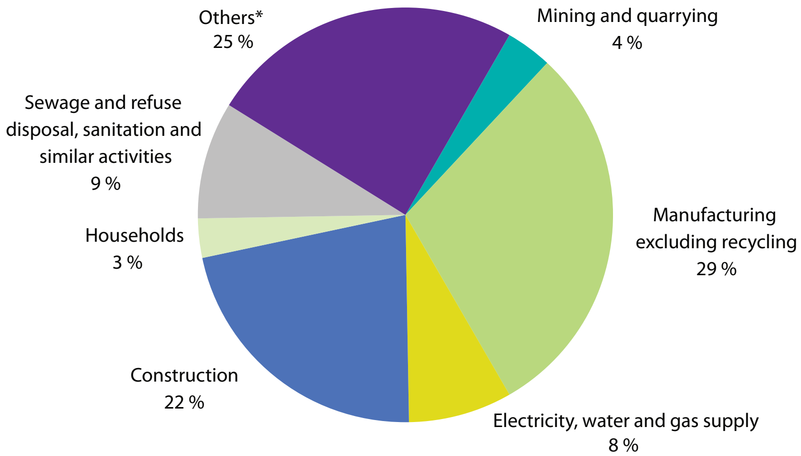


* EU-27 and IE: others include also agriculture, forestry and fishing as well as waste management services.

** TR only reported wastes generated by industry and households.

Source: Eurostat (env_wasgen)

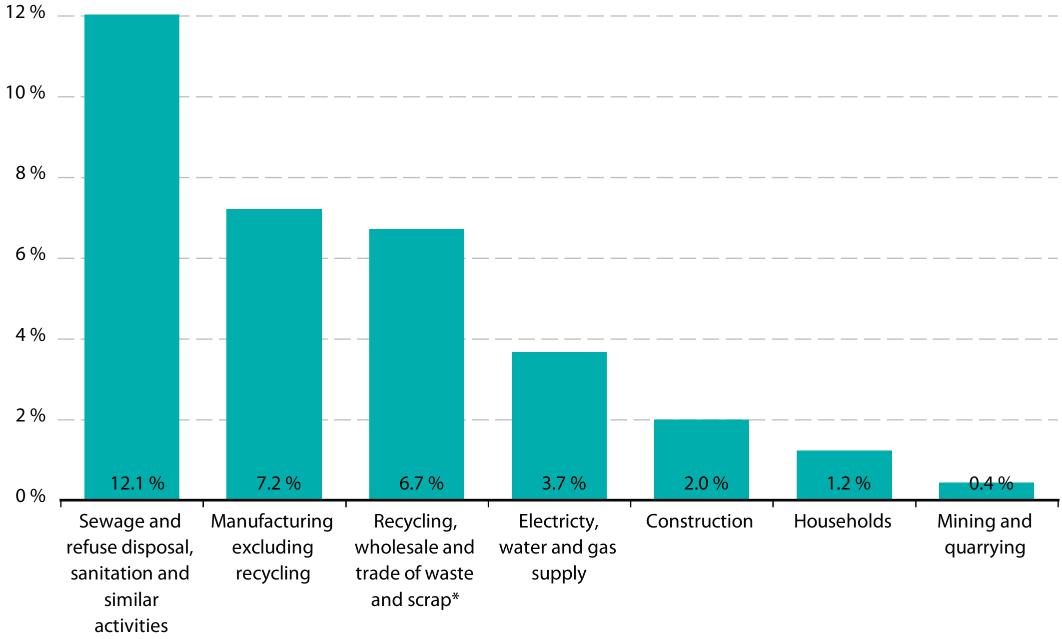
Figure 3.8: Hazardous waste by economic sector, EU-27, 2006 *(% of total hazardous waste)*



*Others include recycling, wholesale and trade of waste and scrap for which 2006 data is not available for the EU-27 due to confidential data. In 2004, 5.4 % of total hazardous waste was generated by this sector.

Source: Eurostat (env_wasgen)

Figure 3.9: Hazardous waste, EU-27, 2006 *(% of total waste generated by economic sector)*



* 2004

Source: Eurostat (env_wasgen)

highest shares of hazardous waste are sewage and refuse disposal, sanitation and similar activities. In fact, 12 % of the waste generated by this sector is hazardous. Only 7 % of the waste generated by the manufacturing sector is hazardous. Although it is the main generator of hazardous waste in the EU-27 and in most European countries, only 0.4 % of waste generated by the mining and quarrying sector is hazardous.

For each economic sector, waste generation and treatment create different pressures on the environment. This is mainly due to the quantity of waste generated, the types of waste generated, and the proportion of the waste which is hazardous.

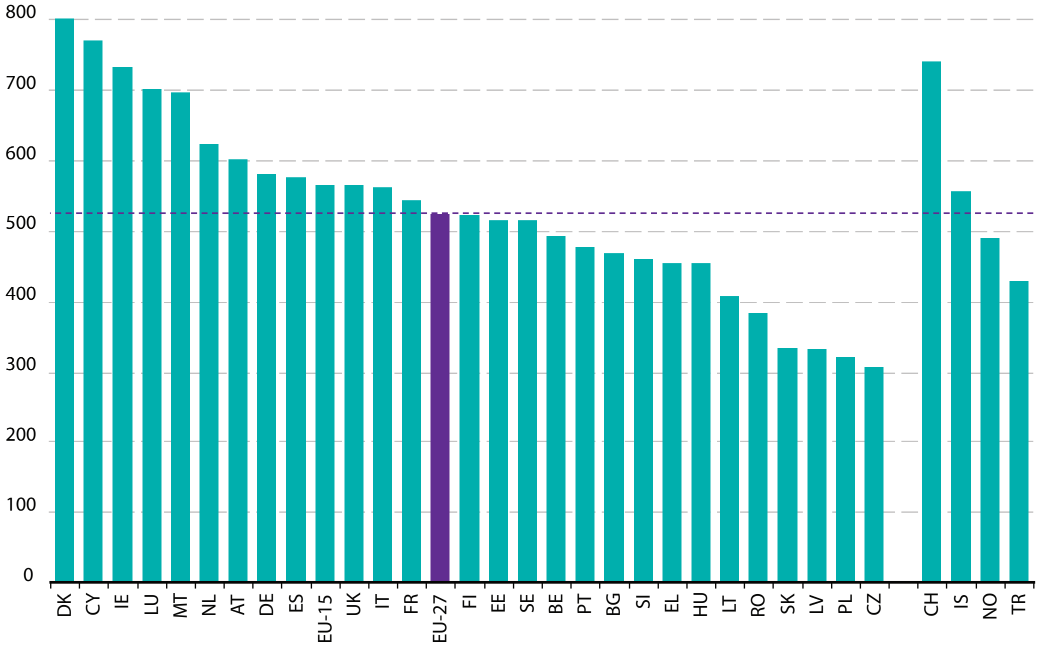
Municipal waste

Waste collected by municipal authorities includes all the waste collected and disposed of through the municipal waste management system. Municipal waste consists of waste generated by households and other wastes, which are similar in nature and composition, collected and managed by or on behalf of municipal authorities. The bulk of this waste stream is from households, though similar wastes from sources such as commerce, offices and public institutions are included. It includes many different types of materials including paper, plastics, food, glass and household appliances.

On average, in the EU-27, municipal waste in 2008 was 524 kg per capita. The generation of municipal waste per capita ranges between 800 kg in Denmark to 300 kg in the Czech Republic. Figure 3.11 shows municipal waste generation in EU-27 from 1995 to 2008.

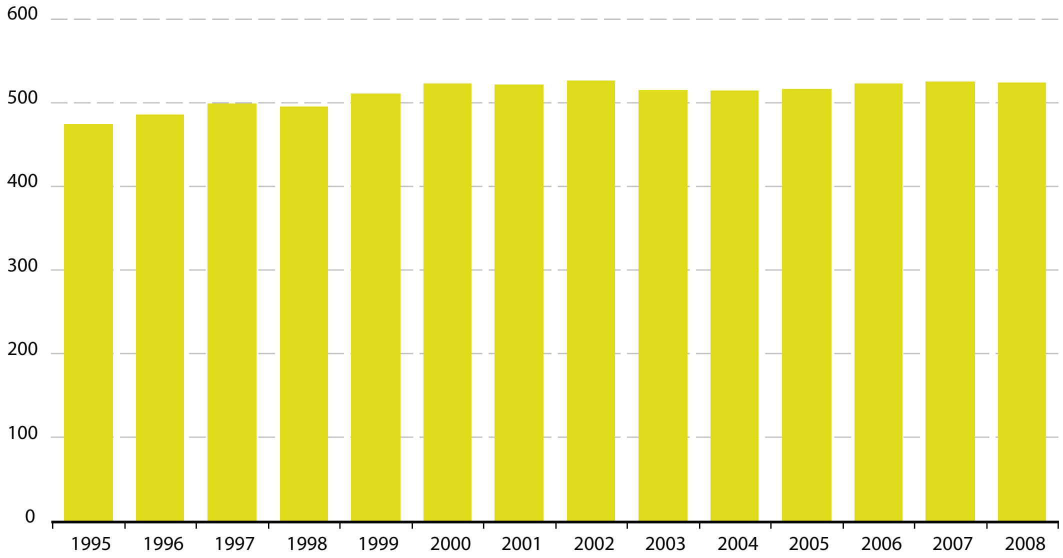
The differences among countries are due to the different waste streams collected by municipal authorities in different countries (the inclusion, by certain Member States, of waste generated not only by households but also by small businesses

Figure 3.10: Municipal waste generated, 2008 *(kg per capita)*



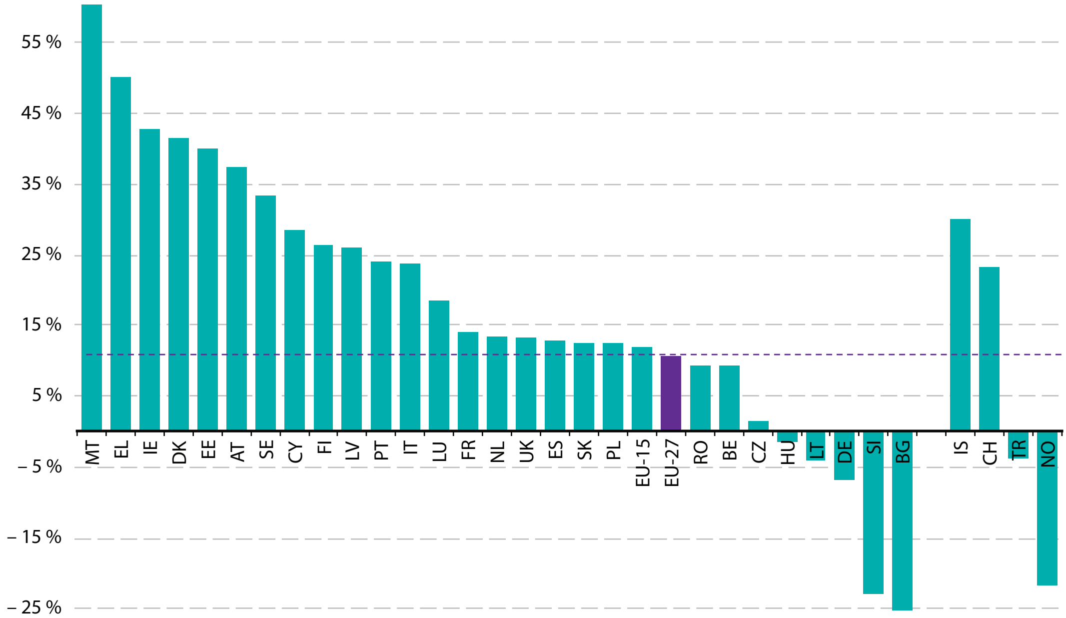
Source: Eurostat (tsdpc210)

Figure 3.11: Municipal waste generated, EU-27 *(kg per capita)*



Source: Eurostat (tsdpc210)

Figure 3.12: Municipal waste generated, 1995 and 2008 *(% change)*



Source: Eurostat (tsdpc210)

and public institutions), as well as differences in national consumption patterns.

Figure 3.12 shows the change in municipal waste generation per capita between 1995 and 2008 in the European countries. Municipal waste increased in almost all European countries. In most countries this increase is at least greater than 10 %. Only seven countries produced less municipal waste per capita in 2008 than in 1995: Hungary, Turkey, Lithuania, Norway, Germany, Slovenia and Bulgaria.

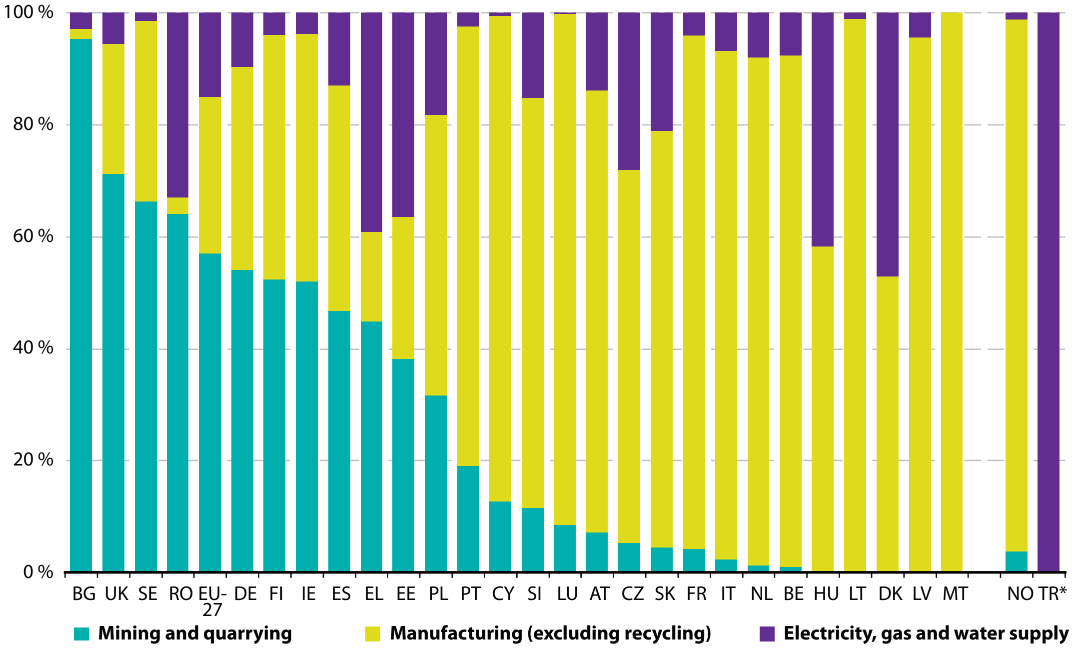
Industrial waste

In 2006, industry generated 1.3 billion tonnes of waste, accounting for 44 % of the waste generated in the EU-27. Industrial waste includes many different waste streams arising from a wide range of industrial processes. The three main industrial subsectors are the manufacturing sector, the electricity and gas supply sector, and the mining and quarrying sector.

Most of the waste generated from industry comes from mining and quarrying activities (57 % of waste generated by industry). Manufacturing activities generated 28 % and the electricity, gas and water supply sector 15 % of waste arising from industry.

Figure 3.13 shows the proportion of generation of waste by the three main industrial sectors in the generation of waste from industry in European countries. These proportions depend on the presence of a mining industry and on different techniques for electricity production. Manufacturing is the most important generator of waste from industry in 18 out of 27 countries.

Figure 3.13: Waste generated by industrial subsector, 2006 *(% of total industrial waste)*



*TR reported only waste from electricity, gas and water supply sector.

Source: Eurostat (env_wasgen)

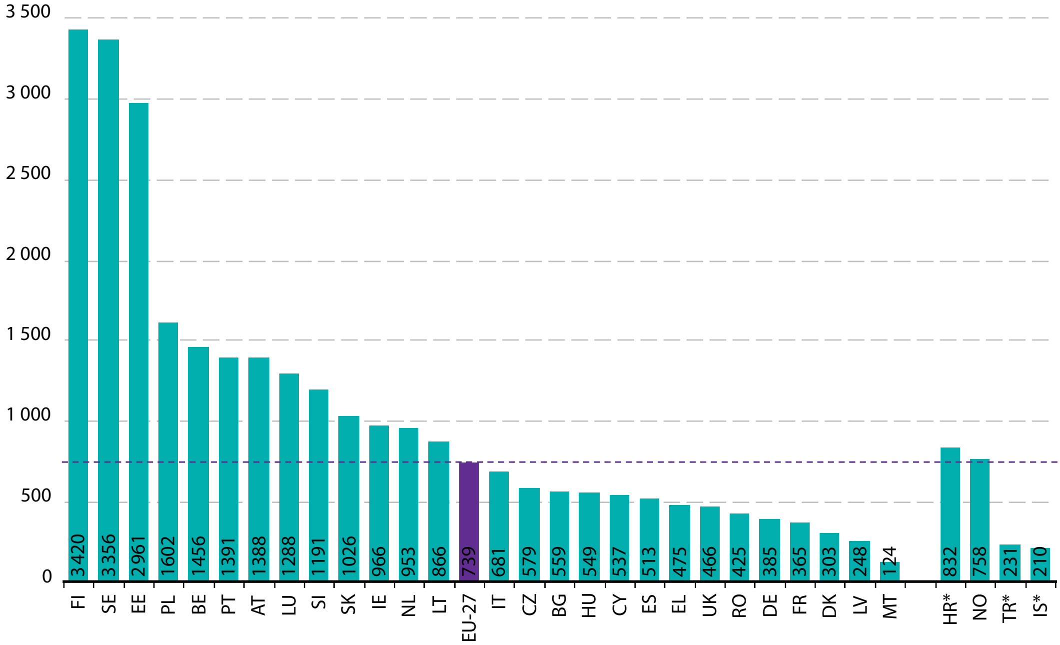
Manufacturing waste

The manufacturing sector is the backbone of industry in European countries. It covers a broad and diverse range of different activities, including establishments engaged in the mechanical, physical or chemical transformation of materials, substances or components into new products. The manufacturing sector generated 739 kg of industrial waste per capita in the EU-27 in 2006.

The manufacturing sector includes industries that produce goods including food, beverages and tobacco products, textiles, apparel, leather and allied products, paper and paper products, printing and related support activities, chemicals, plastics and rubber products, non-metallic mineral products, primary metals and fabricated metal products, machinery, computer and electronic products as well as other electrical equipments, appliances and components, transportation equipment, furniture and related products, medical equipment, jewellery, sporting goods, toys, office supplies, signage and many other products. Every kind of production has its own waste. Thus it is not surprising that the generation of waste from the manufacturing sector depends on the structure of this sector in each country.

The 'manufacture of basic metal' sector generated a third of all manufacturing waste in the EU-27 in 2006. The sectors regarding 'manufacture of textile and textile products', 'coke and refined petroleum' and 'furniture' each represented less than 2 % of EU-27 manufacturing waste.

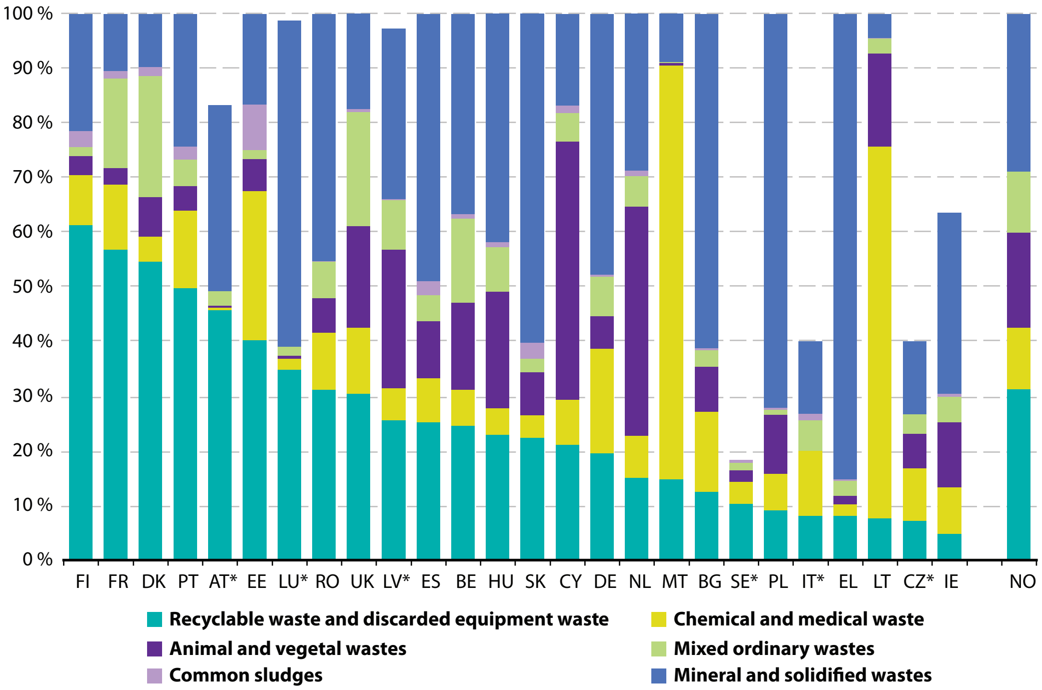
Figure 3.14: Waste generated in the manufacturing sector, 2006 *(kg per capita)*



* 2004

Source: Eurostat (env_wasgen)

Figure 3.15: Waste generated by type, 2006 *(% of total waste generated by manufacturing sector)*



* Due to confidential data, for some countries it is not possible to show the exact share of each type of waste.

Note: Some countries are not included due to very low values or partly missing data.

Source: Eurostat (env_wasgen).

Figure 3.15 compares the types of waste generated by manufacturing activities across European countries. Recyclable waste and discarded equipment, and mineral and solidified waste are the most important sources of waste generated by the manufacturing sector. In Malta and Latvia, chemical waste is the largest waste stream. In the Netherlands and Cyprus, animal and vegetal wastes are the largest waste stream.

Seven per cent of waste arising from the EU manufacturing sector is hazardous. The principal hazardous wastes from manufacturing are chemical wastes. Nonetheless, in many countries hazardous mineral and solidified waste coming mainly from combustion processes (e.g. the autoproduction of energy) and some industrial processes (e.g. the fabrication of metals) is significant.

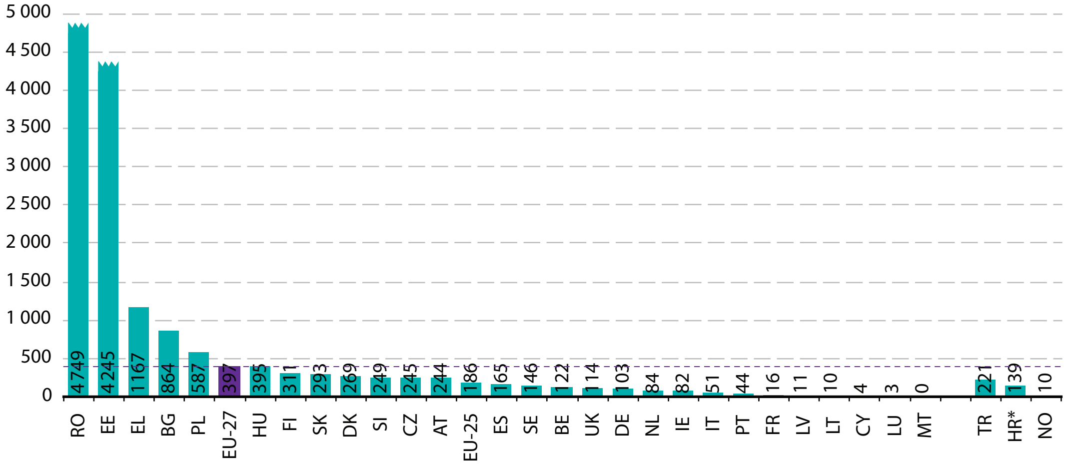
Electricity, gas and water supply waste

Most of the waste from electricity, gas and water supply comes from the generation of electricity and heat, and it is mainly made up of combustion residues.

Some European countries, such as Romania and Estonia, produce huge amounts of waste from electricity production. This is due to peculiarities in their electricity-generating sector such as, for instance, the fuels used for electricity production.

Mineral and solidified waste, which is mainly made up of residuals from burning operations and ashes from filters, is the electricity sector's largest proportion of waste in most European countries. Austria and Luxembourg reported high amounts of recyclable waste and discarded equipment waste.

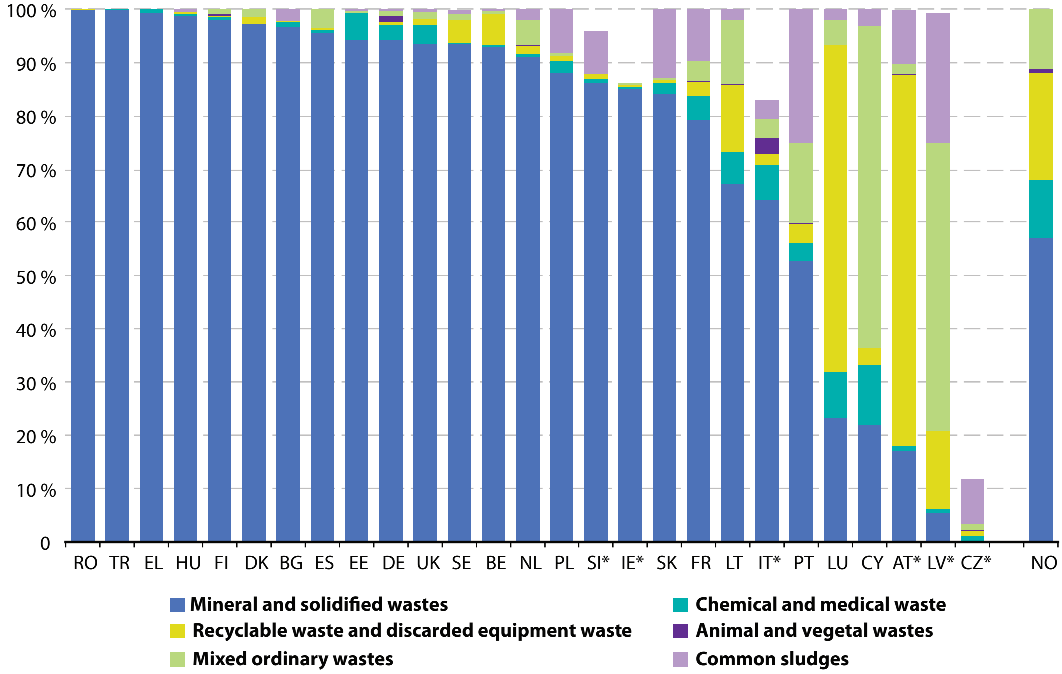
Figure 3.16: Waste generated in the electricity, gas and water supply sector, 2006 *(kg per capita)*



* 2004

Source: Eurostat (env_wasgen)

Figure 3.17: Waste generated by type, 2006 *(% of total waste generated by the electricity, gas and water supply sector)*



* Due to confidential data, for some countries it is not possible to show the exact share of each type of waste.

Source: Eurostat (env_wasgen)

On average in the EU-27, around 4 % of waste generated by the electricity, gas and water supply sector is hazardous. Almost all hazardous waste is made up of hazardous residuals from combustion (87 %).

Mining and quarrying waste

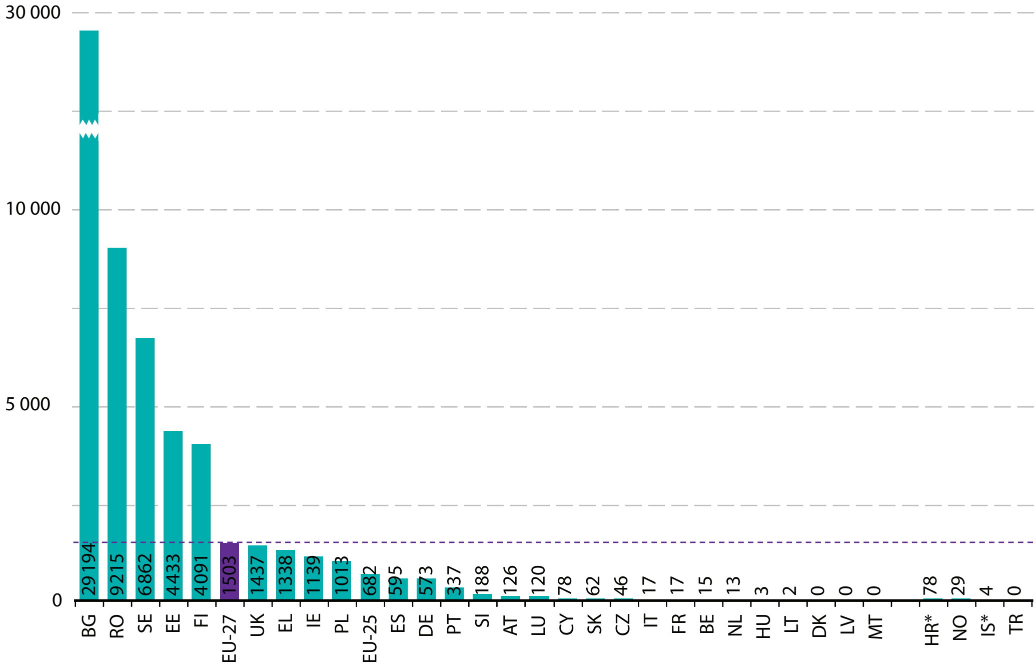
Waste from extractive operations (i.e. waste from the extraction and processing of mineral resources) is the largest waste stream in the EU. It involves materials that must be removed to gain access to the mineral resource, such as topsoil, overburden and waste rock, as well as tailings remaining after minerals have been largely extracted from the ore. Some of these wastes are inert and hence not likely to represent a significant pressure on the environment (although it is possible to find large quantities of heavy metals and other pollutants which are harmful for the environment and human health in this kind of waste).

Figure 3.18 compares the generation of waste from the mining and quarrying sector across European countries. Waste from extractive operations is the largest waste stream in some EU countries.

Waste generation from mining activities is dominated by mineral waste, although in some countries recyclable and discarded equipment waste can be quite significant.

Only 0.4 % of waste in the sector is hazardous. In most countries hazardous waste arising from mining activities is chemical waste (mainly used oils for machinery). In some countries the hazardous waste is mainly the material overlying the deposit of the useful mineral or fossil fuel (i.e. overburden) which has been contaminated by hazardous substances during the extraction activities.

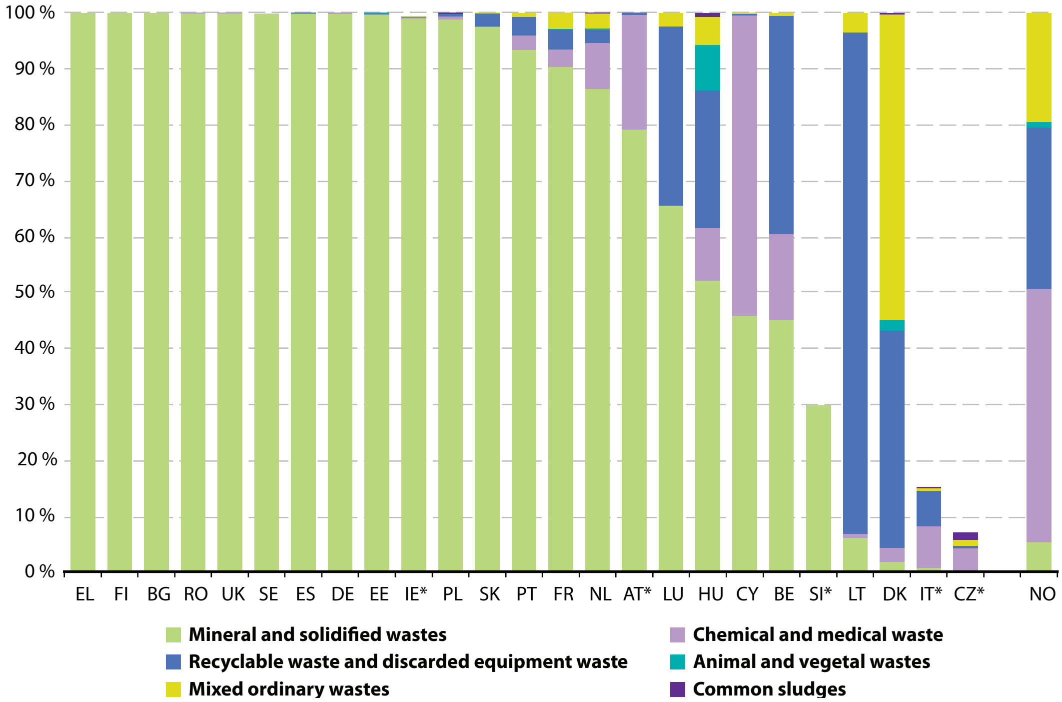
Figure 3.18: Waste generated in the mining and quarrying sector, 2006 *(kg per capita)*



* 2004

Source: Eurostat (env_wasgen)

Figure 3.19: Waste generated by type, 2006 *(% of total waste generated by mining and quarrying sector)*



* Due to confidential data, for some countries it is not possible to show the exact share of each type of waste.

Note: Some countries are not included due to very low values or partly missing data.

Source: Eurostat (env_wasgen).

MINING WASTE DIRECTIVE

In 2006 the EU implemented the mining waste directive (49), which sets a comprehensive framework for the safe management of waste from extractive industries at EU level.

Although it does not fix any targets for the management of mining waste to comply with, this directive provides additional best-practice guidance documents in order to set up a comprehensive framework for the safe management of waste from the extractive and mineral processing industries.

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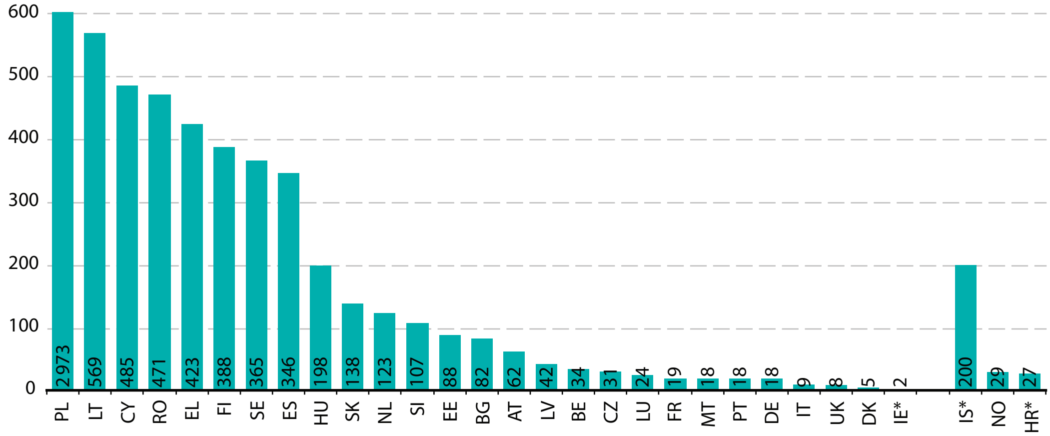
(49) Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries.

Agriculture and forestry waste

Waste from agriculture and forestry includes animal waste, vegetal waste and wood waste but also plastics (e.g. silage and horticultural films), agrochemicals, animal health products (e.g. used syringes), waste from machinery (e.g. oil, tyres and batteries) and building waste (e.g. asbestos sheeting).

The countries in which agriculture and forestry produced the highest quantity of waste per capita in Europe in 2006 were Poland, Lithuania and Cyprus. The countries producing the least amount of waste per capita in the agriculture and forestry sector were Ireland, Denmark and the United Kingdom.

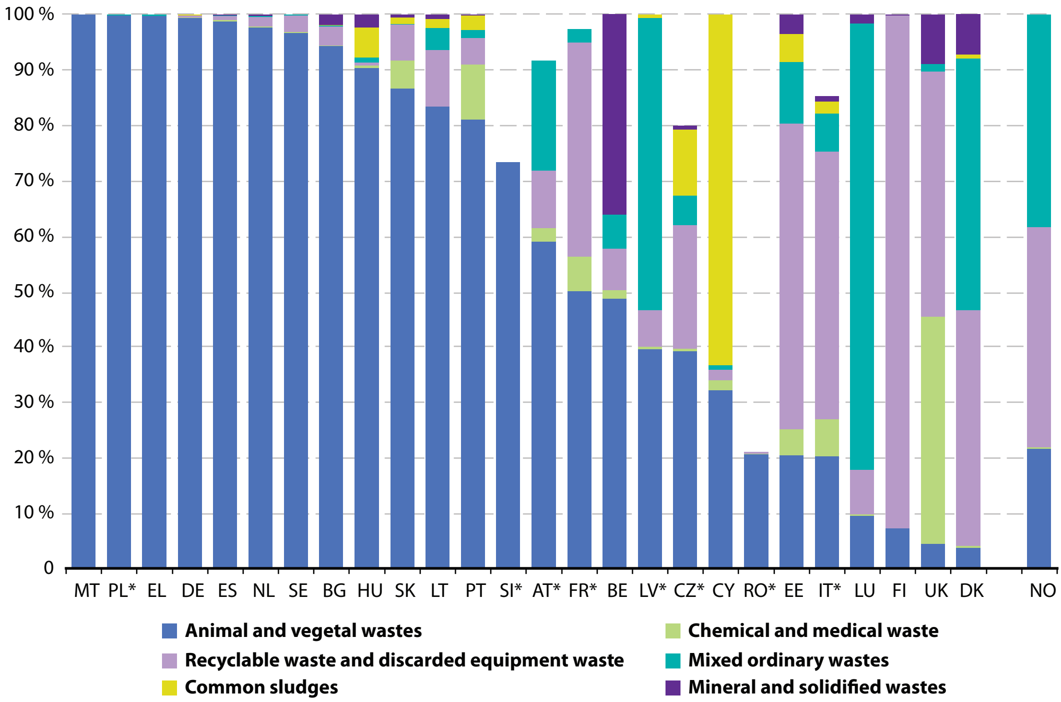
Figure 3.20: Waste generated in the agriculture and forestry sector, 2006 *(kg per capita)*



* 2004

Source: Eurostat (env_wasgen)

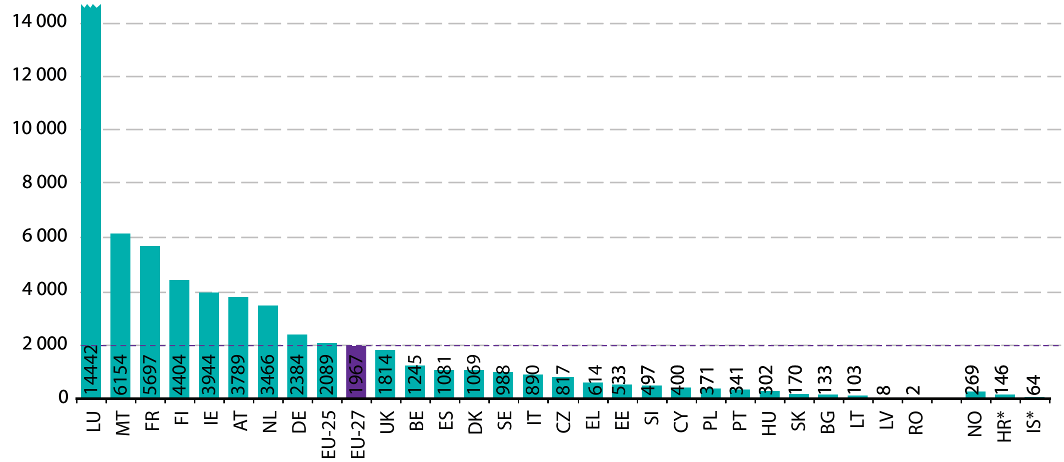
Figure 3.21: Waste generated by type, 2006 *(% of total waste generated by the agriculture and forestry sector)*



* Due to confidential data, for some countries it is not possible to show the exact share of each type of waste.

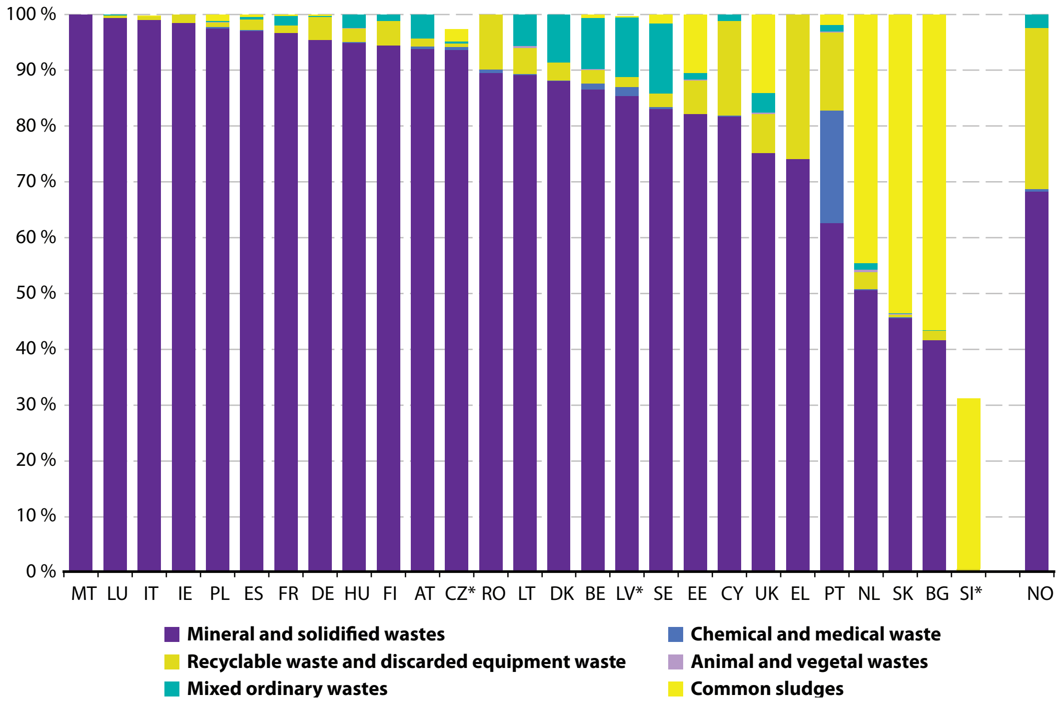
Source: Eurostat (env_wasgen).

Figure 3.22: Waste generated in the construction sector, 2006 *(kg per capita)*



Source: Eurostat (env_wasgen)

Figure 3.23: Waste generated by type, 2006 *(% of total waste generated by the construction sector)*



* Due to confidential data, for some countries it is not possible to show the exact share of each type of waste.

Source: Eurostat (env_wasgen)

Animal and vegetal waste is the main waste of the agriculture and forestry sector in most countries but significant amounts of recyclable and discarded equipment waste arise in some countries.

Hazardous waste in the agricultural sector is mainly made up of chemical waste and hazardous recyclable and discarded equipment waste.

Construction sector waste

Waste generated by the construction sector arises from activities such as the construction of buildings and civil infrastructure, total or partial demolition of buildings and civil infrastructure, road planning and maintenance. Almost 2 tonnes of waste per capita were generated by this sector in the EU-27 in 2006.

As with the mining and quarrying sector, waste generated in the construction and demolition sector varies a lot from country to country.

Mineral waste is the main waste stream from construction and demolition activities. In the Netherlands, Slovakia, Slovenia, and Bulgaria, a significant amount of common sludge arises from construction activities that are mainly related to the maintenance of harbours, rivers and canals.

The main hazardous waste generated by construction activities in most European countries is mineral waste, that is, for instance, overburden contaminated by hazardous substances during excavation or demolition waste. Chemical waste is a major hazardous waste stream in the construction sector in some countries such as Portugal, Latvia and Bulgaria

Transportation of waste

Economic growth and globalisation have led to a worldwide increase of waste transport across borders. These waste movements ('shipments') can involve hazardous waste and create risks for human health and the environment. In other cases, waste, such as materials that can be recycled and reused, is traded to replace natural resources in industrial facilities.

Data on waste shipments cover only notified waste: these are mainly hazardous wastes and some other wastes. The so-called 'green-listed waste', which includes non-hazardous waste, can be exported under a lower level of control to EU and OECD countries and some designated non-OECD countries for recycling purposes.

From 1997 to 2005 the legal export of notified waste from EU Member States to other EU or non-EU countries almost quadrupled (EEA, 2009). Also, the import of notified waste increased by more than a factor of 4. Most of this waste went to other EU countries and only about 1–3 % went to non-OECD countries. In 2005, waste shipments from EU-25 Member States amounted to slightly more than 8 million tonnes. Imports of notified waste were reported at 10.4 million tonnes (EEA, 2009) (50). The levels of imports and exports of notified waste differ among EU countries (Figure 3.24). Exports per capita are highest in the Netherlands, Luxembourg, and Belgium. The most significant importers are Belgium, Norway, Germany and Sweden.

Among the most important driving forces for exports and imports of waste, at least hazardous and green-listed waste, are the differences in prices for treatment processes (which can be due to differences in tax levels), insufficient national waste treatment capacity and the need for special treatment technologies (EEA, 2009).

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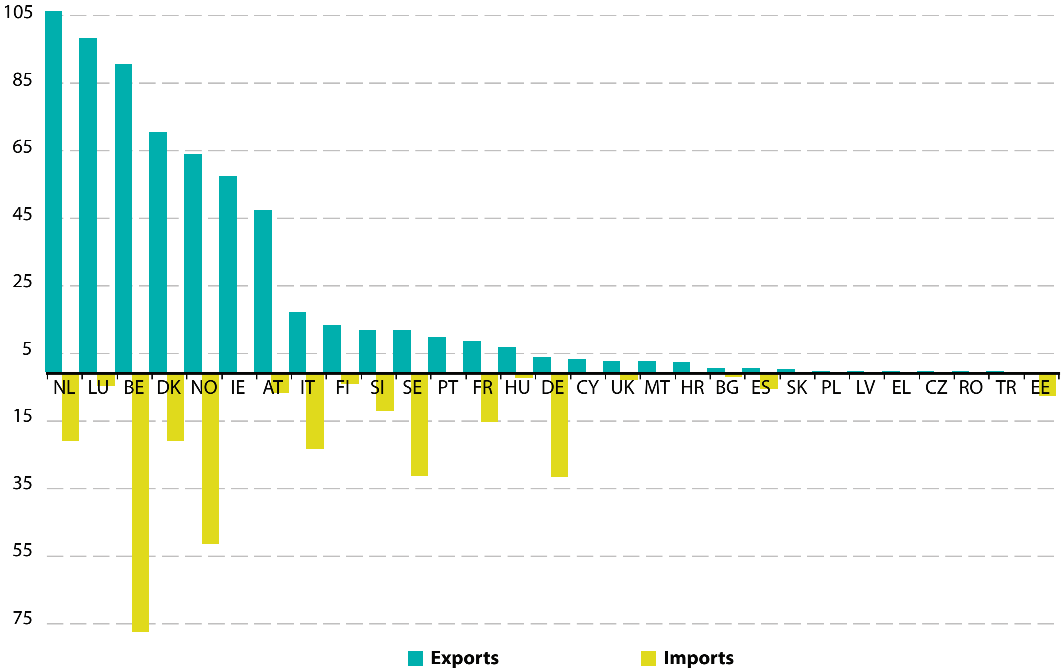
(50) A recent paper by the ETC/SCP provides a more detailed overview of the transboundary shipments of waste based on the European Waste List (and not the waste codes used by the Basel Convention), see ETC/SCP (2009).

Figure 3.24: Waste shipments, 2005 *(kg per capita)*



Source: Basel Convention (http://www.basel.int/natreporting/questables/frsetmain.html)

THE BASEL CONVENTION ON THE CONTROL OF TRANSBOUNDARY MOVEMENTS OF HAZARDOUS WASTE AND THEIR DISPOSAL

At international level, shipments of waste are governed by the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (51). The aim of the convention is to protect human health and the environment from adverse effects caused by the transboundary shipments of waste, especially hazardous waste.

The Basel Convention is implemented by the EU via the waste shipment regulation (52) which aims at strengthening, simplifying and clarifying the control procedures applicable to shipments of waste dictated by the Basel Convention.

All wastes for disposal, hazardous waste and some other waste streams have to be notified before the shipment. Notification means that the exporter has to inform the competent authorities about the details of the planned shipment and needs the written consent from the authority prior to shipment. EU Member States have to report the shipments of notified waste to the European Commission and to the Basel Convention Secretariat.

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(51) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (http://www.basel.int/text/con-e-rev.pdf).

(52) Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste.

Waste management

There are a number of different options available for the treatment and management of waste including prevention, preparing for reuse, recycling, energy recovery ([53]) and disposal, presented in the order stipulated by the waste hierarchy as stated in the waste framework directive. This means that not producing waste or reducing waste is preferred to recycling; recycling is preferred to incineration (with or without energy recovery); and disposal onto and into land is the least preferred option of the accepted methods of disposing of waste. Thus, under EU policy, landfilling is seen as the last resort and should only be used when all the other options have been exhausted. Only material that cannot be reused, recycled or otherwise treated should be landfilled.

However each option has its drawbacks and advantages, which makes waste management decisions increasingly complex for policy-makers and waste managers at all levels.

Waste treatment in European countries

On average in the EU-27, disposal, which includes landfilling as well as land treatment and release into water bodies, represented slightly more than 50 % of waste treatments. The other main waste treatment modes are incineration, energy recovery

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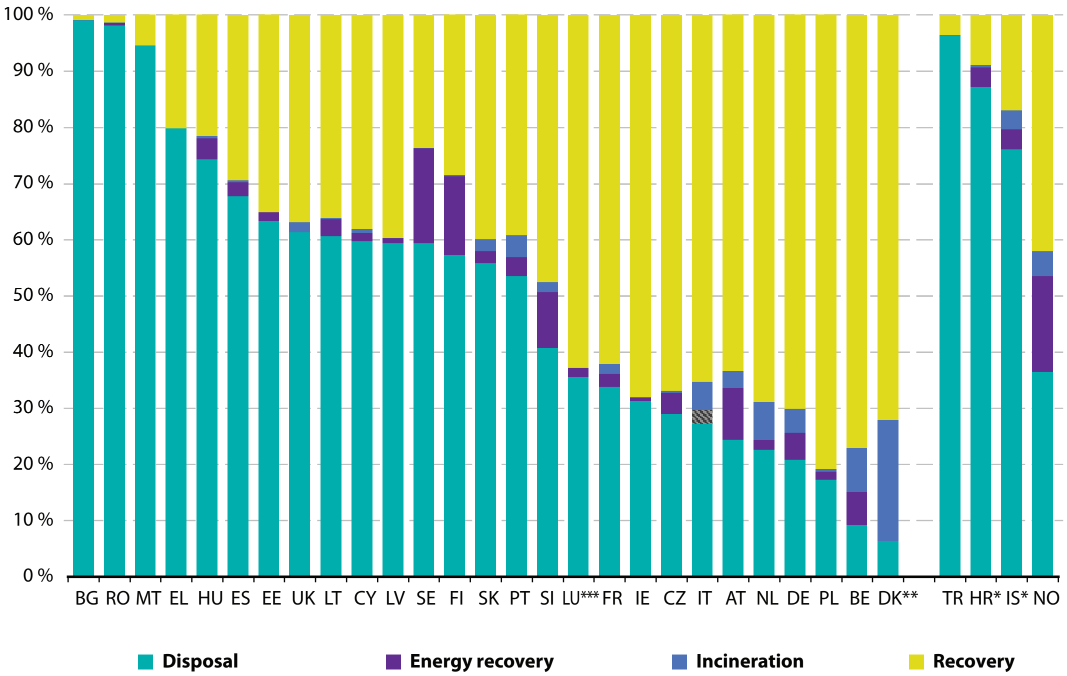
([53]) Energy recovery is the use of combustible waste as a means to generate energy. Directive 2008/98/EC refines the definition of energy recovery, including the energy efficiency of incineration facilities to be equal to or above a certain threshold (Annex II).

Figure 3.25: Waste treatment by type, 2006 *(% of total waste treated)*



* HR and IS: 2004, ** DK:, *** LU: energy recovery and incineration are together due to confidential data.

Source: Eurostat (env_wastrt)

and material recovery, which include all operations leading to materials recovery, e.g. recycling.

In most European countries waste is still disposed of in landfills, despite the accepted principle that waste disposal in or on land should be considered as one of the least desirable options. However, the extent of the use of landfill varies between countries (see Figure 3.25, which summarises the part of waste treated by the four main treatment types: disposal, incineration, energy recovery and recovery) and also depends, among other things, on the most important waste streams generated. For example most mineral waste and overburden is disposed of by landfilling.

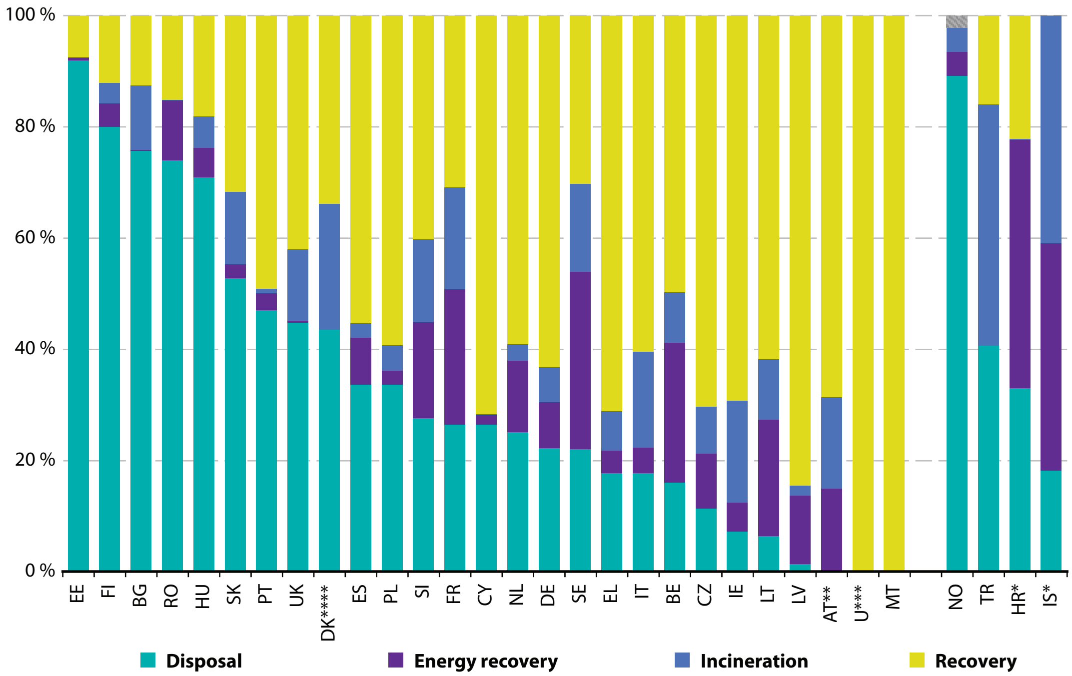
Disposal (which is manly landfilling) is still the first treatment mode in eight countries. Bulgaria and Romania deposited more than 98 % of their waste, which can partly be explained by the fact that the highest volumes of waste generated by these countries were in the mining and quarrying sector.

In some countries, for instance Austria, the Netherlands, Germany, Belgium and Denmark, a great proportion is now recovered or incinerated. This is due to the fact that these countries have imposed restrictions on the landfill of certain waste streams and have put in place policies aiming at recycling and recovery for most of the waste streams.

Hazardous waste treatment

Incineration and energy recovery are much more frequently used for the treatment of hazardous waste than for non-hazardous waste. Disposal is mainly used by countries where the main

Figure 3.26: Hazardous waste treatment by type, 2006 *(% of total hazardous waste treated)*



* HR and IS: 2004, ** AT: recovery and disposal are together since recovery is confidential, *** LU: energy recovery is confidential, disposal is 0, **** DK: land treatment and release into water bodies in deposit is missing

Source: Eurostat (env_wastrt)

hazardous waste is, for example, mining and combustion waste, as in Estonia, Finland, Bulgaria and Romania.

Municipal waste treatment

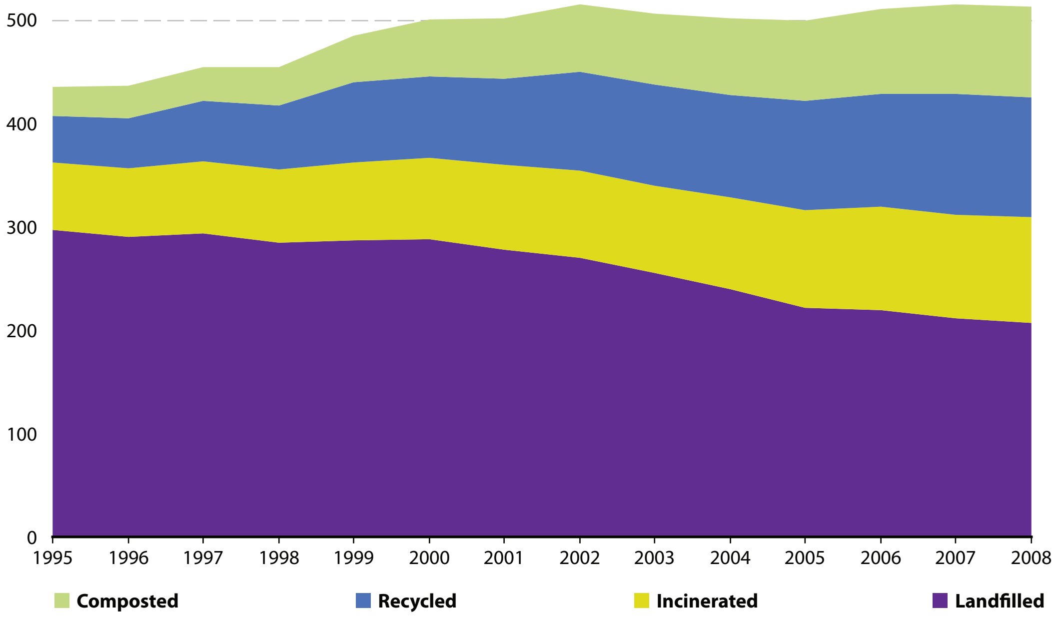
As far as municipal waste is concerned, Figure 3.27 and Figure 3.28 show the way this waste stream is treated in the EU-27 and in European countries.

Forty per cent of municipal waste treated in the EU-27 in 2008 was landfilled, 23 % recycled, 20 % incinerated and 17 % composted. Although it is still the first treatment mode, landfilling has been steadily decreasing since 1995 (-30 %). Incineration went up 56 % while composting and recycling boomed, growing by 217 % and 155 % respectively in the same period.

This can be partially explained by the implementation of the packaging and packaging waste directive and of the landfill directive, which aimed to increase the recycling and recovery of packaging waste and to divert biodegradable municipal waste away from landfill.

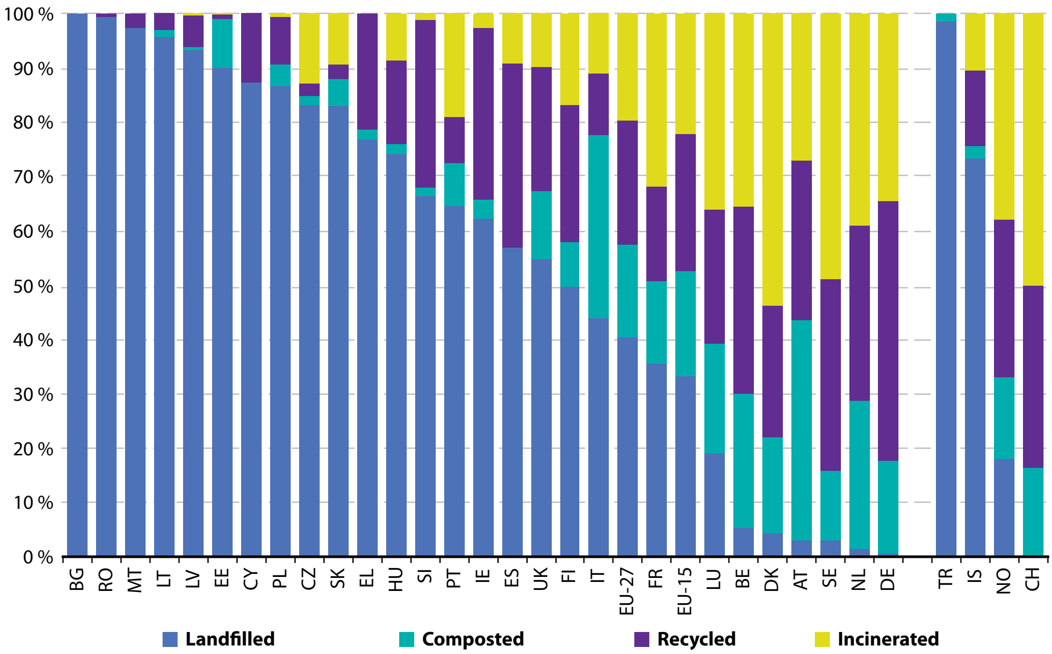
Landfilling, however, accounts for more than 50 % of the municipal waste treated in 19 out of 27 countries.

Figure 3.27: Municipal waste treatment, EU-27, *(kg per capita)*



Source: Eurostat (tsdpc210)

Figure 3.28: Municipal waste treatment, 2008 *(% of total municipal waste treated)*



Source: Eurostat (tsdpc210)

The recycling sector

The recycling sector plays a fundamental role in waste management. Recycling is crucial for both waste reduction and the reduction of consumption of natural resources. Increased recycling would also help Europe to be less dependent on the import of primary raw materials.

Thus, it is not surprising that the recycling sector is growing in economic importance in the European Union, with a significant contribution to employment.

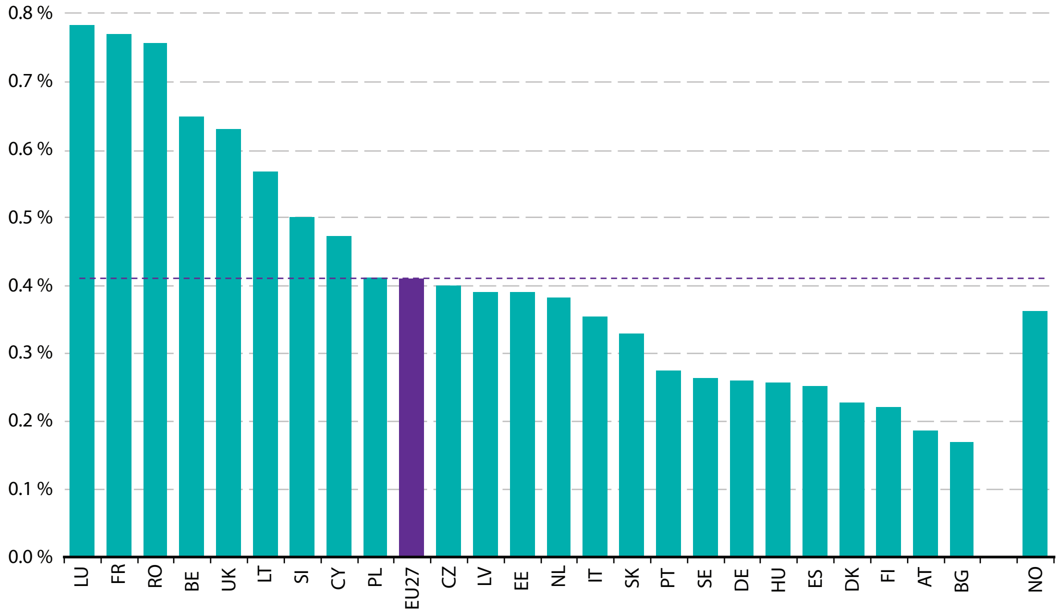
Since 2000, output in the EU-27 recycling industry has grown at an average annual rate of 4.2 %, far ahead of the industrial average over the same period (1.6 %). As such this was the fastest-growing industrial sector during this period (Eurostat, 2009).

In 2006, 0.4 % of the persons employed in the EU-27 industrial sector worked in the recycling industry, which equates to slightly more than 150 000 persons employed. In Romania, France and Luxembourg the share of persons employed in the recycling sector is almost double than for the EU-27. Recycling activities generated 0.4 % of the total value added by industry in the EU-27 in 2006.

Information (volume and value) on some post-consumer and post-industrial waste materials such as glass, paper and plastic — which is used as input in the recycling industry — can be found in the foreign trade statistics. The data refer to current trading activities, including trades from short-term as well as long-term contracts.

Figures 3.30, 31 and 3.32 show the total volume and a price index for glass (Figure 3.30), paper (Figure 3.31) and plastic (Figure 3.32) waste between 2000 and 2008.

Figure 3.29: Employment in the recycling industry, 2006 *(% of industry's number of persons employed)*



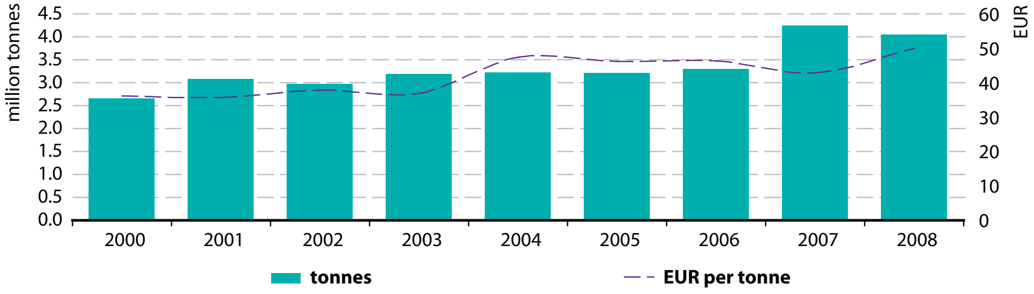
Note: Some countries are not included due to very low values or partly missing data.

Source: Eurostat (nama_nace60_e)

For each material, the foreign trade statistics offer several positions from post-consumer waste to highly priced well-defined high-quality process residues. The index aims to monitor the specific price for a defined, fixed set of materials, not just an average price.

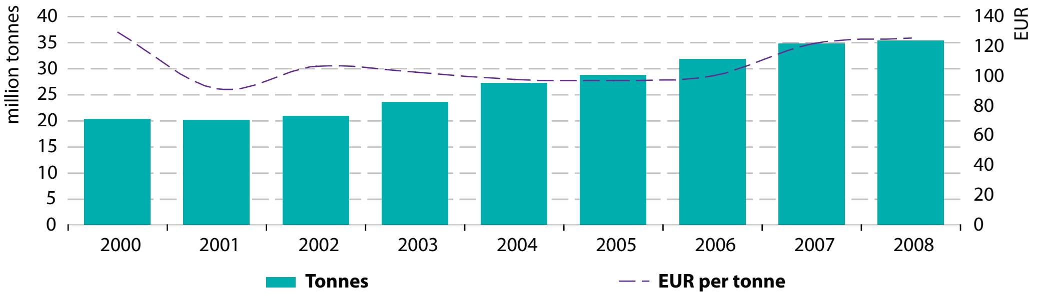
The total volume traded is an indicator of the market activity. The price of waste materials is highly influenced by the price of raw materials and thus by the overall economic development. The revenues for secondary material pay for a substantial portion of the waste management schemes.

Figure 3.30: Volume and price index of glass waste, EU-27 *(million tonnes and EUR)*



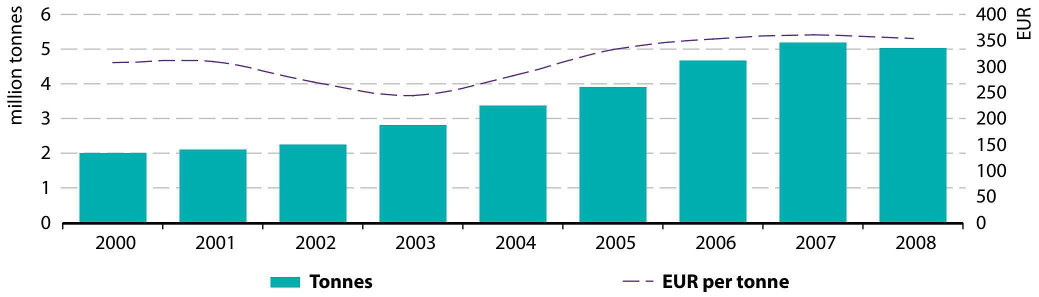
Source: Environmental Data Centre on Waste.

Figure 3.31: Volume and price index of waste paper, EU-27 *(million tonnes and EUR)*



Source: Environmental Data Centre on Waste

Figure 3.32: Volume and price index of plastic waste materials, EU-27 *(million tonnes and EUR)*



Source: Environmental Data Centre on Waste

EU rules for specific waste streams

Although the magnitude of the various waste streams varies across European countries, it is possible to identify waste streams that require specific consideration. Four examples are: packaging waste, batteries, end-of-life vehicles (ELV) and waste electrical and electronic equipment (WEEE).

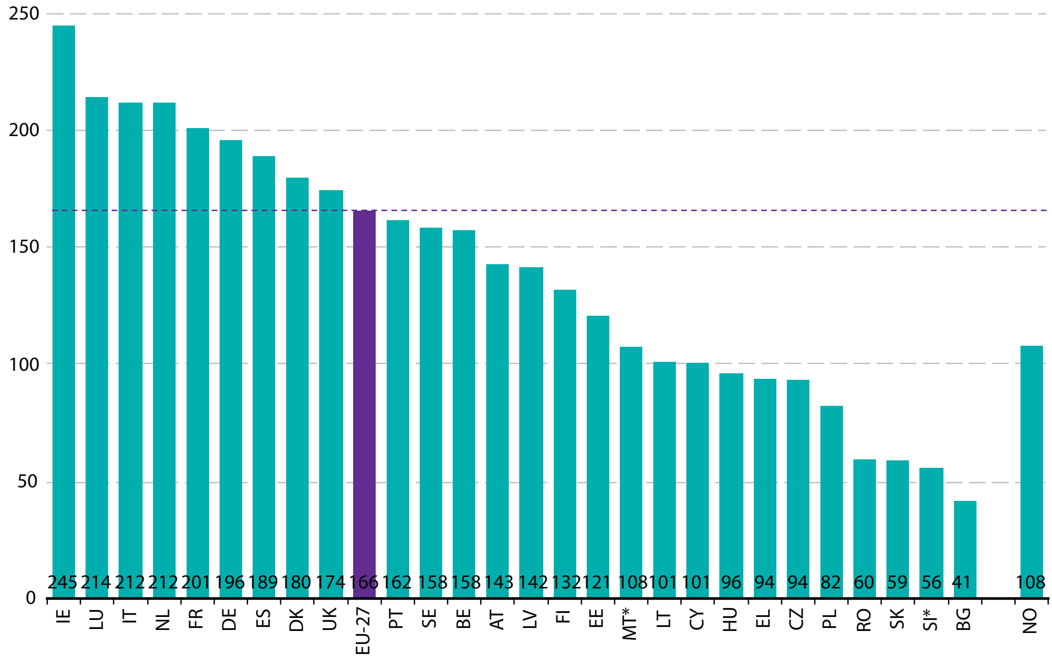
Packaging waste

Packaging is defined as any material which is used to contain, protect, handle, deliver and present goods. Packaging waste can arise from a wide range of sources including supermarkets, retail outlets, manufacturing industries, households, hotels, hospitals, restaurants and transport companies.

Items like glass bottles, plastic containers, aluminium cans, food wrappers, timber pallets, and drums are all classified as packaging.

In the EU-27, 166 kg per capita of packaging waste were generated in 2007. This quantity varied between 50 and 250 kg per capita across European countries. As Figure 3.34 shows, paper and cardboard, glass, plastic, wood, and metals are, in that order, the most common types of packaging waste in European countries.

Figure 3.33: Packaging waste generated, 2007 *(kg per capita)*



* 2004

Source: Eurostat (env_waspac)

THE PACKAGING WASTE DIRECTIVE

The packaging and packaging waste directive (54) aims at harmonising national measures concerning the management of packaging and packaging waste in order, on the one hand, prevent any impact thereof on the environment of all Member States as well as of third countries, or to reduce such impact, thus providing a high level of environmental protection, and, on the other hand, ensure the functioning of the internal market, and to avoid obstacles to trade and distortion and restriction of competition within the Community.

To this end, this directive lays down measures aimed, as a first priority, at preventing the production of packaging waste and, as additional fundamental principles, at reusing packaging, at recycling and other forms of recovering packaging waste and, hence, at reducing the final disposal of such waste.

The packaging and packaging waste directive sets out the following targets (by no later than 31 December 2008): a minimum of 60 % recovery rate (including waste incineration); between 55 and 80 % by weight of packaging waste to be recycled; with minimum rates of 60 % by weight for glass, paper and cardboard; 50 % by weight for metals; 22.5 % by weight for plastics; and 15 % by weight for wood.

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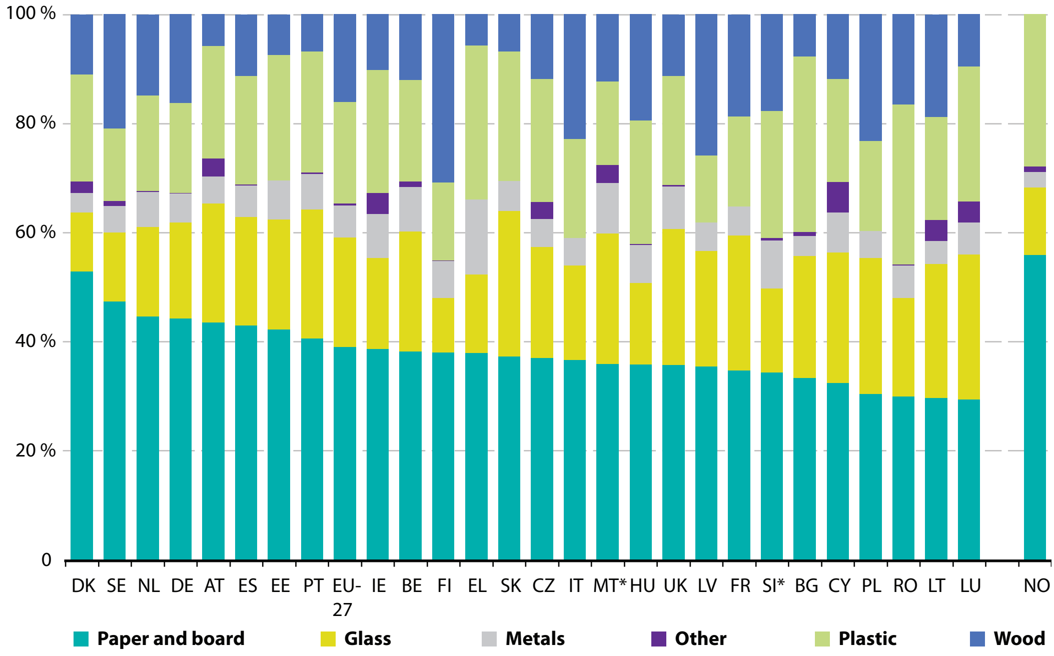
(54) European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, as amended by Directive 2004/12/EC.

Figure 3.34: Packaging waste generated by type, 2007 *(% of total packaging waste)*



* 2006

Source: Eurostat (env_waspac)

A recycling rate can be calculated by dividing the amount of packaging waste recycled by total amount of packaging waste generated. This rate was 58 % for the EU-27 in 2007 and ranged between 10 % in Malta and 80 % in Belgium.

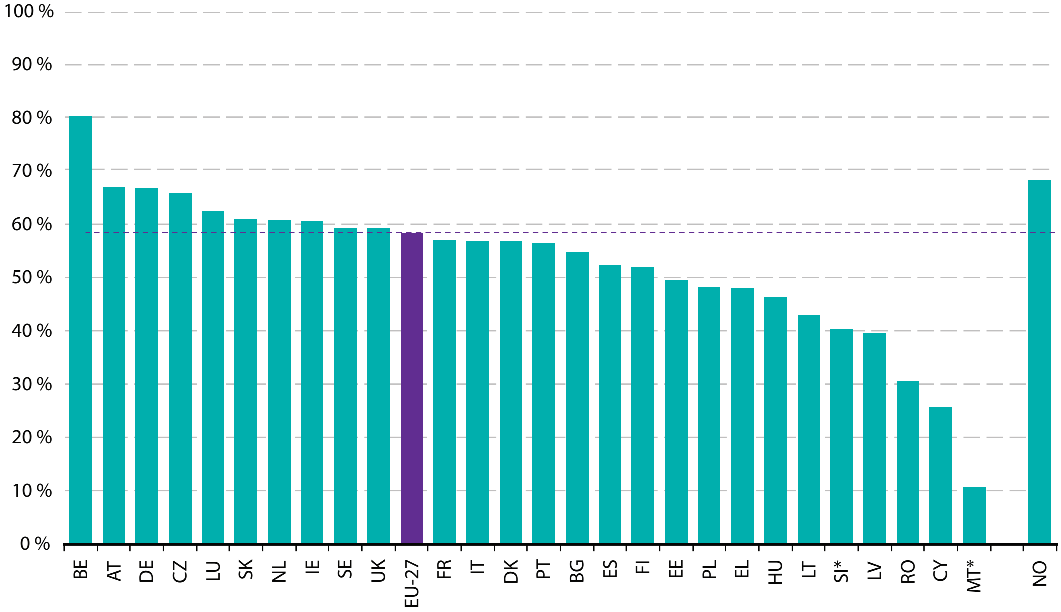
Policies for the reduction of packaging waste have insisted on two main items: producer responsibility and secondary market development. Producer responsibility arrangements — that sometimes include deposit refund systems — were set in place throughout Europe to increase packaging recycling and recovery rates. However, the success of recycling strategies is very much dependent on the functionality of secondary (recycled) materials markets too.

Figure 3.36 shows the evolution of the packaging recycling rate in the EU-15 countries.

The amount of recycled and recovered packaging has steadily increased in the EU. In the EU-15 the recycling rate of packaging waste went up from 46 % to 58 % between 1997 and 2007. If energy and other forms of recovery are also taken into account, the rate of recovery or incineration at waste incineration plants with energy recovery went up from 52 % to 72 %.

The recycling rate went up in almost all EU-15 countries between 1997 and 2007 (see Figure 3.36). The only exception is Germany, where the recycling rate went down from 80 % to 65 %. This can be explained by the contemporaneous rise of the recovery rate from 80 % to 94 %, meaning that an increasing share of packaging waste has been treated by recovery operations other than recycling (such as incineration with energy recovery, for example).

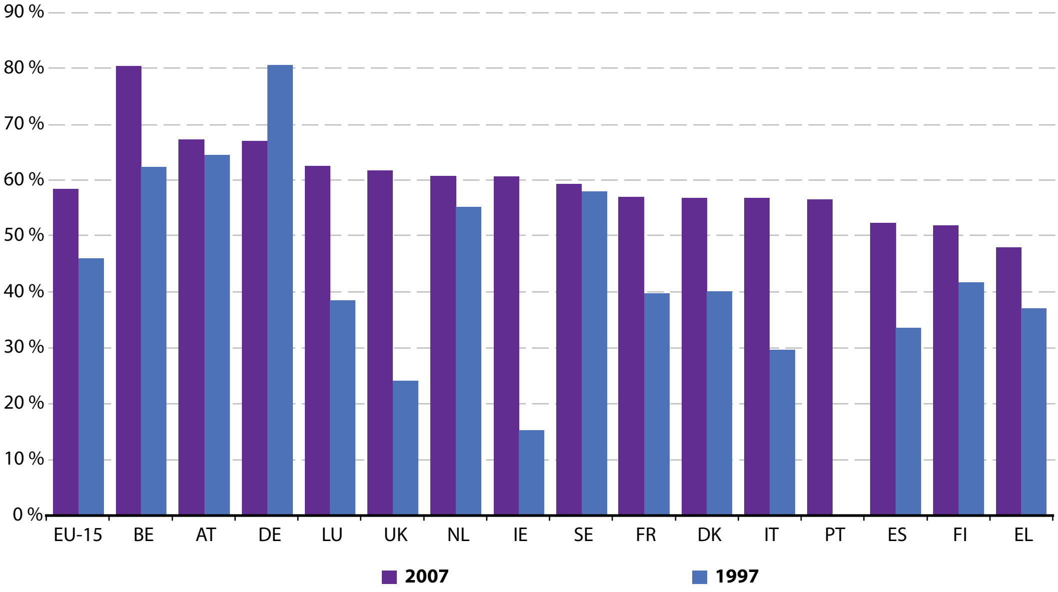
Figure 3.35: Packaging waste recycling rate, 2007



* 2006

Source: Eurostat (env_waspac)

Figure 3.36: Packaging waste recycling rate, 1997 and 2007



Source: Eurostat (env_waspac)

Disposal of batteries

DIRECTIVE ON THE DISPOSAL OF SPENT BATTERIES AND ACCUMULATORS (55)

Stricter rules on manufacturing and recycling batteries and accumulators (i.e. rechargeable batteries) have been introduced through the implementation of the directive on the disposal of spent batteries and accumulators. The directive prohibits the placing on the market of certain batteries and accumulators with a proportional mercury or cadmium content above a fixed threshold. In addition, it includes requirements on collecting, treating and recycling waste batteries and accumulators.

The aim is to cut the amount of hazardous substances — in particular, mercury, cadmium and lead — dumped in the environment; this should be achieved by reducing the use of these substances in batteries and accumulators and by treating and reusing the amounts that are used.

In particular, the directive sets:

- a 25 % collection rate for waste portable batteries to be met by September 2012, rising to 45 % by September 2016;
- a recycling rate of 65 % for lead acid batteries, 75 % for nickel-cadmium batteries and 50 % for other waste batteries;
- a prohibition on the disposal by landfill or incineration of waste industrial and automotive batteries — in effect setting a 100 % collection and recycling target for these types of batteries.

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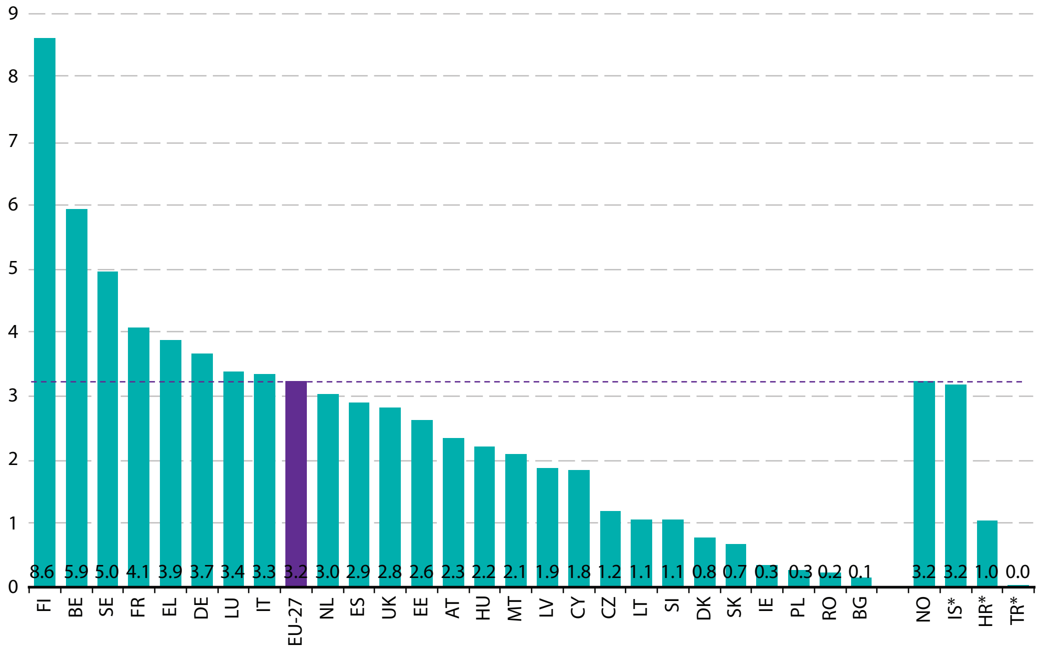
(55) Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC entered into force on 26 September 2006.

Figure 3.37: Batteries and accumulators waste, European countries, 2006 *(kg per capita)*



* 2004

Source: Eurostat (env_wasgen)

Primary batteries and secondary batteries (accumulators) are widely used. They often contain heavy metals such as mercury, cadmium, and lead among others, that may be emitted as gaseous emission or as leachate during disposal. Furthermore, the batteries contain valuable metals such as cobalt, nickel and lithium, and recycling may help to replace natural resources.

Due to the wide range of batteries that exist, and the varying component metals of which they are made, there are specific recycling processes for each battery type. Before recycling can take place, the first step is to sort the batteries into groups by type. Where batteries are not collected separately they enter the municipal waste stream and are either landfilled or incinerated.

In 2006, 3 kg of battery waste per capita were generated in the EU-27.

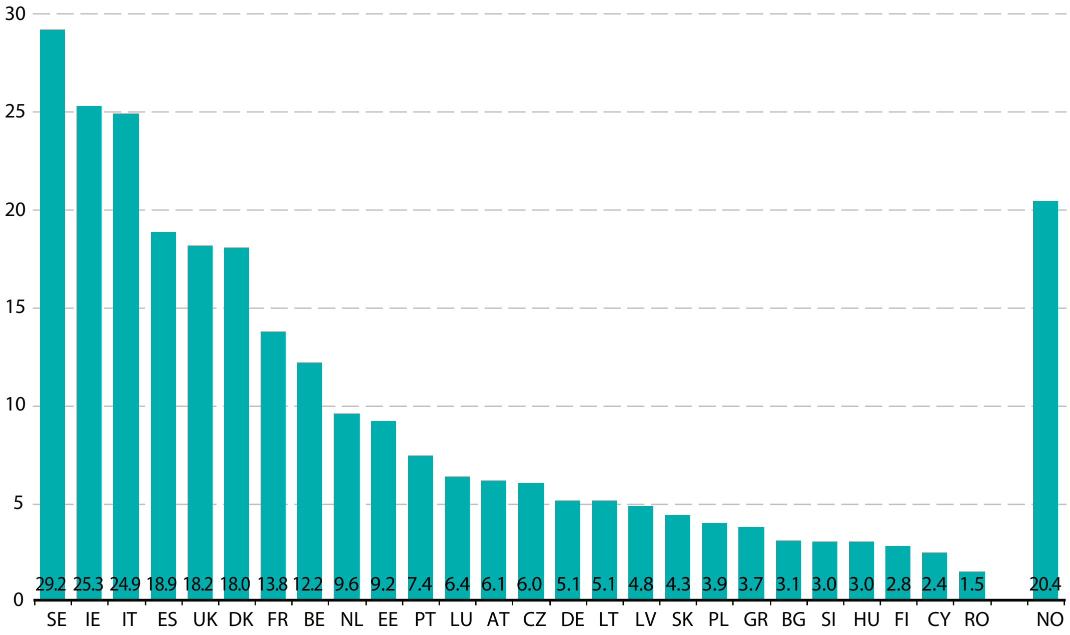
Reuse, recycling and recovery of end-of-life vehicles

End-of-life vehicles as defined by the ELV directive cover vehicles that hold up to a maximum of eight passengers in addition to the driver, and trucks and lorries that are used to carry goods up to a maximum mass of 3.5 tonnes. Thus ELVs come not only from households but also from other sources such as commercial and industrial uses.

Five Member States (Germany, the United Kingdom, France, Spain and Italy) account for approximately 75 % of EU-27 ELV waste arising.

ELV waste represents 1.5 kg to 30 kg per capita in European countries. In most new Member States the quantity of ELVs generated per capita is relatively small. For example, in Romania, ELV waste in 2007 was only 1.5 kg per capita. In Cyprus, Bulgaria and Hungary it was no more than 3 kg per capita. Nonetheless, differences also appear between EU-15 countries: Germany, and to a lesser extent France, reported a fifth and half

Figure 3.38: ELV: generation of waste, 2007 *(kg per capita)*



Source: Environmental Data Centre on Waste.

of the ELV waste generated per capita in Italy, respectively.

Figure 3.39 compares reuse and recycling (recovery) rates for ELVs across European countries. These are above 80 % for most of the countries.

Waste electrical and electronic equipment

Waste electrical and electronic equipment (WEEE) is currently considered to be one of the fastest-growing waste streams. Keeping a close interest in WEEE recycling is important considering the hazardous substances contained in many of the products in this waste stream (55), and that currently a large quantity of waste is being sent to non-OECD countries (illegally declared as used

END-OF-LIFE VEHICLES DIRECTIVE (56)

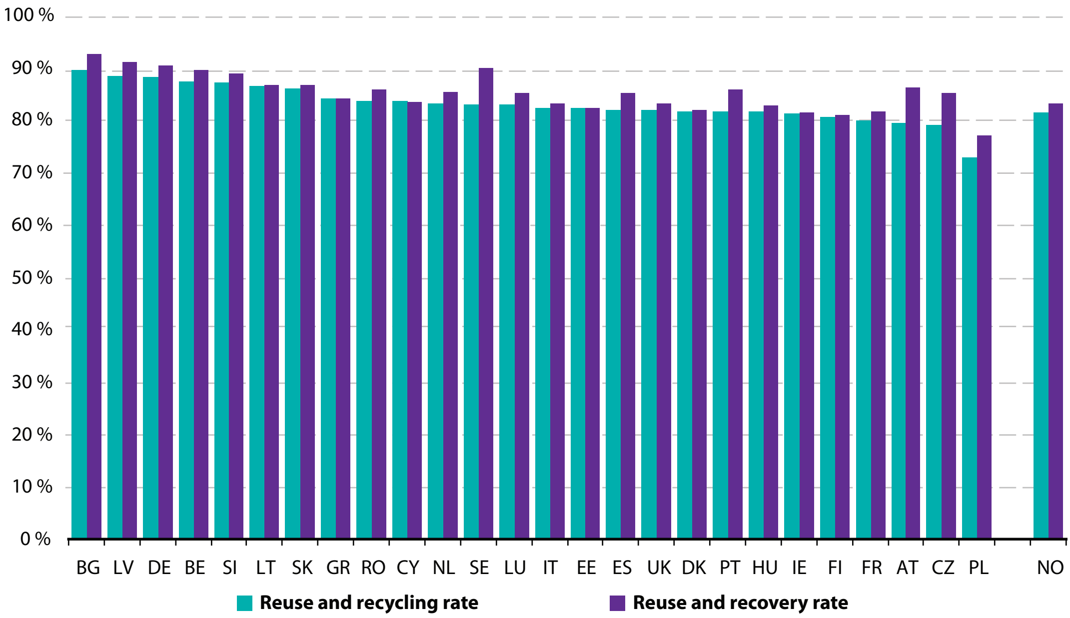
The directive on end-of-life vehicles lays down specific requirements for the management of end-of-life vehicles. The directive's main objective is the prevention of environmental pollution, hazardous waste from vehicles and, in addition to this, the reuse, recycling and other forms of recovery of end-of-life vehicles and their components so as to reduce the disposal of waste.

The European targets for ELV are that a minimum of 85 % of vehicles be reused or recovered (including energy recovery) and at least 80 % must be reused or recycled from 2006. These targets will shift to 95 % reused or recovered (including energy recovery) and 85 % reused or recycled by 2015.

The directive also aims to improve the environmental performance of all economic operators involved in the life cycle of vehicles and especially the operators directly involved in the treatment of end-of-life vehicles.

(56) Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles.

Figure 3.39: ELV reuse and recycling, and reuse and recovery rate, 2007



Source: Environmental Data Centre on Waste

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(55) Use of hazardous substances is restricted by the directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS). It also requires heavy metals (for example lead, mercury and cadmium) and flame retardants (for example polybrominated biphenyls (PBB) and polybrominated diphenyl (PBDE)) to be substituted. (see the chapter on chemicals for further information).

goods) where workers can be subjected to these substances in unregulated recycling operations.

Dumping electronic and electrical waste is also a waste of valuable, and increasingly limited, natural resources: WEEE contain precious metals of high economic value — not only gold, silver and platinum, but also ruthenium, rhodium, palladium, osmium and iridium.

The quantity of WEEE collected varies considerably among countries. This is due to the different degrees of implementation of policies based on the producer responsibility. In a small number European countries the quantity of WEEE collected is higher than half of the quantity of electrical appliances put on the market. This is the case in Norway, Sweden, Luxembourg and the Netherlands. This seems to indicate that WEEE policies are on the right track for success.

However, the weakness of the collection rate is that it mainly reflects the collection of heavy, large household appliances, and misses the small devices containing valuable resources (e.g. mobile phones and electronic devices).

THE WEEE DIRECTIVE (57)

Directive 2002/96/EC promoting the collection and recycling of electric and electronic equipments has been in force since February 2003. The legislation provides for the creation of collection schemes where consumers return their used e-waste free of charge. The objective of these schemes is to increase the recycling and/or re-use of such products.

The WEEE Directive strongly focuses on producer responsibility as a key policy mechanism for reducing the quantity of WEEE going to end disposal treatment facilities.

It currently sets a minimum collection target of 4 kg per annum per inhabitant for WEEE from households. A proposal has currently been submitted to alter the collection target from 4 kg per annum per inhabitant to a 65 % collection rate, calculated according to the average amount of WEEE placed on the market in the two preceding years. In addition, in order to encourage the re-use of whole appliances, it is proposed that such re-use be included within the 65 % target.

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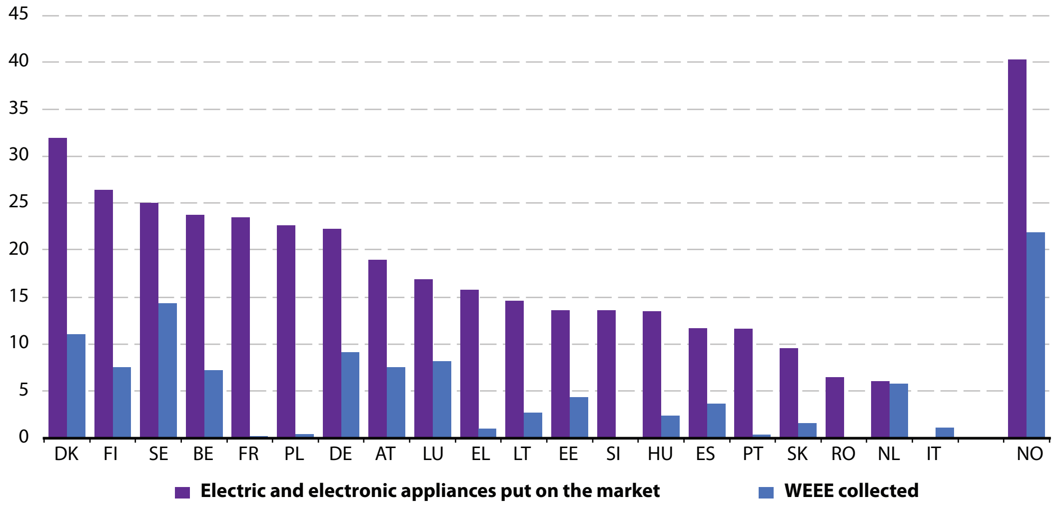
(57) Directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE).

Figure 3.40: Electric and electronic appliances put on the market and WEEE collection, 2006 *(kg per capita)*



Source: Environmental Data Centre on Waste.

Once it is collected, WEEE can undergo different treatment modes. In many European countries the recovery rates of the largest share of electronic equipment (i.e. large and small household appliances, IT and telecommunication appliances and lighting equipment) is well above 75 %. However, the recovery rates take into account only the portion of electronic equipment which is collected. This portion can be very small when compared to the total amount of electronic equipment put on the market. Raising the collection rate is crucial for the success of the EU policy on WEEE.

Conclusions: Waste in the European Union

From extraction, production, and distribution, final consumption of goods and services as well as during waste collection and treatment (e.g. sorting residues in recycling facilities and incinerator slag), all human activities are potential sources of waste.

The nature and dimension of waste impacts on the environment depend upon the amount and composition of waste streams as well as on the method adopted for treating them. Improper management of waste has already caused numerous cases of contamination of soil and groundwater, threatening the natural functioning of ecosystems and the health of the exposed population. The generation of waste represents also an inefficient use of valuable resources.

Almost 3 billion tonnes of waste (6 tonnes per capita) were generated in the EU-27 in 2006. Around 3 % of total waste generated in EU-27 in 2006 was hazardous (88 million tonnes) which poses substantial or potential threats to human health or the environment. Construction, mining and quarrying as well as manufacturing activities are the major sources of waste in the European Union: a third of all waste generated in the EU-27 (970 million tonnes) came from the construction sector, a quarter (741 million tonnes) from mining and quarrying, and manufacturing activities generated 364 million tonnes of waste. Households accounted for 7 % of the waste generated in 2006 in the EU-27 (215 million tonnes). The quantity and the compositon of waste generated across the European countries reflect differences in the economic structure, the consumption patterns and the different degree of implementation of waste policies.

On the total amount of waste treated in the EU-27, disposal (which includes landfilling as well as land treatment and release into water bodies) represented slightly more than 50 %. The other main waste treatment modes are incineration, energy recovery and recycling (material recovery). In some countries, restrictions have been imposed on the landfill of certain waste streams and a great proportion of total waste generated is now recovered or incinerated.

Through the Waste Data Centre, operated by Eurostat, Member States report data under European waste legislation to a single entry point. Data for specific waste streams as well as official waste statistics are becoming available in a common reporting, processing and dissemination environment to allow for cross validations and assessments. This one-stop-shop approach allows policy-makers, stakeholders, users from other European bodies and the interested public to find the data needed to assess the effectiveness of the European Union's waste policy. Data and indicators will show the development in (the reduction of) the amount of waste generated, the sound management of waste and the better use of resources; elements that are crucial for the protection of the environment, but also for the development of the EU economy, which is highly dependent on natural resources not available in Europe.

Eurostat will continue its effort towards a better comparability of data by use of common methodologies, classifications and definitions in the field of waste. The integration of data collections into official statistics will streamline reporting and should also lead to a reduction of the burden for respondents.

Further information

Eurostat main tables and database

Environment, see: Generation of waste by economic activity (ten00106); Generation of waste by economic activity (hazardous, non-hazardous), latest available year (ten00107); Generation of waste by waste category (ten00108); Generation of waste by waste category (hazardous, non-hazardous), latest available year (ten00109); Waste generated by households by year and waste category (ten00110); Municipal waste generated (tsien120); Municipal waste by type of treatment (tsien130)

Environment, see: Waste Statistics (env_wasr)

Eurostat dedicated section

Environmental Data Centre on Waste: http://ec.europa.eu/eurostat/waste

Statistics explained: waste statistics http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Waste_statistics

Eurostat publications

Waste generated and treated in Europe — data 1990–2001, *Detailed Tables*, 2003

Waste generated and treated in Europe — data 1995–2003, *Detailed Tables*, 2005

Hazardous and industrial waste management in accession countries, *Detailed Tables*, 2003

Energy, transport and environment indicators pocketbook, *Eurostat Pocketbook*, 2009

'Generation and treatment of waste', *Statistics in Focus* 30/2009, 2009

European business: Facts and figures — 2009 edition, *Statistical Books*, 2009

Further reading

European Environmental Agency, *European state of the environment and outlook report* (SOER 2010), Publications Office for the European Union, Luxembourg, forthcoming.

European Environmental Agency, *Waste without borders in the EU?*, Publications Office of the European Union, Luxembourg, 2009

European Topic Centre on Sustainable Consumption and Production, 'Data availability on transboundary shipments of waste based on the European waste list', European Topic Centre on Sustainable Consumption and Production, Copenhagen, 2009

See also

European Commission — Environment DG — Waste: http://ec.europa.eu/environment/waste/

European Environment Agency — Waste: http://www.eea.europa.eu/themes/waste

Methodological notes

Most of the data used in this chapter come from Regulation (EC) No 2150/2002 of the European Parliament and of the Council on waste statistics, the waste statistics regulation (WStatR). It establishes a coherent framework for the production of statistics on waste generation and treatment by Member States. This regulation responds to the need to monitor the implementation of waste policy. Starting with the reference year 2004, the regulation requires the EU Member States to provide data on the generation, recovery and disposal of waste every two years.

Data from the WStatR are reputed to be of good quality although only two rounds of data collection have been concluded so far and efforts for improving data coherence between countries are still needed. Comparison between 2004 and 2006 data should take into account improvements in data collection methods. Data for the reference year 2008 will be published at the end of 2010.

The coding system used for classifying waste at the European level (the so-called 'European waste catalogue for statistics' (EWC-STAT)) is a (mainly) substance-oriented statistical classification containing 13 categories which are subdivided into individual waste types.

For European Union Member States the regulation on waste statistics replaces the OECD/Eurostat joint questionnaire as the main source of waste data. Whereas reporting by the joint questionnaire was voluntary, the provisions of the regulation are binding in law.

The concept of 'municipal waste', a central waste category of the joint questionnaire, is replaced in the waste statistics regulation by the category 'waste generated by households'. The concept has always been disputed as its content is directly linked to different national or regional waste management systems. However, data on municipal waste is collected annually from the countries, as it is part of the series of structural indicators on the environment. These data are available from 1995 onwards.

In order to control waste shipments, certain procedures and requirements have been introduced in international and EU law. Data on waste shipments comes from the database of the Basel Convention. Definition of waste under the Basel Convention as well as the categorisation of waste streams are not always coherent with the WStatR.

Most of the legislations dealing with special waste streams contains obligations of providing data for the following up of the implementation of each specific waste stream policy.

Statistics on employment and value added (at factor cost) were extracted from the structural business statistics. NACE codes refer to NACE rev 1.1.

Population statistics, which are used to calculate per capita figures, refer to the population at 1 January of each year and come from the demographic section of the Eurostat database.

4

Water

Cornerstones of water-related policies

WATER QUALITY

Water quality indicates the chemical, physical and biological characteristics of water, usually in respect to its suitability for a particular purpose.

The vulnerability of surface water and groundwater to degradation depends on a combination of natural characteristics such as geology, topography and soils, and climate and atmospheric conditions. The human activities which impact adversely upon the water are usually distinguished in point sources of pollution and diffuse pollution sources. The former is the case of sewage and industrial effluent discharges, which are responsible for most oxygen-consuming substances and hazardous chemicals. The latter is mainly the case of pollutants from agricultural activities, which includes nutrients, pesticides, sediment and faecal microbes.

The prevention of any further deterioration of the quality of water resources is fundamental not only to impede any risks to human health but also to protect and enhance the status of aquatic ecosystems. Collecting data on water quality is fundamental when taking into consideration the designing of and following up of water-related policies.

Eurostat collects data on water resources, the use of water and on wastewater treatment, but does not collect any data which refer directly to the quality of water in Europe. However, information on water quality can be accessed through the Water Information System for Europe (WISE), a gateway to information on European water issues which compiles various data and information collected at EU level by a number of institutions and bodies (see further information at the end of this chapter).

EU WATER POLICIES

Water issues have been a high priority for the EU since it started adopting legislation in the area of environmental protection. As water flows between countries, water-related issues transcend national boundaries, and thus concerted action at the level of the EU has become necessary to ensure effective action. The stakes are high: prevention of water resource depletion and the protection of fresh and salt water ecosystems, which means in turn protecting drinking water and safeguarding bathing water, to cite just a few examples.

The first legislative acts adopted by the EU fixed quality standards for protecting human health and the living environment including measures for surface water used for drinking water (58), bathing water (59), fish waters, shellfish waters, groundwater and water for human consumption (60). In the same 'generation' of legislation, a directive (61) that set standards for the discharge of dangerous substances into the aquatic environment was for many years the main instrument of control for industrial emissions.

The directive on urban wastewater treatment (62) requires Member States to invest in infrastructure for collecting and treating sewage in urban areas while the nitrates directive (63) requires farmers to control the amounts of nitrogen fertilisers applied to fields. Furthermore, the ddirective on integrated pollution prevention and control (64), adopted a few years later, aims to minimise pollutants discharged from large industrial installations.

To make this patchwork of policies and legislation more coherent, the EU adopted the water framework directive (65) (WFD) in 2000, to protect and restore clean water across Europe and ensure its long-term and sustainable use.

The directive sets an innovative approach for water management, based on river basins and the natural geographical and hydrological units, and fixes specific deadlines for Member States to achieve ambitious environmental objectives for aquatic ecosystems. The directive addresses inland surface waters, transitional (66) waters, coastal waters and groundwater.

In 2007, the European Commission (67) identified an initial set of policy options to be taken at European, regional, and national levels to address water scarcity within the EU. This set of proposed policies aims to move the EU towards a water-efficient and water-saving economy.

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(58) Council Directive 75/440/EEC of 16 June 1975 concerning the quality required of surface water intended for the abstraction of drinking water in the Member States, as amended by Council Directive 79/869/EEC (further amended by Council Directive 81/855/EEC and Council Regulation 807/2003/EC) and both amended by Council Directive 91/692/EEC (further amended by Regulation (EC) No 1882/2003).

(59) Council Directive 76/160/EEC of 8 December 1975 concerning the quality of bathing water, as amended by Council Directive 91/692/EEC (further amended by Council Regulation (EC) No 1882/2003), and Council Regulation (EC) No 807/2003.

(60) Council Directive 80/778/EEC of 15 July 1980 relating to the quality of water intended for human consumption, as amended by Council Directives 81/858/EEC and 91/692/EEC (further amended by Council Regulation (EC) No 1882/2003).

(61) Council Directive 76/464/EEC of 4 May 1976 on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community, codified in Directive 2006/11/EC of the European Parliament and of the Council of 15 February 2006.

(62) Council Directive 91/271/EEC of 21 May 1991 concerning urban waste water treatment, as amended by Directive 98/15/EC.

(63) Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources.

(64) Directive 96/61/EC, as amended by Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control.

(65) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

(66) Transitional waters are those waters between the land and the sea and include fjords, estuaries, lagoons, deltas and rias.

(67) Communication from the Commission to the European Parliament and the Council 'Addressing the challenge of water scarcity and droughts in the European Union' (COM(2007) 414 final).

Life, and its quality, for both humans and ecological systems depend on an adequate supply of water both in quantity and in quality.

Water is used in virtually everything humans make and do. It is the most widely used resource by industry; it is used to produce energy; it is an important part of our transportation network; it provides the basis for much of our outdoor recreation; and it provides important cultural and amenity values. This shows the importance of integrating water issues in any planning of human activities.

Although on average, Europe is considered as having abundant water resources (EEA, 2009), water is not always in the right place, at the right time, and of the right quality. So, while combating water pollution, European countries have to ensure that the rates of abstraction of water resources are sustainable over the long term.

Thus it is not surprising that the two main cornerstones for any water-related policy are the prevention of water resource depletion and the preservation of water quality.

This chapter devoted to water mainly illustrates the availability of water resources and use of water across European countries (11). It also discusses the different economic sectors and deals with issues related to wastewater management.

Water resource availability

The supply of water available for our use is limited by nature. For most of their daily uses (e.g. agriculture, industry and domestic), people rely on freshwater resources, which are either stocked in the ground (groundwater) or are available through rivers, lakes, reservoirs, etc. (surface water).

Freshwater resources are continuously renewed by the natural processes of the hydrological cycle.

The hydrological cycle, or water cycle, is a continuous process by which water is purified by evaporation and transported from the earth's surface (including the oceans) to the atmosphere and back to the land and oceans in form of precipitations.

There are many pathways the water may take in its continuous cycle of falling as rainfall or snowfall and returning to the atmosphere. A part of the precipitation falling on land returns to the atmosphere through evaporation and transpiration. The remainder can flow to rivers and finally to the sea. But it can percolate into the soil and evaporate directly from the soil surface as it dries or be transpired by growing plants. It can percolate through the soil to aquifers to be stored or it may flow to wells or springs or back to streams by seepage. It can also recharge glaciers, being captured for millions of years in polar ice caps. This cycle may be short, a few hours or days, or it may take millions of years.

When it is used by humans, water is diverted temporarily from one part of the cycle by pumping it from the ground or drawing it from a river or lake. When considering countries' political boundaries, groundwater and surface water are replenished by precipitation in the country as well as precipitation in other countries which may enter national boundaries through rivers or aquifers.

This means that, for a country, the sources of fresh water are precipitation (minus evapotranspiration), which is made available as groundwater or surface water (this is referred to as 'internal flow' of water in Figure 4.1), and the surface and groundwater which flow from other countries (this is referred to as 'actual external inflow' in Figure 4.1).

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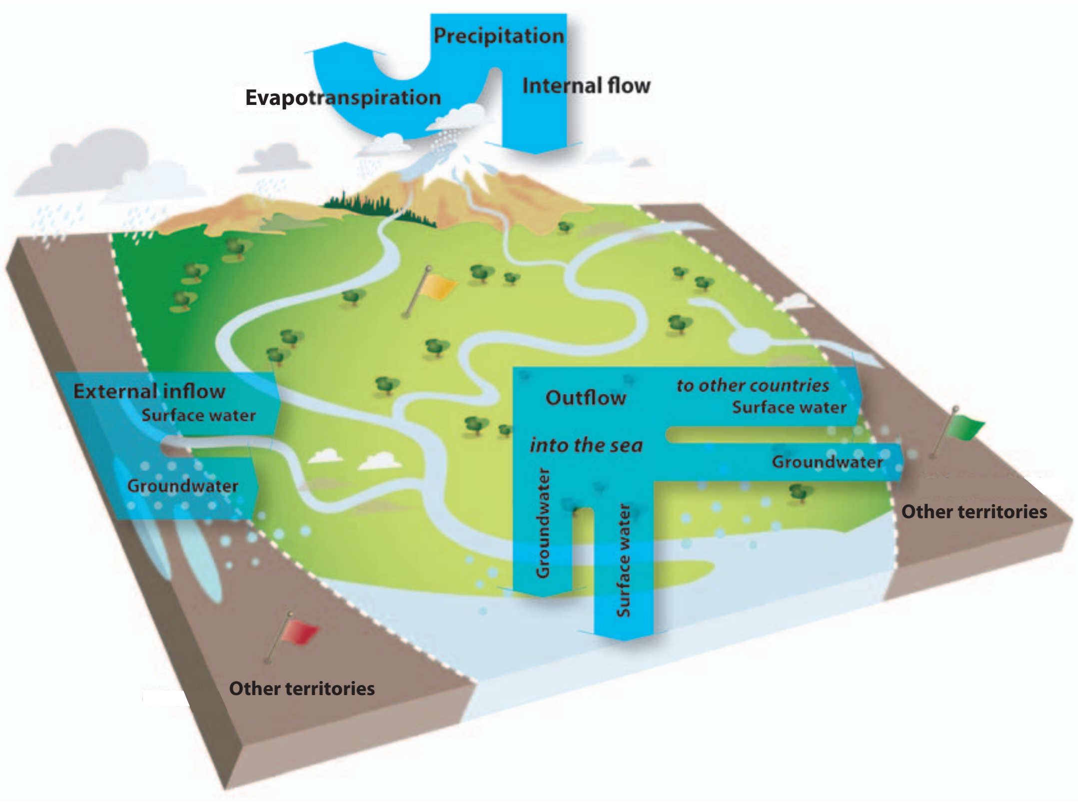
(68) The data presented in the chapter are country averages, which can hide differences across regions in the same country. For more information on the availability of more detailed data at river basin level, see the methodological notes at the end of this chapter.

Figure 4.1: Hydrological cycle and sources of water



European water resources

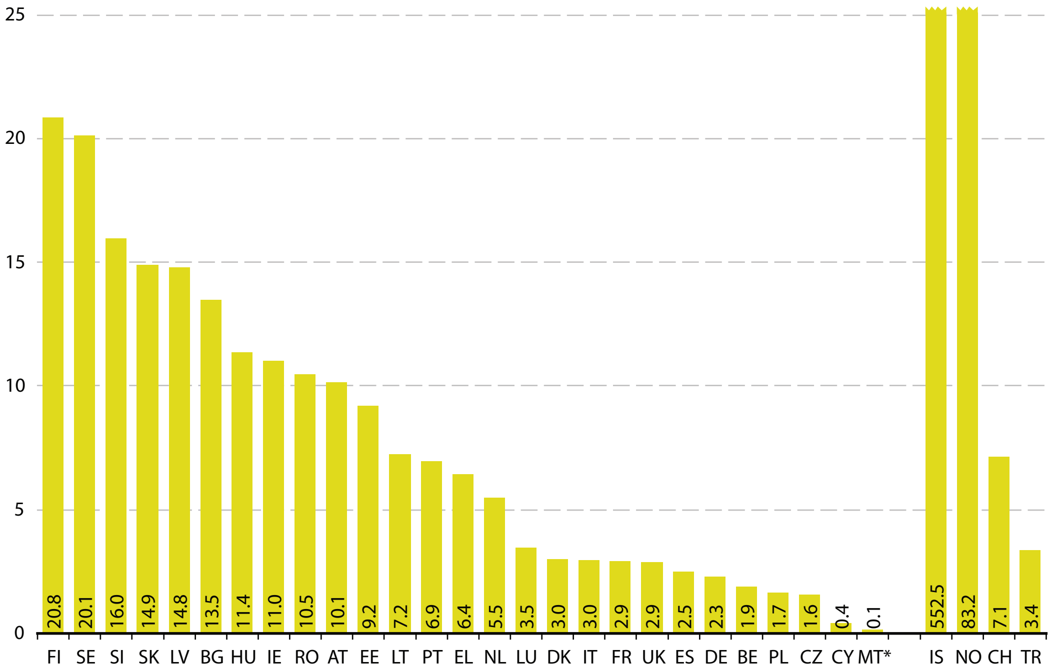
Europe has abundant water resources. However these resources are unevenly distributed, as can be seen when taking into account population density. Figure 4.2 compares freshwater resources per capita across European countries. Freshwater resources range from less than 500 m^3 per capita in Malta and Cyprus to more than 500 000 m^3 per capita in Iceland.

There are substantial differences across Europe in the amount of water available. These differences could be exacerbated by climate changes, with decreasing amounts of rain but more intense rainfall events predicted to occur in southern Europe coupled with more summer droughts, and increasing rainfall in central and northern Europe (EEA, 2009).

Most freshwater resources in European countries originate from precipitation (internal flow: precipitation minus evapotranspiration). Figure 4.3 compares the source of freshwater resources among European countries.

The actual external inflow, when represented as a percentage of total freshwater resources (Figure 4.3), can be interpreted as a dependency ratio and used as a measure of the part of total freshwater resources originating outside the country's boundaries.

Figure 4.2: Total freshwater resources, long-term annual average *(1 000 m³ per capita)*



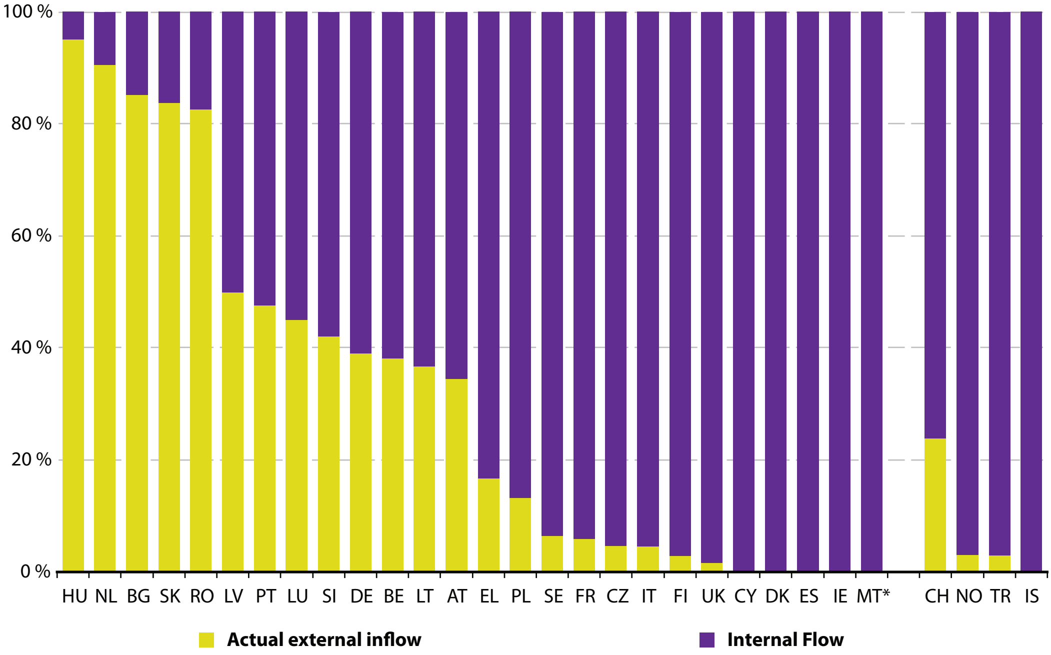
Population in 2007
Total freshwater resources, long-term annual average for all countries but:
* MT: average 1995–2007.

Source: Eurostat (env_watq1a) and Eurostat (demo_pop)

WATER AND CLIMATE CHANGE

Climate change could cause deterioration concerning the water situation in many European regions and countries. The main climate change consequences related to water resources are increases in temperature, shifts in precipitation patterns and snow cover, an increase in the frequency of flooding and droughts, and the possible serious impact of future sea-level rises. All of these will impact on the availability of water (EEA, 2007). As average temperatures rise, sea levels are also rising, glaciers are melting, and the frequency of extreme weather events and precipitation is changing. Climate change is likely to increase flood hazard across much of Europe. The risk of water shortage is projected to increase, particularly in southern Europe, and water resource differences between northern and southern Europe will widen (EEA, JRC, WHO, 2008). This has led to an increasing urgency to adapt water resource management to meet the future challenges as water will no longer be the problem of a few regions, but will concern all Europeans.

Figure 4.3: Freshwater resources: actual external inflow and internal flow, long-term annual average *(% of total fresh water)*



Total freshwater resources: long-term annual average for all countries but:

* MT: average 1995–2007.

Source: Eurostat (env_watq1a)

Fifteen European countries are dependent for more than 10 % of their water resources on river water from neighbouring countries; this figure rises to more than 40 % in the case of Latvia, Portugal, Luxembourg and Slovenia, and to more than 80 % for the Netherlands, Hungary, Bulgaria, Romania and Slovakia.

Those countries, whose internal inflow is not sufficient to cover their needs and show a high dependency ratio, are highly dependent on water originating outside their borders to meet the needs of the population and of their economy. They are therefore particularly vulnerable to the effects of extraction, impoundment, and pollution by countries upstream.

For Cyprus, Malta, Ireland and Iceland, the dependency ratio is 0 since these countries are islands. No major rivers (nor aquifers) flow into Denmark and Spain from neighbouring countries, which makes external inflows equal to 0.

Abstraction rates across European countries

Surface and groundwater have many economic uses, from industry to agriculture, transport and many others, and they are of course a source of drinking water.

Water scarcity problems occur when the demand for water exceeds the amount available during a certain period. They occur frequently in areas with low rainfall and high population density, and in areas with intensive agricultural or industrial activity. Apart from water supply problems, overexploitation of water can lead to the drying out of natural areas particularly dependent on water, and to salt-water intrusion in aquifers.

Water is abstracted from groundwater and surface water bodies by the different sectors of the economy at different rates across European countries.

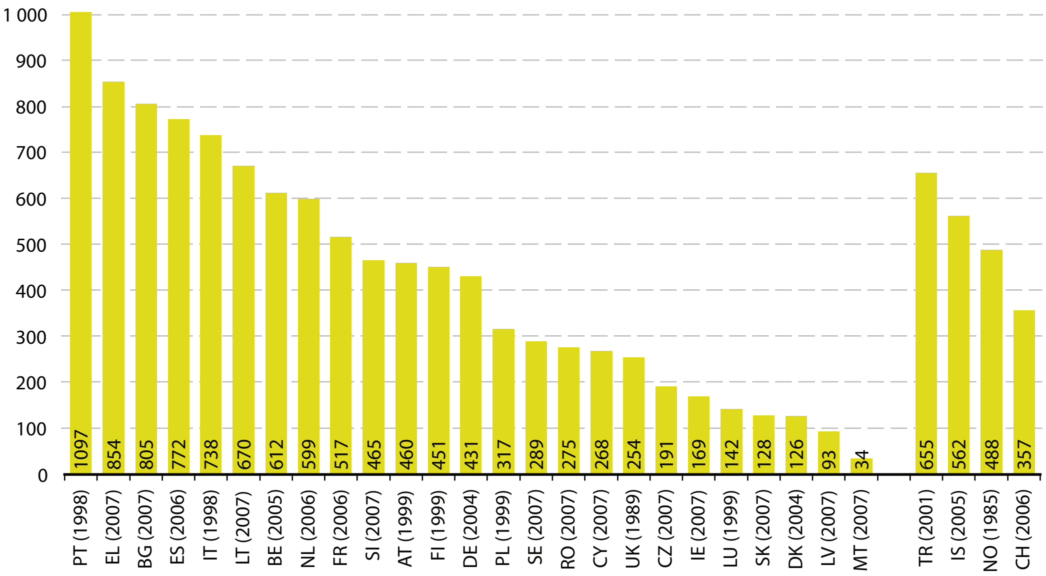
Figure 4.4 compares the quantity of water abstracted across European countries. It ranges from 1 097 m³ in Portugal (in 1998) to 34 m³ per capita in Malta (in 2007). The five most water-abstracting countries are south and south-east European countries abstracting more than 700 m³ of water per capita.

It should be remarked that Cyprus and Malta use water from alternative sources such as desalination and reuse (see the box on other sources of water, page 145).

When analysing the trends of total water abstraction across Europe, it emerges that in most European countries water abstraction remained constant or was reduced in the period 1989–2007 (although data is not available for all countries for this period and/or for the whole period).

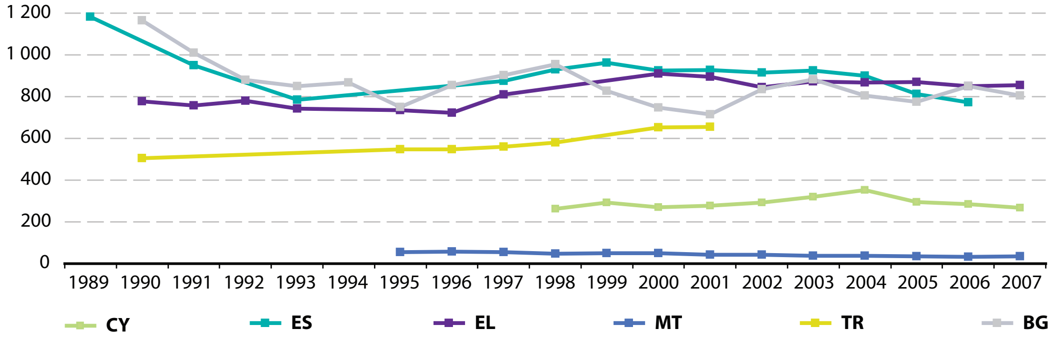
In south European countries (Figure 4.5), water abstraction remained constant in Malta and Cyprus. In Spain, Greece and Turkey an increase in water abstraction is evident in the period

Figure 4.4: Water abstraction, latest available year (in brackets) *(m³ per capita)*



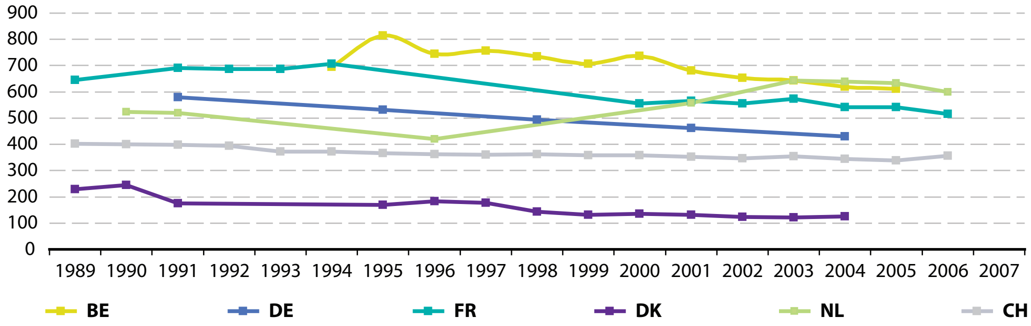
Source: Eurostat (env_watq2_1ind)

Figure 4.5: Water abstraction in south European countries *(m³ per capita)*



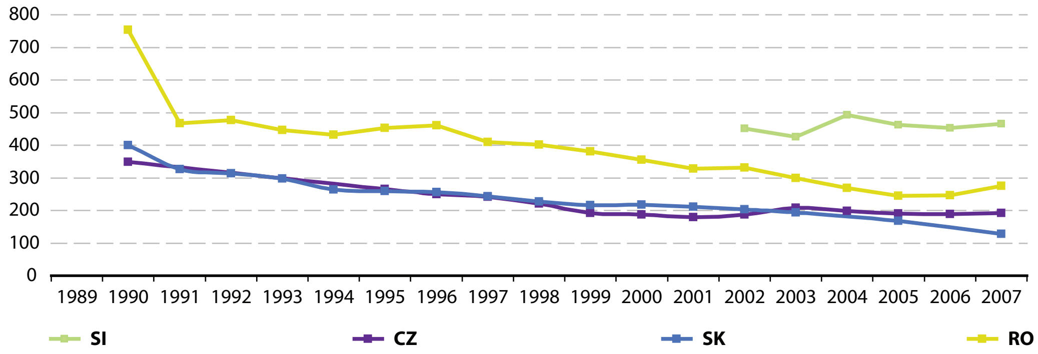
Source: Eurostat (env_watq2_1ind).

Figure 4.6: Water abstraction in western central European countries *(m³ per capita)*



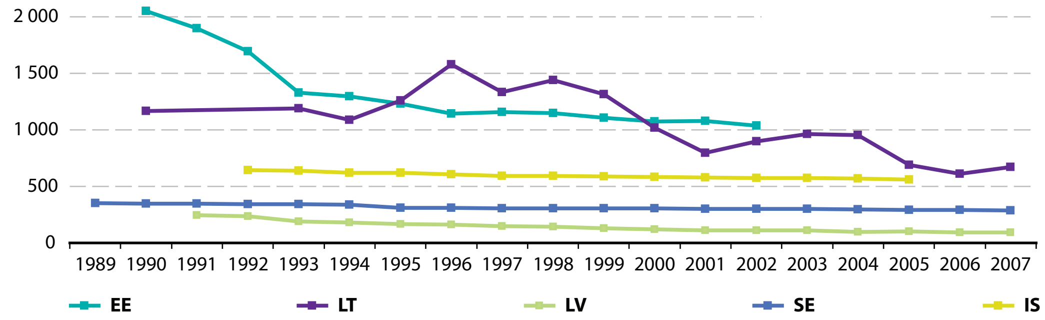
Source: Eurostat (env_watq2_1ind).

Figure 4.7: Water abstraction in eastern central European countries *(m³ per capita)*



Source: Eurostat (env_watq2_1ind)

Figure 4.8: Water abstraction in north European countries *(m³ per capita)*



Source: Eurostat (env_watq2_1ind)

1990–2001. Water abstraction subsequently decreased in Spain to a level comparable to that of 1990, while in Greece it stabilised to a level higher than that of 1990.

In all other European regions (Figures 4.6, 4.7 and 4.8), water abstraction decreased between 1990 and 2007 with the exception of Bulgaria and the Czech Republic, where it remained almost constant.

Water resources management sustainability indicators

The water exploitation index

Comparing water resources and water abstraction is important in order to have an idea of water availability/scarcity in European countries. The water exploitation index (WEI) is a tool to highlight stressed water resources, since it represents the total water abstracted as a percentage of long-term renewable water resources (this information is shown in Figure 4.2 and Figure 4.4 combined).

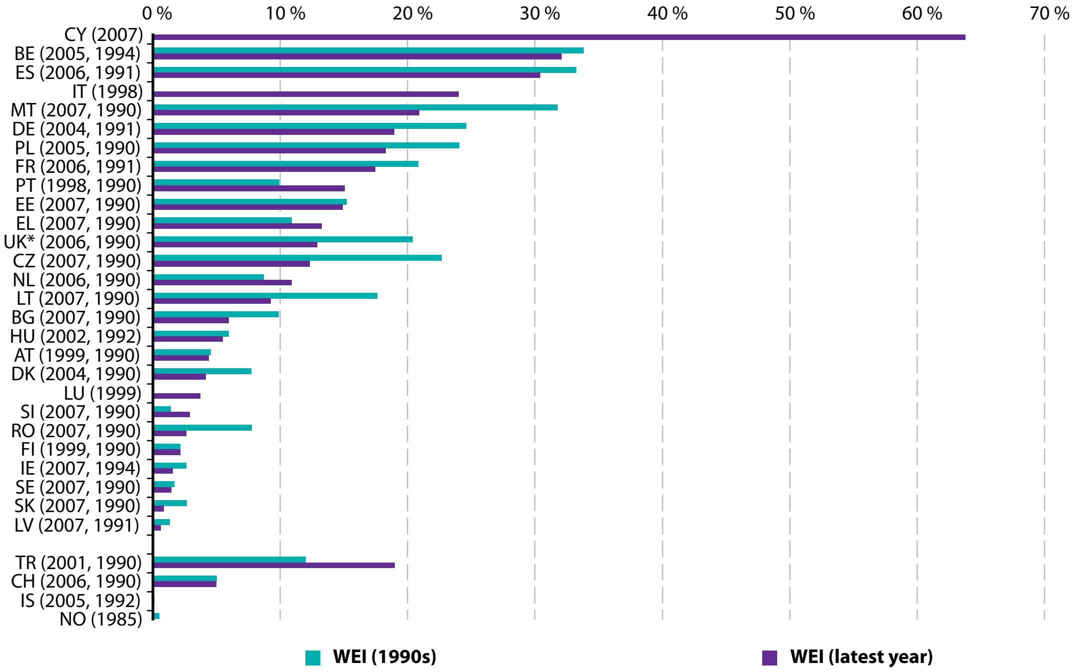
An index of over 20 % usually indicates water scarcity and an index of over 40 % is a signal of severe stress on water resources. This does not mean that the countries above the limit necessarily face severe water shortages. A high WEI means that a large share of water resources are diverted for human use and natural ecosystems could suffer water stress, which is considered an indicator of unsustainable water management (Cosgrove et al., 2000).

As Figure 4.9 shows, five countries can be considered as facing water scarcity problems (i.e. a WEI greater than 20 %): Cyprus, Belgium, Spain, Italy and Malta. For Cyprus the WEI stands at 63 %, which is by far the highest level in Europe. In Belgium, whose WEI is 32 %, 60 % of the water abstracted is for cooling purposes in the production of electricity.

In 21 countries the WEI decreased in the period 1990–2007. In particular, the decrease was significant in some new Member States, such as Bulgaria, the Czech Republic, Romania, Lithuania and Estonia. The change in the economic structure and in the industrial sector which led to a reduction in water abstraction is likely to be responsible for this trend.

Some countries show an increase in WEI which is due to increases in water abstraction: Turkey, Greece, the Netherlands and Slovenia.

Figure 4.9: The water exploitation index, 1990s and latest available year (in brackets) *(%)*



UK*: England and Wales only

Source: EEA

The advantage of the WEI is that it is easy to understand. The disadvantage of the WEI is that some uses are non-consumptive and allow reuse, while others consume a smaller or larger part of the withdrawn water. This is the case, for example, for Belgium, where a large amount of abstracted water is used for cooling and thus returns to rivers. In the case of a WEI calculated at country level (as in **Figure 4.9**), the indicator could hide differences among regions in the same country.

Sources of abstracted water

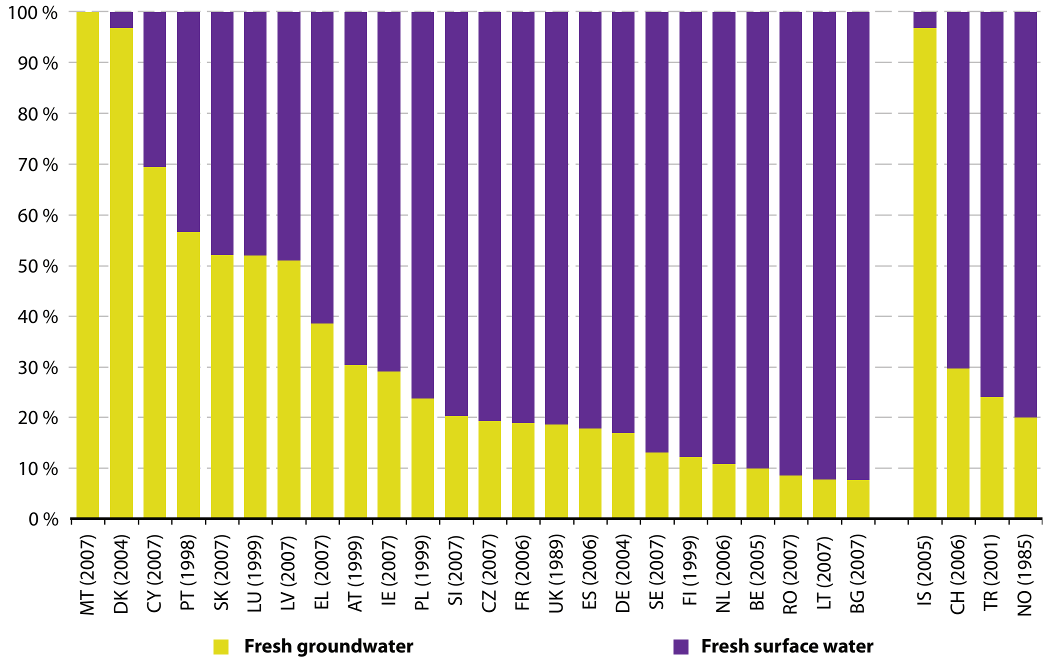
As Figure 4.10 demonstrates, in most of the countries, most of the water abstracted is surface water. In fact, large volumes of surface water can be withdrawn at a lower cost than groundwater, especially when the quality of water is not a primary concern.

Stress on groundwater resources

Groundwater is an important element in the earth's hydrological cycle. Groundwater resources are stored in aquifers, which are permeable rock formations or unconsolidated deposits, mainly gravels, sands and silts. It is the most difficult water resource to determine since it is stocked in relatively inaccessible locations and has very low flow rates, resulting in long residence times and slow reaction to changes on the surface.

In spite of its non-visibility, groundwater has very important functions, including economic functions, ecological functions and those relating to public health. For example, due to its quality and

Figure 4.10: Surface and groundwater abstraction, 2007 *(% of total abstraction)*



OTHER SOURCES OF WATER

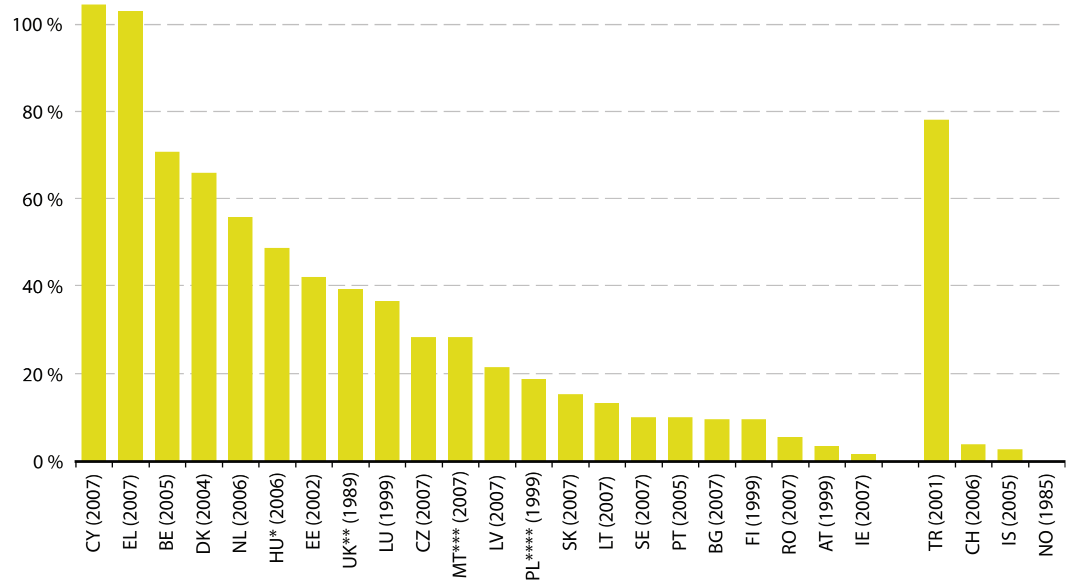
Apart from fresh water, other sources of water can be used for some specific uses or needs. These other sources include desalinated water and marine and brackish water. Desalination is an artificial process by which salt water (generally sea water) is converted to fresh water. Desalination provides a large share of the water used in countries such as Malta (17 million m^3 in 2007, which is 42 m^3 per capita), Cyprus (27 million m^3 in 2006 which is 34 m^3 per capita) and to a lesser extent (but with greater volumes) Spain (425 million m^3 in 2006 which is 10 m^3 per capita).

Marine and brackish water can be also used for some applications (e.g. cooling). This is quite relevant in Sweden (11 830 million m^3 and 1 298 m^3 per capita in 2007) and Denmark (4 092 million m^3 in 2004 which is 758 m^3 per capita) and to a lesser extent in the Netherlands (4 607 million m^3 in 2006, which is 282 m^3 per capita).

the fact that it represents a more reliable supply than surface water in summer months, groundwater is an important source for drinking water and public supply in general.

Human activity, however, can greatly affect the quantity and quality of the available groundwater resources. Due to their characteristics, groundwater systems are normally very stable, in both quantity and quality. However, the effects of

Figure 4.11: Groundwater abstracted, latest available year (in brackets) *(% of groundwater resources available for abstraction)*



Groundwater available for abstraction is the long-term annual average but:

* HU: average 1992–2006,

** UK: 1998,

*** MT: average 1995–2007,

**** PL: average 1991–2005.

Source: Eurostat (env_watq2_1ind)

pollution and overexploitation accumulate over time and the recovery periods could be centuries and decades, respectively.

Polluted groundwater is less visible, but more insidious and difficult to clean up than pollution in rivers and lakes. Groundwater pollution is linked to the nitrates and phosphates coming from improperly treated wastewater and the use of fertilisers in agriculture. Groundwater pollution can also result from improper disposal of waste on land. Other sources of pollution include industrial and household chemicals and landfill sites, industrial waste lagoons, tailings and process wastewater from mines, oil field brine pits, leaking underground oil storage tanks and pipelines, sewage sludge and septic systems.

The availability of groundwater is limited by two natural features: the total amount of recharge (renewal of groundwater), resulting from precipitation, evapotranspiration, infiltration and seepage from rivers and lakes; and the properties of the soil and aquifer (permeability, porosity, etc.). The use of groundwater can also be limited by the quality (i.e. the pollution) of the recharged water.

Figure 4.11 compares the ratio of groundwater abstracted to groundwater available for annual abstraction across European countries. Groundwater available for annual abstraction is the recharge (i.e. the total amount of water added from outside to the zone of saturation of an aquifer) minus the long-term annual average flow required to achieve ecological quality objectives of associated surface water.

In Greece and Cyprus more than 100 % of the groundwater available for annual abstraction was reported to be extracted in 2007. This means that these countries are seriously over-stressing their groundwater resources since they are exploiting groundwater beyond what has been set as the ecological limit. In Turkey, Belgium, Denmark and the Netherlands more than 50 % of groundwater available was extracted. These countries therefore place groundwater resources under stress.

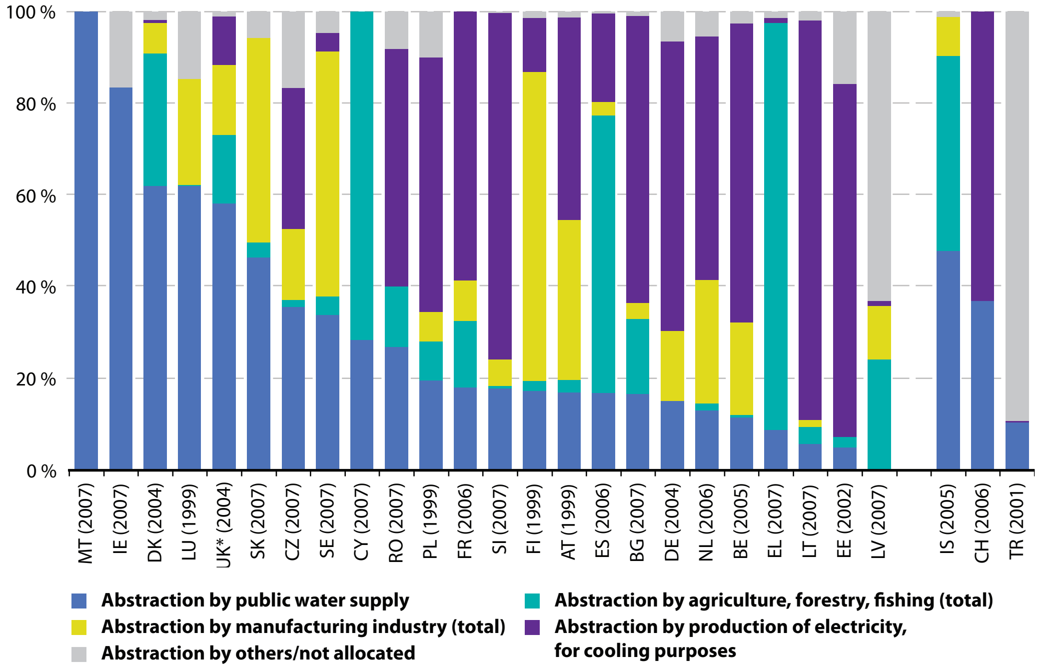
Purposes of water abstraction

Water is mainly abstracted for irrigation, cooling purposes and public water supply. Agriculture, industry and public water supply are the sectors abstracting most of the water in almost all European countries.

Figure 4.12 compares water abstraction by sector across European countries.

The breakdown of water abstraction between the various economic sectors varies considerably from one country to another, depending

Figure 4.12: Abstraction by sector in European countries, latest available year (in brackets) *(% of total gross abstraction)*



*UK: Wales and England only.

Source: Eurostat (env_watq2)

on natural conditions and economic and demographic structures. Agriculture accounts for most of the water abstracted in southern Europe, while cooling for electricity generation (e.g. thermal power plants) is dominant in central European countries.

In Greece, Spain and Cyprus, water is mostly used for agriculture. In Finland and Sweden, most of the water abstracted is used in manufacturing processes. In these countries, cellulose and paper production, both highly intensive water-consuming industries, are significant activities.

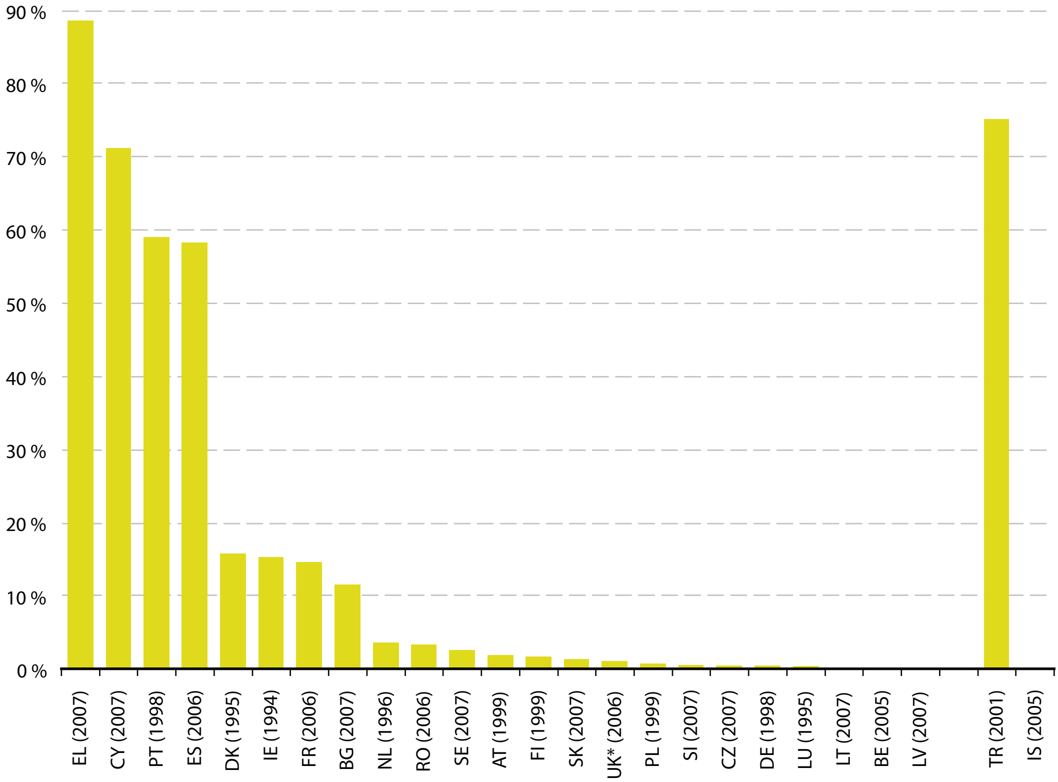
Water abstraction in agriculture

Agricultural activities represent one of the biggest pressures on water resources. This is due in particular to irrigation practices.

The role of irrigation differs between countries and regions because of climatic conditions. In southern Europe, it is an essential element of agricultural production, whereas in central and northern Europe, irrigation is generally used to cope with dry summers.

In Greece, Turkey, Portugal and Spain more than 50 % of the water which is withdrawn is

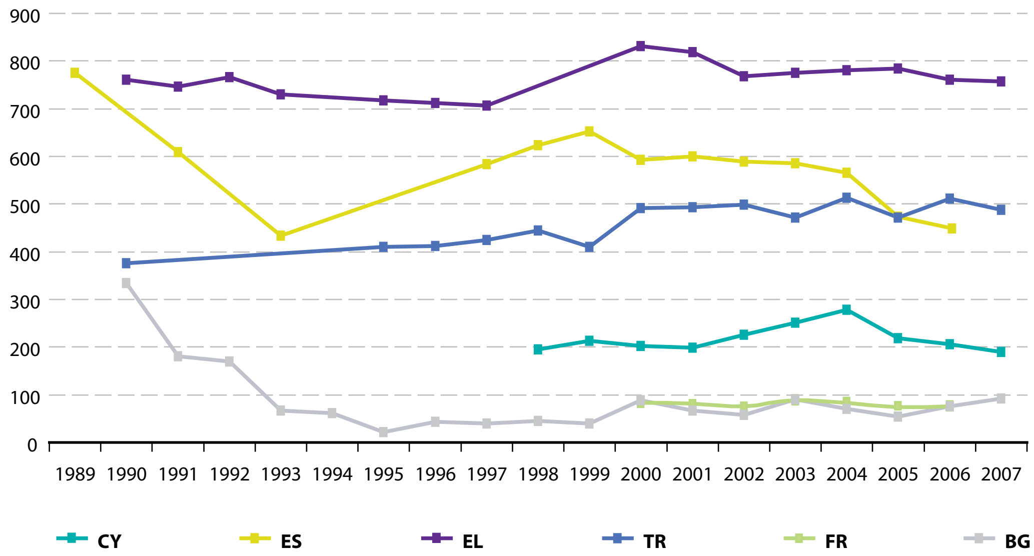
Figure 4.13: Abstraction for irrigation use in agriculture, latest available year (in brackets)
(% of total gross abstraction)



* UK: Wales and England only.

Source: Eurostat (env_watq2_1)

Figure 4.14: Abstraction for irrigation use in agriculture in south European countries *(m³ per capita)*



Source: Eurostat (env_watq2_1ind)

used for irrigation. This is due to higher temperatures and higher evapotranspiration, which make average water use per hectare higher in south European countries compared with the rest of Europe.

Figure 4.14 shows the change in abstraction for irrigation use in agriculture for the European countries whose water abstraction for irrigation is more than 10 % of total water abstraction (and for which time series are available). In Bulgaria, water abstraction for irrigation decreased between 1990 and 1995 and then was increasing up to 2007. All south European countries succeeded in stabilising (or reducing, in the case of Spain) water abstraction for irrigation except Turkey. Illegal water abstraction could nonetheless influence the quality of water statistics regarding water abstraction for irrigation. For example, data for Mediterranean countries could underestimate the quantity of water abstracted for agriculture as illegal water abstraction is a recognised and serious problem in these countries.

Water abstraction in the manufacturing sector

The production of any kind of goods requires a certain amount of water. In the manufacturing sector it is used for instance as a raw material, a coolant, a solvent or a cleaning agent.

The amount of water used by the manufacturing sector varies greatly among countries. Manufacturing accounted for more than 20 % of water withdrawals in seven European countries: Belgium, Luxembourg, the Netherlands, Austria, Slovakia, Sweden and Finland.

Figures 4.15, 4.16, 4.17 and 4.18 show the change in abstraction in the manufacturing sector across European countries. In most European countries, water abstracted for manufacturing

Table 4.1: Abstraction by the manufacturing sector in European countries

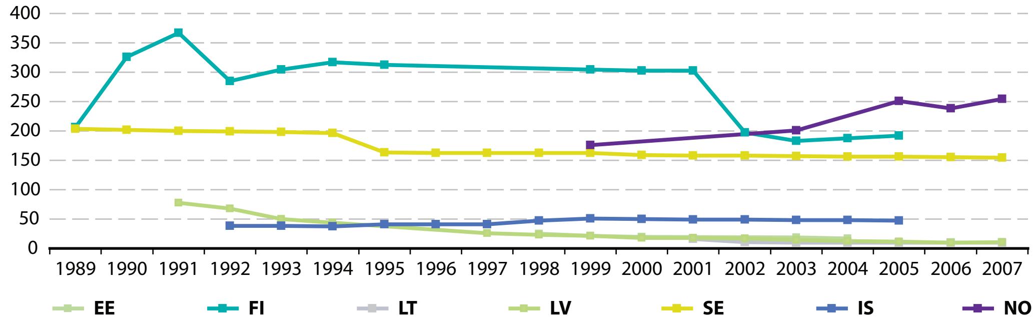
Country (year)	m³ per capita	Million m³	% of total gross abstraction	Country (year)	m³ per capita	Million m³	% of total gross abstraction
AT (2002)	151.3	1 220.2	35 %	LU (1999)	32.8	14	23 %
BE (2005)	123.5	1 290.4	20 %	LV (2007)	10.7	24.5	12 %
BG (2007)	28.4	218	4 %	MT	:	:	:
CY	:	:	:	NL (2006)	161.6	2 639.7	27 %
CZ (2007)	29.5	303.8	15 %	PL (2007)	12.9	2007	7 %
DE (2004)	65.6	5 411.8	15 %	PT (1998)	39.1	395.4	4 %
DK (2004)	8.3	44.9	7 %	RO (2006)	36.4	787	15 %
EE (2004)	17.3	23.4	:	SE (2007)	154.3	1406	53 %
ES (2006)	21.9	960	3 %	SI (2007)	27.3	54.9	6 %
FI (2005)	192.1	1 005.9	67 %	SK (2007)	56.9	307	45 %
FR (2006)	45.4	2 861.3	9 %	UK* (2005)	:	1361	15 %
EL (2003)	14.4	158.1	2 %	CH	:	:	:
HU (2006)	8.9	89.2	:	HR (2007)	10.3	45.8	:
IE (1994)	69.8	250	21 %	IS (2005)	47.7	14	8 %
IT	:	:	:	NO (2007)	254.5	1 191.2	:
LT (2007)	10	33.9	1 %	TR (2004)	7.3	516.8	2 %

: not available.

*UK: Wales and England only.

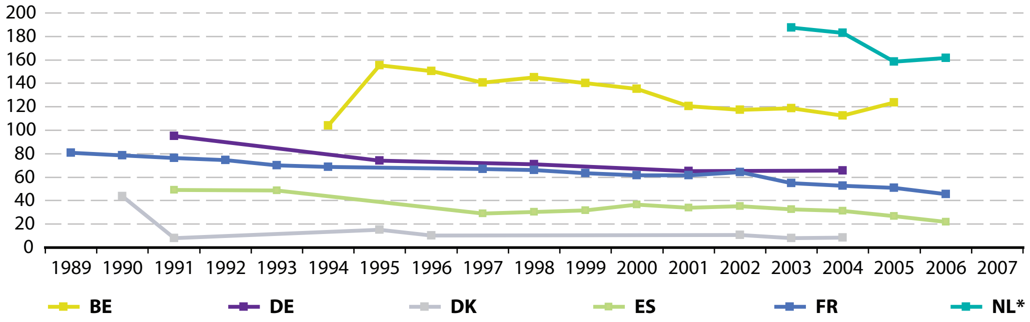
Source: Eurostat (env_watq2_1) and (env_watq2_1ind)

Figure 4.15: Abstraction in the manufacturing sector in north European countries *(m³ per capita)*



Source: Eurostat (env_watq2_1nd)

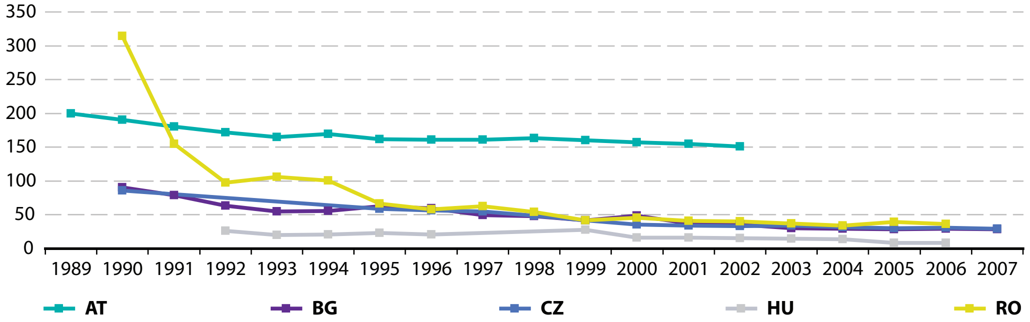
Figure 4.16: Abstraction in the manufacturing sector in western central European countries
(m³ per capita)



**NL :* a break in the series occurred between 2001 and 2003. Since data from 1996 to 2001 have not yet been recalculated only data from 2003 onwards is presented.

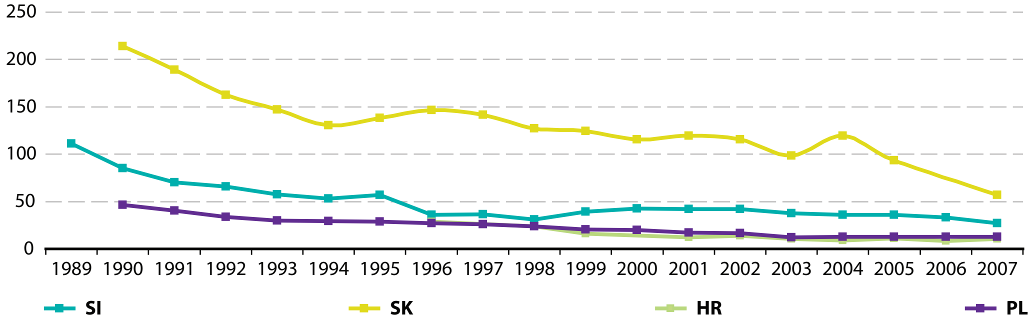
Source: Eurostat (env_watq2_1ind)

Figure 4.17: Abstraction in the manufacturing sector in eastern central European countries (1)
(m³ per capita)



Source: Eurostat (env_watq2_1nd)

Figure 4.18: Abstraction in the manufacturing sector in eastern central European countries (2)
(m³ per capita)



Source: Eurostat (env_watq2_1nd)

products decreased between 1990 and 2007. In north European countries, where water in the manufacturing sector is mainly used for the paper and metal industries, water abstraction decreased in all countries except Norway and to a lesser extent Iceland.

Also, in central European countries, water abstracted for the manufacturing sector decreased in all countries.

Water in electricity generation

The electricity generation sector (69) is responsible for most of the water abstracted in most European countries.

Water is used in the generation of electricity mostly for condenser cooling, which requires a continuous flow of cooling water circulating through the condenser. All the cooling water is therefore returned to the environment but with

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(69) Hydroelectricity generation is not included among the water-abstracting activities in the electricity generation sector. Water used in hydroelectric power generation is considered as an *in situ* use.

Table 4.2: Abstraction in the electricity sector for cooling purposes in European countries

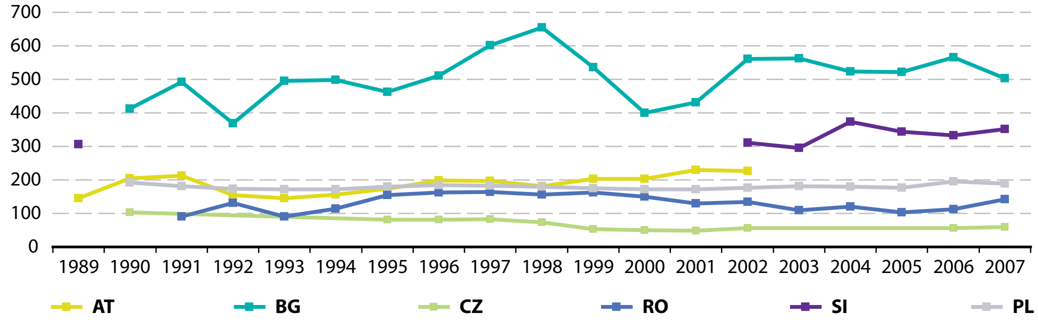
Country (year)	m^3 per capita	Million m^3	% of total gross abstraction	Country (year)	m^3 per capita	Million m^3	% of total gross abstraction
AT (2002)	227	1 830.9	:	LU (1999)	0	0	0 %
BE (2005)	398.7	4 164.9	65 %	LV (2007)	1	2.2	1 %
BG (2007)	502.9	3 861.6	62 %	MT	:	:	:
CY	:	:	:	NL (2006)	318.5	5 202.7	53 %
CZ (2007)	59	607.1	31 %	PL (2007)	189.2	7 213.1	3 %
DE (2004)	272.3	22 470.1	63 %	PT (1998)	122.4	1237	11 %
DK (2004)	0.8	4.3	1 %	RO (2007)	142.3	3 069.6	52 %
EE (2002)	801.2	1 090.6	77 %	SE (2007)	11.3	103	4 %
ES (2006)	149.1	6 525	19 %	SI (2007)	351.3	706.3	76 %
FI (2005)	33.2	174	12 %	SK	:	:	:
FR (2006)	302.7	19 072.2	59 %	UK* (2006)	:	194.8	2 %
EL (2007)	9	100.4	1 %	CH (2006)	225.2	1 680	63 %
HU	:	:	:	HR	:	:	:
IE (1994)	77.3	277	24 %	IS (2005)	0	0	0 %
IT	:	:	:	NO	:	:	:
LT (2007)	584.8	1 979.4	87 %	TR (2006)	0.9	84.8	0 %

: not available.

*UK: Wales and England only.

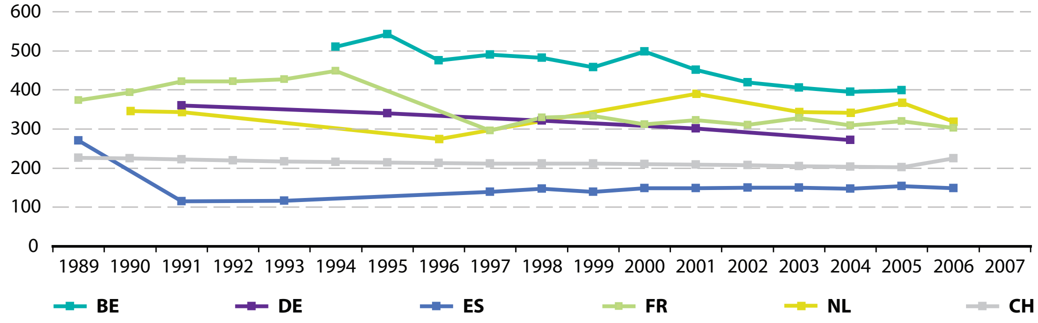
Source: Eurostat (env_watq2_1) and (env_watq2_1ind)

Figure 4.19: Abstraction for cooling in the electricity sector in eastern central European countries *(m³ per capita)*



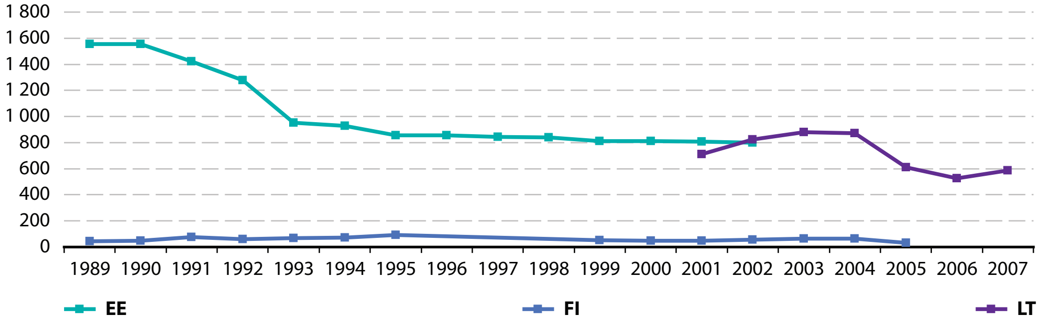
Source: *Eurostat* (env_watq2_1)

Figure 4.20: Abstraction for cooling in the electricity sector in western central European countries and Spain *(m³ per capita)*



Source: Eurostat (env_watq2_1)

Figure 4.21: Abstraction for cooling in the electricity sector in northern European countries *(m³ per capita)*



Source: Eurostat (env_watq2_1nd)

increased temperature. However, the temperature can be reduced using cooling towers and other similar devices.

Figures 4.19, 4.20 and 4.21 compare the trend in the abstraction of water for cooling purposes in the generation of electricity across European countries.

Public water supply

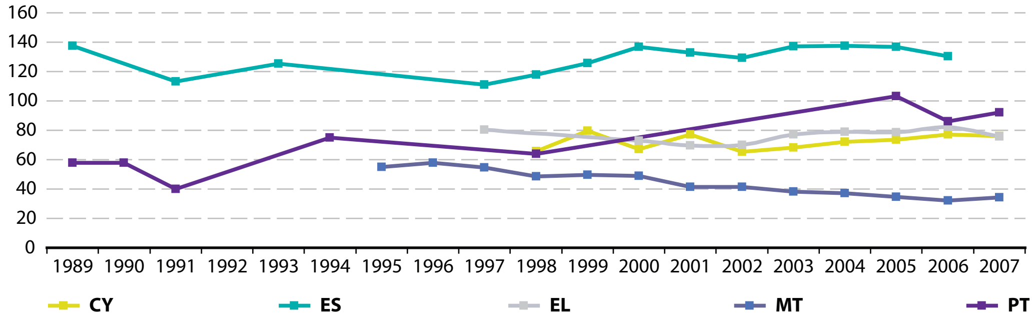
Public water supply (PWS) is a system that provides water via piping or other constructed conveyances principally to domestic (e.g. households) and services uses. It provides also water to industry.

Figure 4.22 compares public water supply across European countries. Public water supply provides

Figure 4.22: Public water supply abstraction, 2007, latest available year (in brackets) *(m^3 per capita)*

Source: Eurostat (env_watq2ind)

Figure 4.23: Abstraction for public water supply in south European countries *(m^3 per capita)*



Source: Eurostat (env_watq2_1nd)

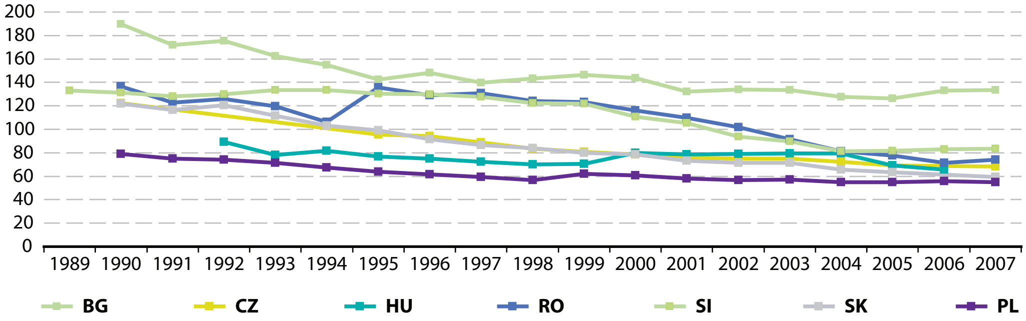


Figure 4.24: Abstraction for public water supply in eastern central European countries *(m³ per capita)*

Source: Eurostat (env_watq2_1nd)

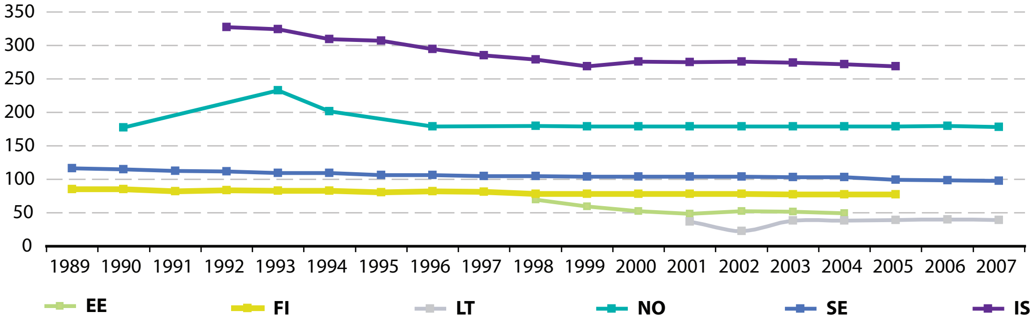


Figure 4.25: Abstraction for public water supply in north European countries *(m³ per capita)*

Source: Eurostat (env_watq2_1nd)

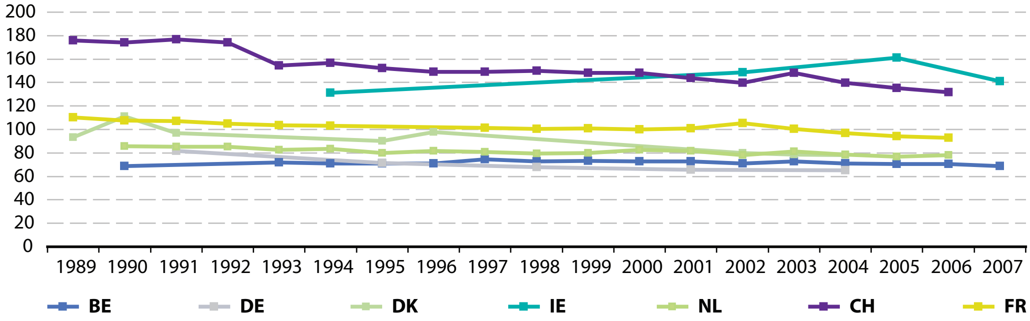
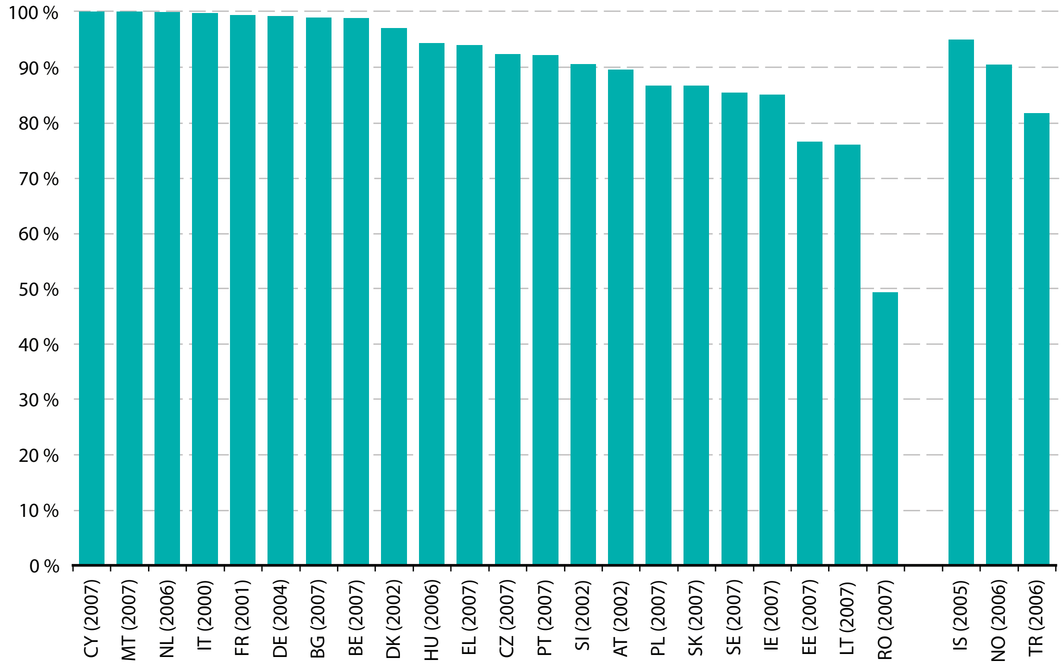


Figure 4.26: Abstraction for public water supply in western central European countries *(m³ per capita)*

Source: Eurostat (env_watq2_1nd)

Figure 4.27: Population connected to water supply network, latest available year (in brackets)
(% of population)



Source: Eurostat (env_watq3ind)

between 50 and 150 m³ of water per capita in EU countries. Only in two countries is abstraction for water supply less than 50 m³ per capita: Malta and Lithuania. In Iceland it was the highest among European countries: 260 m³ per capita. When comparing the quantity of water abstracted for public water supply, public water supply is the first sector for water abstraction in several small countries.

Figures 4.23, 4.24, 4.25 and 4.26 show the trends in abstraction of water for public water supply. This has fallen in most central and east European countries and is slightly decreasing in most other European countries.

Public water-supply systems are basic services of vital importance to all inhabitants. These can be government- or privately-run facilities that withdraw water from rivers, lakes, reservoirs and wells. They then purify it and finally deliver it to households, services and industries.

As Figure 4.27 shows, most of the European population has direct access to the public water supply. Where public water supply is not accessible, the population relies mainly on self supply. This is the case in sparsely populated rural areas, such as agricultural regions, where it is not economically viable to extend public water supply pipelines.

Wastewater management and treatment

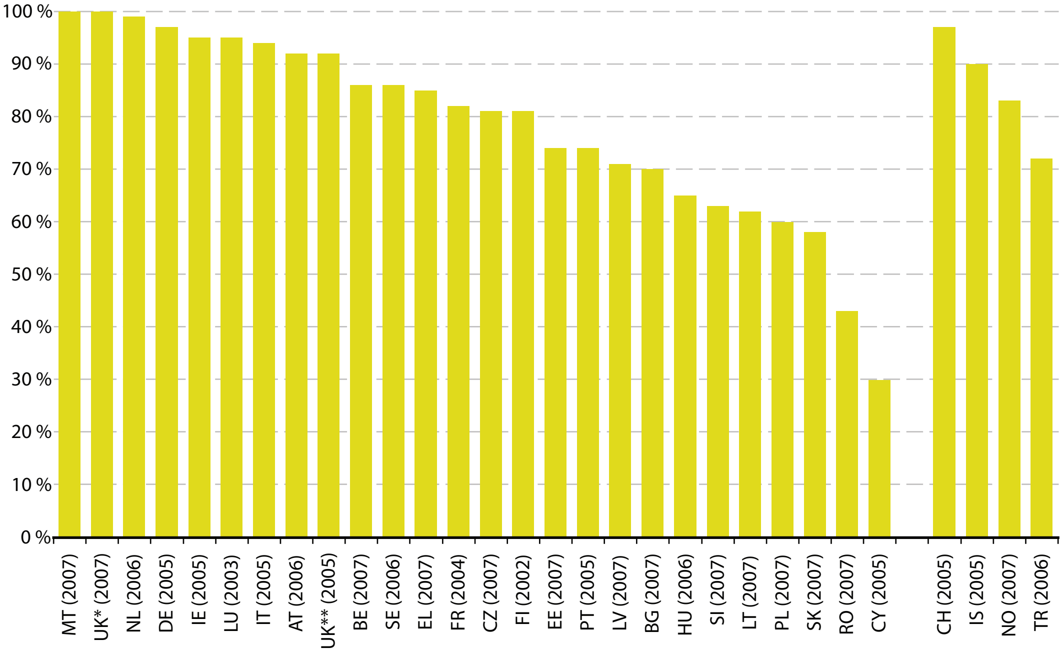
After use, water is returned to another part of the cycle: perhaps discharged downstream or allowed to percolate into the ground. Nature has an incredible ability to cope with small amounts of pollution but much of the water used by homes, industries and businesses must be treated before it is released back to the environment. Treatment plants reduce pollutants in wastewater to a level that nature can cope with.

Wastewater from households is mainly water from sinks, showers, bathtubs, toilets, washing machines and dishwashers. Businesses and industries contribute their share of used water which often includes hazardous pollutants (e.g. chemical residues and used oils). Wastewater also includes storm runoff which contains harmful substances that are washed off roads, parking lots and rooftops.

If wastewater is not properly treated, this can have a negative impact both on the environment and on human health. These impacts can include harm to water ecosystems, for example fish and wildlife populations, beach closures and other restrictions on recreational water use, restrictions on fish and shellfish harvesting and contamination of drinking water.

Figure 4.28 compares the part of the population connected to wastewater collecting systems

Figure 4.28: Resident population connected to urban wastewater collecting systems, latest available years (in brackets) *(% of population)*

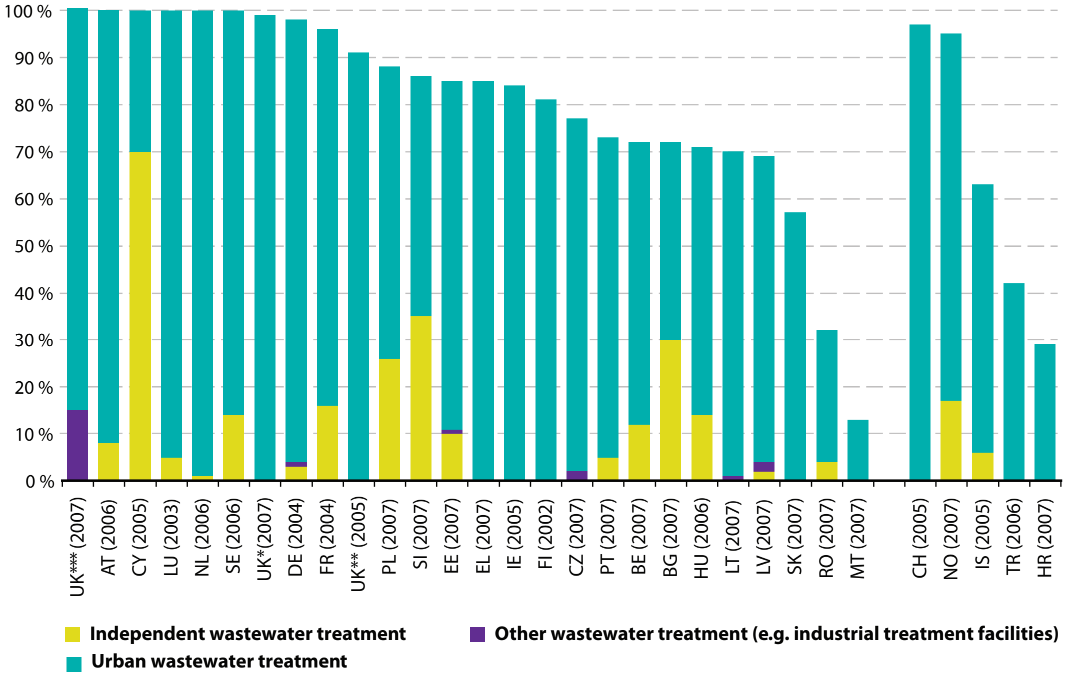


* UK: England and Wales.

** UK: Scotland.

Source: Eurostat (env_watq4)

Figure 4.29: Resident population served by wastewater treatment systems, latest available year (in brackets) *(% of population)*



* UK: England and Wales.

** UK: Scotland.

*** UK: Northern Ireland.

Source: Eurostat (env_watq4).

across European countries (70). In most European countries at least 60 % of the population is connected to a wastewater collection system. Romania and Cyprus are the exceptions, as only 40 % and 30 % of the population, respectively, are connected to urban wastewater collecting systems.

The resident population can be connected to wastewater collecting systems with or without treatment. It is also possible for resident populations not to be connected to wastewater collecting systems while having their wastewater treated (this is the case for much of Cyprus, for example).

Figure 4.29 compares the proportion of the population served by wastewater treatment systems across European countries. Most Europeans are connected to urban wastewater treatment systems. In some countries, such as Cyprus, Slovenia and Bulgaria, independent wastewater treatment facilities play an important role. These are individual, usually private, treatment facilities where the public wastewater network is not in place (septic tanks, filtration beds, etc.).

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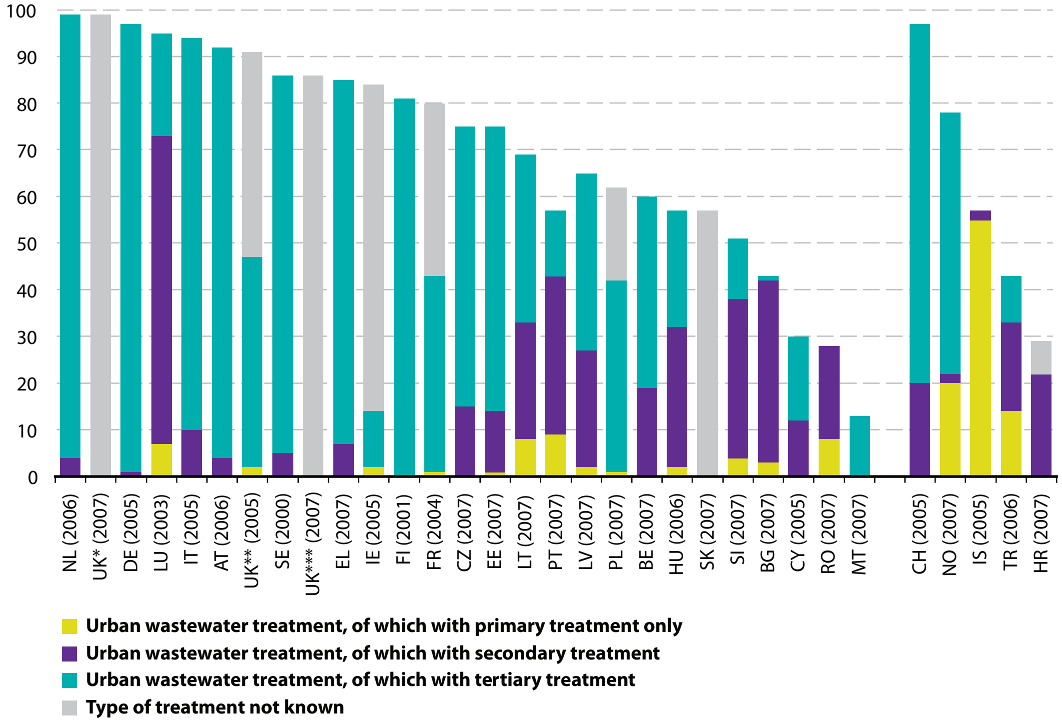
(70) Data refer to resident population: the average over one year of the number of persons belonging to the permanent population living in a territory.

Figure 4.30: Resident population connected to urban wastewater collecting system with treatment, latest available year (in brackets) *(% of population)*



* UK: England and Wales.

** UK: Scotland.

*** UK: Northern Ireland.

Source: Eurostat (env_watq4)

Malta is building three treatment plants scheduled to be operational by the end of 2010. This will increase the part of the population connected to wastewater treatment systems to 100 %.

Figure 4.30 also details the types of urban wastewater treatment available in European countries.

The major aim of wastewater treatment is to remove as much of the pollution (dissolved substances and suspended solids) as possible before the remaining water, called effluent, is discharged back to the environment.

Primary treatment removes by means of settling typically about 60 % of suspended solids from wastewater. Secondary treatment (biological) removes more than 90 % of suspended solids and a considerable part of the nutrients. Tertiary treatment includes targeted removal of nutrients such as phosphorus and nitrogen and practically all suspended and organic matter from wastewater.

The by-product of treating wastewater is sludge: the accumulated settled solids separated from various types of water either moist or mixed with a liquid component as a result of natural or artificial processes.

THE URBAN WASTEWATER TREATMENT DIRECTIVE

The urban wastewater treatment directive (71) concerns the collection, treatment and discharge of urban wastewater and the treatment and discharge of wastewater from certain industrial sectors. The directive requires that all significant discharges of sewage be treated whether the discharge is to inland surface waters, groundwater, estuaries or coastal waters. The standards to be met depend on the size of population served and whether the receiving waters are classified as normal, sensitive or less sensitive. The directive requires the collection and treatment of wastewater in all agglomerations of more than 2 000 population equivalents (p.e.). Secondary treatment should be applied to all discharges from agglomerations of more than 2 000 p.e., and more advanced (i.e. tertiary) treatment for agglomerations of more than 10 000 p.e. in designated sensitive areas and their catchments.

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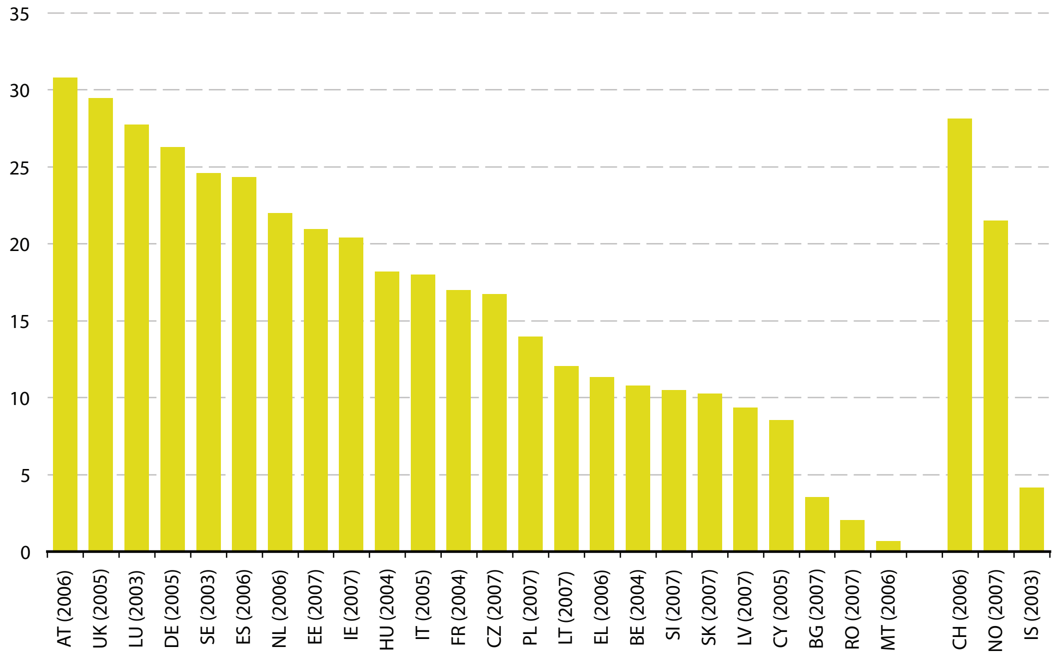
(71) Council Directive 91/271/EEC concerning urban wastewater treatment.

Figure 4.31 compares the quantity of sludge disposed of in European countries. The production of sludge varies between 10 and 30 kg per capita in most European countries.

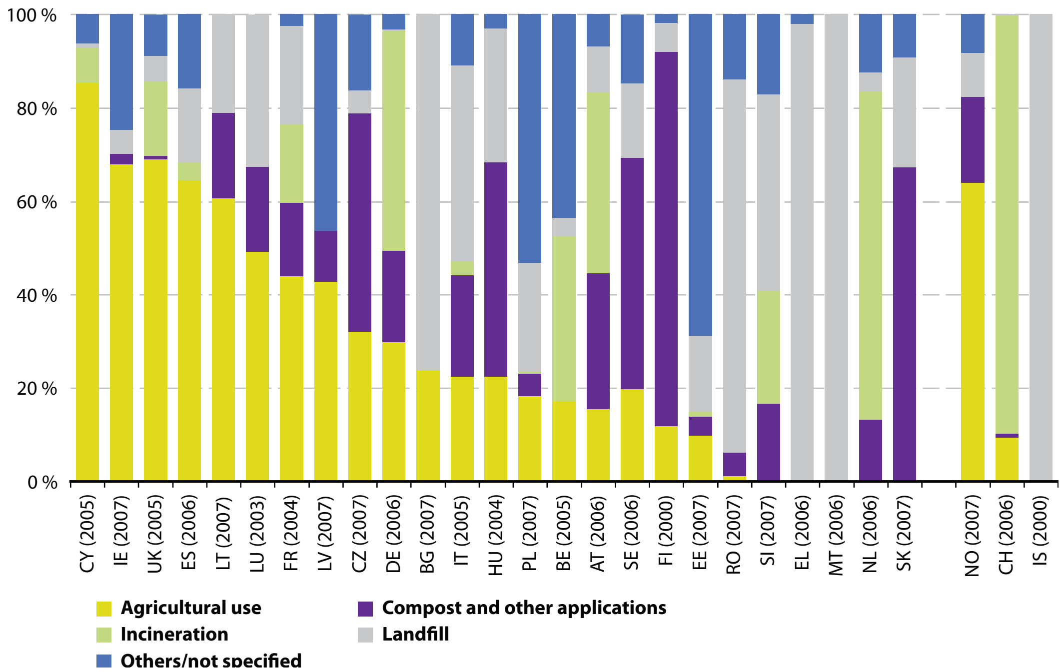
Sewage sludge cannot be simply disposed of due to its microbiological and chemical characteristics. The sludge in fact tends to concentrate heavy metals and poorly biodegradable organic compounds as well as potentially pathogenic organisms (viruses, bacteria,

Figure 4.31: Total sludge disposal, latest available year (in brackets) *(kg per capita)*



Source: Eurostat (env_watq6ind)

Figure 4.32: Total sludge by type of disposal, 2007 *(% of total sludge treated)*



Source: Eurostat (env_watq6ind)

etc.). The characteristics of the sludge depend on the source, i.e. the sector which generated it. Thus for example industrial sludge will be more contaminated by non-biodegradable compounds while agricultural sludge can contain more potentially pathogenic organisms.

Sewage sludge is, however, rich in nutrients such as nitrogen and phosphorous and contains valuable organic matter that is useful when soils are depleted thereof or are subject to erosion. Organic matter and nutrients are the two main elements that make this kind of waste suitable for spreading on land. It serves as a fertiliser or an organic soil improver.

Sewage sludge can only be disposed of in a proper manner after proper treatments. Figure 4.32 compares the different options for sludge disposal in European countries.

Sludge composition determines the type of treatment required and defines disposal options. Sludge is either used in agriculture, landfilled, incinerated or transformed into compost. Sewage sludge has valuable agronomic properties. Nevertheless, when using sewage sludge, the nutrient needs of the plants must be taken into account without, however, impairing the quality of the soil, surface water and groundwater. Furthermore, some heavy metals present in sewage sludge may be toxic to plants and humans.

Sewage sludge incineration is traditionally applied when the sludge has been significantly contaminated with heavy metals, for example, and the sludge is therefore unsuitable for application to agricultural land or results in uneconomic application rates.

Conclusions: Water resources in the European Union

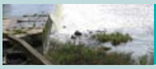
Water is used for a variety of activities and sectors such as households, industries, agriculture and the production of electricity. The risk of depleting, and contaminating, water resources through current uses is high.

Most European countries for which data are available appear to have reduced pressures on water resources by reducing or stabilising their abstraction rates per capita between 1989 and 2007.

Although the situation can widely differ within a given country, the water exploitation index (WEI) shows that in most European countries the reduction in water abstraction rates reduced the pressure on water resources in the period 1990–2007. In particular, the decrease was important in some new Member States, such as Bulgaria, the Czech Republic, Romania, Lithuania and Estonia. Some countries show an increase in the WEI which is due to increases in water abstraction. This is the case for Turkey, Greece, the Netherlands and Slovenia.

Most of the European population is connected to urban wastewater treatment. In all European countries the share of the population served by urban wastewater treatment stands at at least 70 % with only a few exceptions such as Slovakia, Romania, Turkey, Iceland and Croatia.

High-quality data are needed to evaluate the effectiveness of EU water policies. Data on water collected by Eurostat is mainly focused on water quantity (resources, abstractions and uses) and wastewater treatment, dealing only marginally with the issues of water quality. However, the availability of these data is increasing in importance to meet the demand for information in the water domain, including for the development of key environmental indicators and to complement work initiated by the water framework directive. Filling gaps and ensuring data comparability across European countries are among the main objectives of the efforts of Eurostat in the water domain. During the coming years, Eurostat will also continue to support countries in establishing data aggregations for the level of river basin districts — an important step to complement the work done in relation to the water framework directive and thus to support the modern river basin-oriented water policies.



Further information

Eurostat main tables and database

Environment, see: Water tables (t_env_wat : ten00001 to ten00035).

Environment, see: Water statistics (env_wat).

Eurostat dedicated section

Water statistics (http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Water_statistics).

Further reading

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European Environment Agency, *Europe's water: An indicator-based assessment*, Office for Official Publications of the European Communities, Luxembourg, 2003.

European Environment Agency, *Water resources across Europe — Confronting water scarcity and drought*, Publications Office of the European Union, Luxembourg, 2009.

European Environment Agency, Joint Research Centre, World Health Organisation, *Impacts of Europe's changing climate — 2008 Indicator-based assessment: Joint EEA–JRC–WHO report;* EEA Report No 4/2008, JRC Reference Report No JRC47756, Office for Official Publications of the European Communities, Luxembourg, 2008.

See also

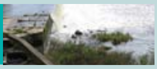
European Environmental Agency: water theme (http://www.eea.europa.eu/themes/water).

Water Information System for Europe (http://water.europa.eu/).

Environment DG: Water (http://ec.europa.eu/environment/water/index_en.htm).

OECD: Water (http://www.oecd.org/document/16/0,3343,en_2649_34285_42289488_1_1_1_37465,00.html).

World Health Organisation: Water (http://www.who.int/topics/water/en/).



Methodological notes

Eurostat collects data on water from countries by means of a questionnaire on inland waters, organised jointly with the OECD. Most of the data used in this chapter comes from this data collection tool.

This joint OECD/Eurostat questionnaire on water statistics is sent out to Member States every two years. The data collected currently covers the following fields: water resources, abstraction of surface water and groundwater, water use, wastewater collection and treatment facilities, production and disposal of sewage sludge, and discharges to wastewater.

The reporting is not covered by a legal obligation and the responses are usually incomplete with a rate that varies considerably among countries. For this reason, tables contain gaps and the latest available years in the figures differ among countries.

Evapotranspiration is the total volume of evaporation from the ground, wetlands and natural water bodies and transpiration of plants. According to the definition of this concept in hydrology, the evapotranspiration generated by all human interventions is excluded, except unirrigated agriculture and forestry.

Fresh surface water is water which flows over, or rests on the surface of, a land mass: natural watercourses such as rivers, streams, brooks, lakes, etc., as well as artificial watercourses such as irrigation, industrial and navigation canals, drainage systems and artificial reservoirs. Bank filtration is included under fresh surface water. Seawater and transitional waters, such as brackish swamps, lagoons and estuarine areas, are not considered as surface water.

Groundwater available for annual abstraction is defined as the recharge less the long-term annual average rate of flow required to achieve ecological quality objectives for associated surface water.

Gross water abstraction is water removed from any source, either permanently or temporarily.

The minimum period of calculation for the long-term annual average (LTAA) is 20 years

Resident population is the average over a year of the number of persons belonging to the permanent population living in a territory.

Countries have been regrouped in some figures for the sake of readability of graphics. The following geographical areas have been used to pool together European countries in the figures:

— south European countries: Greece, Spain, Italy, Cyprus, Malta, Bulgaria and Turkey;

— western central European countries: France, Belgium, the Netherlands, Luxembourg, Germany, Switzerland and Denmark;

— eastern central European countries: Austria, the Czech Republic, Slovakia, Slovenia, Hungary, Croatia, Romania and Poland;

— north European countries: Sweden, Finland, Norway, Estonia, Lithuania, Latvia and Iceland.

Population statistics, which are used to calculate per capita figures, refer to the population at 1 January of each year and they come from the demographic section of the Eurostat database.

5

Air emissions accounts

Purpose of air emissions accounts

Air emissions accounts link with national economic accounts

Air emissions accounts are a statistical information system that combines conventional national accounts and environmental accounts. National accounts are organised in a standardised accounting system (71) representing all economic activities in a given national economy. Prominent indicators such as gross domestic product (GDP) are derived from the national accounts. Environmental accounts consist of environmental variables that are organised in a format compatible with the standardised system of national accounting. It allows for environmental pressure data to be linked directly to economic consumption and production activities.

In this chapter, the environmental variables are the environmental pressure data 'air emissions of greenhouse gases and air pollutants to the atmosphere'. In an air emissions accounts system, the air emissions are reported by economic activities, following the same industry classification (72) as for economic variables in the national accounts. The key point of the approach resides in the comparability of air accounts with economic data from national accounts. It allows for integrated analysis of economic and air emissions accounts to shed light on the environmental pressures induced by consumption and production. It should be noted, however, that the accounting methodology is not suited for monitoring progress towards internationally agreed emissions reduction targets.

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(71) Called System of National Accounts (SNA).
(72) NACE (Rev 1.1) plus households (NACE is the classification for economic activities).

Air emissions accounts as distinct from Kyoto and Gothenburg protocols target monitoring

The Kyoto Protocol is an international and legally binding agreement to reduce greenhouse gas emissions worldwide. It is an addition to a treaty called the United Nations Framework Convention on Climate Change (UNFCCC) which sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change.

The Gothenburg Protocol sets emission ceilings for four air pollutants (sulphur oxides, NOx, VOCs and ammonia) which contribute especially to acidification. It is the latest (1999) extension to the Convention on Long-range Transboundary Air Pollution (CLRTAP) which was the first international legally binding instrument to deal with problems of air pollution on a broad regional basis.

The UNFCCC and CLRTAP have established methodological guidelines for the reporting of emission inventories for greenhouse gases and air pollutants. The emission inventories differ in their structure and scope from the air emissions accounts. These emission inventories are the only suitable data to assess progress towards the targets set by the Kyoto and Gothenburg Protocols. Air emissions accounts are not suited for that purpose.

The European Environment Agency (EEA) is the body responsible for collecting national emission inventories and producing inventories aggregated at the EU level (73). This chapter concentrates on the air emissions accounts compiled by Eurostat and their linkages with economic data. It does not intend to address any target monitoring.

Links between air emissions accounts and emission inventories

For the reasons explained below, one should not directly compare emissions data from inventories and from accounts. To produce most air emissions accounts, statistics on air emissions reported in emissions inventories for the UNFCCC and CLRTAP are adjusted to the accounting principle and structure of the national accounts. Emission inventories are classified according to technical characteristics while air emissions accounts follow a classification defined by industries (economic units). To assign emissions from an inventory to a particular industry in the account is not trivial (74). Furthermore, there is a fundamental difference in the scope of the two approaches. While boundaries for national emissions inventories are those of the territorial border, the scope for air emissions accounts encompasses all nationally registered businesses (including those operating in other countries — called the 'residence principle').

For some countries, there is a noticeable difference between total emissions from the emissions accounts and from emissions inventories. Figure 5.1 shows the case of Denmark, which has a large fleet of ships operating overseas. In the national accounts the purchases of fuel are included in the balance of payments and also as an operating expense for the shipping enterprises. The emissions from these ships, which are Danish residents abroad, do not belong to national emissions inventories based on the territory principle, but they need to be added in order to obtain the air emissions accounts, based on the resident principle. This is illustrated by Figure 5.1, which also shows that, relative to the shipping emissions, there are close to no emissions from non-residents on the territory of Denmark that would need to be subtracted from the emissions inventories in order to obtain the emissions accounts.

---

(73) EEA dataset on greenhouse gases (http://www.eea.europa.eu/data-and-maps/data/national-emissions-reported-to-the-unfccc-and-to-the-EU-greenhouse-gas-monitoring-mechanism-3).

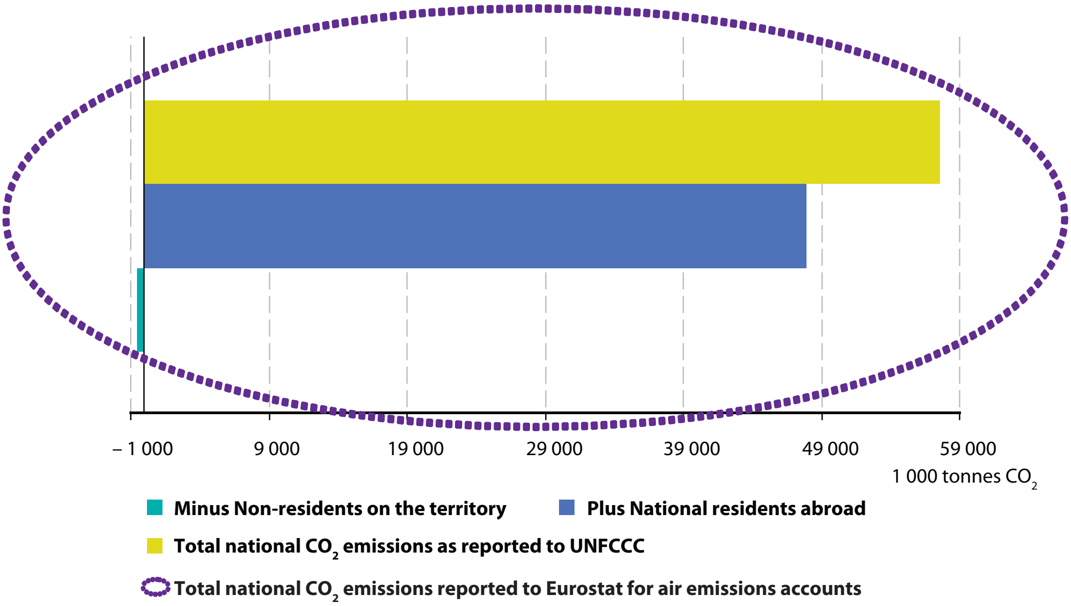
EEA dataset on air pollutants (http://www.eea.europa.eu/publications/lrtap-emission-inventory-report-1990-2007).

(74) For example, the emissions from the 'Road transportation' inventory category need to be distributed over all industries in the classification for emissions accounts.

Table 5.1: Differences in scope of air emissions accounts and emission inventories

	National emissions inventories (territory principle)	**Air emissions accounts (residence principle)**
Scope of national emissions reported	Direct emissions within the geographical national territory and: – emissions from international bunkers allocated to country where the fuel is sold and not to the nationality of the purchasing unit; – emissions/removals induced by land use change and forestry are accounted for.	Emissions within the economic territory of the country covered, for example: – emissions of entities registered in the country (e.g. ships operating abroad, residents); – CO_2 from biomass is included since these emissions arise when using these energy carriers.

Figure 5.1: Bridging air emissions accounts and air emission inventories for Denmark, 2006 *(1 000 tonnes of CO_2)*



Source: Air emissions accounts totals bridging to emission inventory totals — Eurostat (env_ac_aibridg)

How to use air emissions accounts

When considering an economy and the pressures it generates on the environment, one can either consider the direct pressures linked to production and final consumption nationally, or one can investigate environmental pressures directly and indirectly caused by national consumption. In the former case, referred to as the production perspective, emissions from national production facilities, agriculture and transport services, and direct emissions from households (heating, private cars) are included. In the latter case, referred to as the consumption perspective, pressures from the national production only for the home market are

Table 5.2: Calculation of aggregated environmental pressures

Theme	Unit	Substance	Weighting factors	Pressure
Greenhouse gases	CO_2 equivalents	carbon dioxide (CO_2)	1	Aggregated greenhouse gas emissions (in CO_2 equivalents using the global warming potential weighting factors for 100 years)
		methane (CH_4)	21	
		nitrous oxide (N_2O)	310	
Acidification	SO_2 equivalents	sulphur dioxide (SO_2)	1	Aggregated acidification emissions (in SO_2 equivalents)
		nitrogen oxides (NOx)	0.7	
		ammonia (NH_3)	1.9	
Tropospheric ozone formation	NMVOC equivalents	Non-methane volatile organic compounds (NMVOCs)	1	Aggregated emissions of tropospheric ozone-forming precursors (in NMVOC equivalents)
		nitrous oxides (NOx)	1.22	
		carbon monoxide (CO)	0.11	
		methane (CH_4)	0.014	

*Air emission accounts currently only include three of the Kyoto Protocol greenhouse gases. The PFCs, HFCs and SF_6 are currently not included since the distribution of these gases by industry categories (NACE) is difficult for most countries.

included, plus pressures abroad for the production of imported goods.

In this chapter, the production perspective is investigated. It is directly accessible from the air emissions account tables available from the Eurostat dissemination database. These tables show exactly how much each industry in the economy has directly emitted. The economic data from the national accounts have the same format, therefore these two data sets can be directly linked (75). It should be noted that in this chapter direct emissions from households are excluded from the graphs and calculations, unless otherwise stated.

The consumption perspective, which is not treated here, requires considerably more effort. With the use of sophisticated environmentally extended input–output analyses, which involve complex matrix transformations, it is possible to estimate the emissions (direct and indirect) arising along the international production chain of all products consumed nationally.

Emissions of single greenhouse gases and air pollutants available in air emissions accounts can be aggregated into three environmental pressures, as shown in Table 5.2. The aggregated pressures account for the relative effect of the different emissions. That is, a kilogram of methane (CH_4) has 21 times the climate change effect of a kilogram of CO_2.

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(75) By simply dividing the environmental pressure of an individual industry by its economic output, one obtains an environmental pressure intensity (i.e. pressure per euro of output).

European production systems result in air emissions

European production patterns from an economic view point

The European production system can be studied from the perspectives of monetary and environmental pressures using the environmental accounts data.

In Figure 5.2, production is shown using six industry groups. It shows the share that each group contributes economically (in total European gross monetary output) for the years 1995 and 2006. During the decade from 1995 to 2006, these shares remained relatively stable — showing changes of less than 1 % in most cases.

Although in some countries there are trends showing an increase in the share of services to national economies, in the EU-25 the service sector generated more than half (57 %) of the EU's total production in 1995 as well as in 2006 (76).

Together, all manufacturing industries account for around 30 % of total production. Transport and communication services represent 7–8 %. Next is the supply of electricity, water and gas, which contributes 2–3 %. Primary industries including agriculture, forestry and fisheries play a minor role at around 2 %. Mining and quarrying represents less than 1 % of EU-25 output.

Environmental pressures arising from European production

When looking at air emissions of the economic output of the same six industry groups, the

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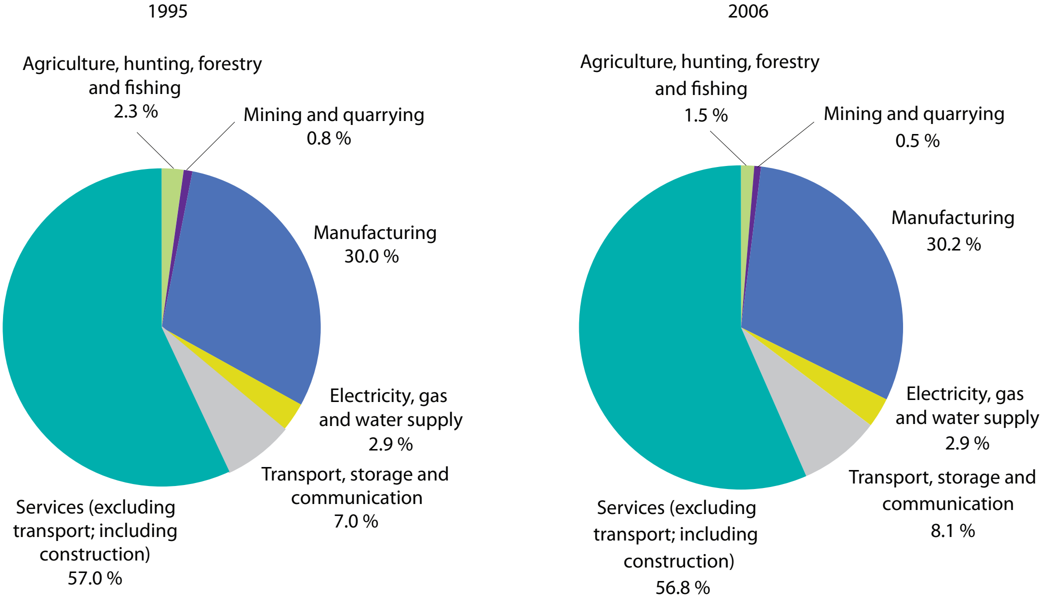
(76) Transport services are excluded from this share, but it includes other market services (construction, real estate, renting, retail and wholesale, trade) and non-market services (public administration, education, health and social work).

Figure 5.2: Gross monetary output by economic industry group, EU-25 *(% in chain-linked volumes to reference year 2000)*



Source: EU KLEMS growth and productivity accounts (November 2009 release) adjusted to 2000 constant prices

image (Figure 5.3) is very different from the economic picture. The service industries (excluding transport services but including construction) that account for more than half of the total monetary output were responsible for only around 12 % of direct greenhouse gas emissions from all EU-25 production, 5–6 % of total acidifying emissions and 13 % of ground ozone precursors in 2006 (down from 17 % in 1995).

At the same time, four economic industry groups together accounted for 84 %, 93 % and 81 % of the direct global warming, acidification and tropospheric ozone formation in 2006 (down from 86 %, 94 % and 85 % in 1995). These main air emissions industries are the primary industries (agriculture, forestry and fishing), the electricity, gas and water supply industry, the manufacturing industries and transport services ([77]). Although these industries contribute the majority of emissions, they only account for around 43 % of total monetary output (with manufacturing alone accounting for 30 %).

When looking only at the three greenhouse gas (GHG) emissions (CO_2, CH_4 and N_2O), electricity production (32 % in 1995, 34 % in 2006) dominates the picture, while the manufacturing industries are in second place (29 % in 1995, 27 % in 2006). For all industries except agriculture, GHG emissions consist mainly of CO_2 emissions from the combustion of fossil fuels. In the case of agriculture, CH_4 from livestock and N_2O from soils and manure management make the largest contributions to the GHG emissions.

Concerning acidifying emissions, electricity production was the largest contributor in 1995 (36 %), mainly due to SO_2 emissions from fossil fuel combustion, followed by agriculture (28 %), mainly due to NH_3 emissions. The picture is somewhat different in 2006, with agriculture contributing the largest share (34 %), while electricity production is down to 23 %, closely followed by transport services (22 %, up from 12 % in 1995). The latter emissions are mainly SO_2 and NOx from fossil fuel combustion in vehicle engines, in particular road freight transport.

More than half of ground level ozone precursors come from transportation (mainly NMVOCs and NOx) and the manufacturing industries (mainly NMVOCs). Agriculture contributes 16–17 %, mainly with NMVOC and CH_4 emissions, closely followed by services (including construction) with 17 % in 1995 and 13 % in 2006. The largest increase is seen in the transport industry.

Economic–environmental profiles of production activities

This section examines each of the different groups of industries and their economic and environmental profiles. This can help identify which economic activity contributes to which environmental pressure, which in turn can be helpful in knowing which types of policy focus are needed.

Integrated overviews are needed since the solution for the reduction of one type of pressure can increase another type of environmental pressure. For example, automobiles using diesel fuels are typically more fuel efficient and have lower CO_2 emissions per kilometre but typically have higher particulate and NOx emissions per kilometre, which means that as the greenhouse gas emissions are reduced by using diesel vehicles, the acidification and ground-level ozone emissions increase.

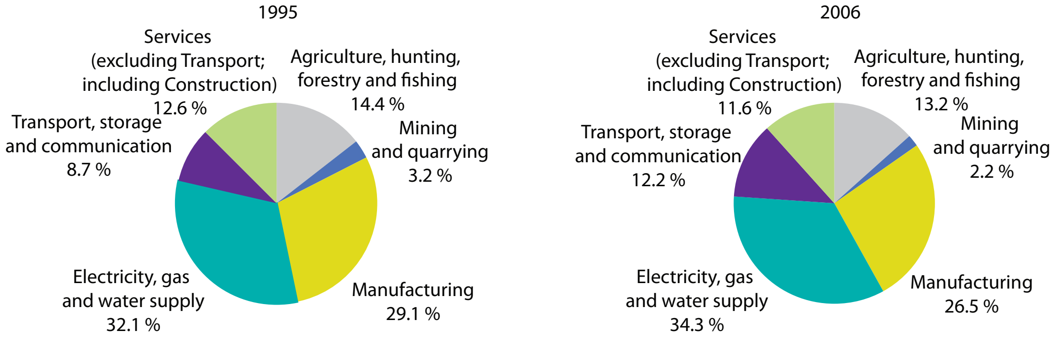
Figure 5.4 shows the economic–environmental profiles of the six industry groups in the EU-25 for the year 2006. Groups of industries often exhibit typical patterns of economic contribution and environmental pressures.

The agriculture, forestry and fishing industries are characterised by a low contribution to total gross monetary output, a modest contribution to employment, while at the same time being the largest emitters of acidifying compounds, principally due to emissions of ammonia.

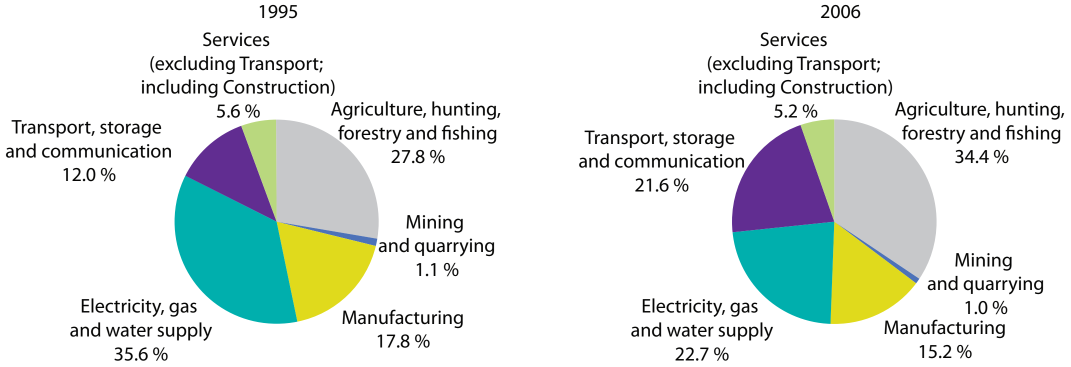
([77]) Greenhouse gases directly emitted by households through the use of private cars are not considered in this chapter, which adopts only the production perspective. Business emissions arising from road freight, public road transport, railways and air traffic, etc. are included here.

Figure 5.3: Direct emissions of greenhouse gases, acidifying compounds, and ground level ozone precursors by industry, EU-25 *(%)*

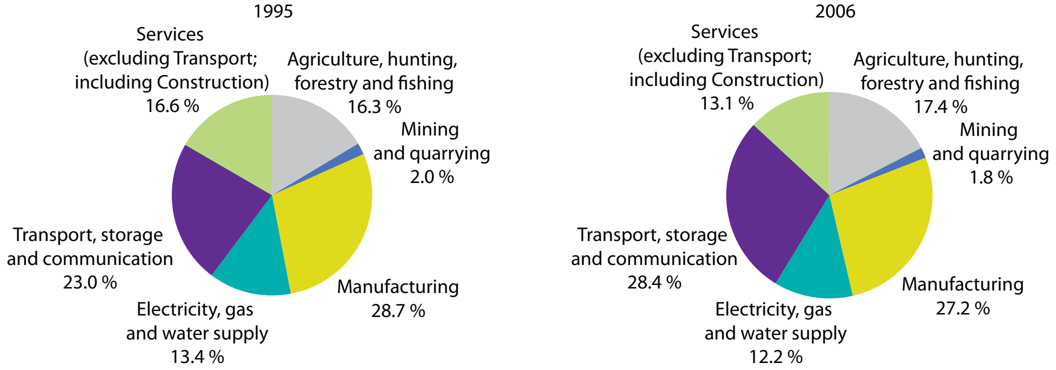
Emissions of greenhouse gases in EU-25. Industries (excluding households). Per cent.
(Co_2-equivalents including 3 greenhouse gases CO_2, CH_4 and N_2O)



Acidifying emissions in EU-25. Industries (excluding households). Per cent.
(Acid equivalents of gases SO_2, NH_3 and NOx)

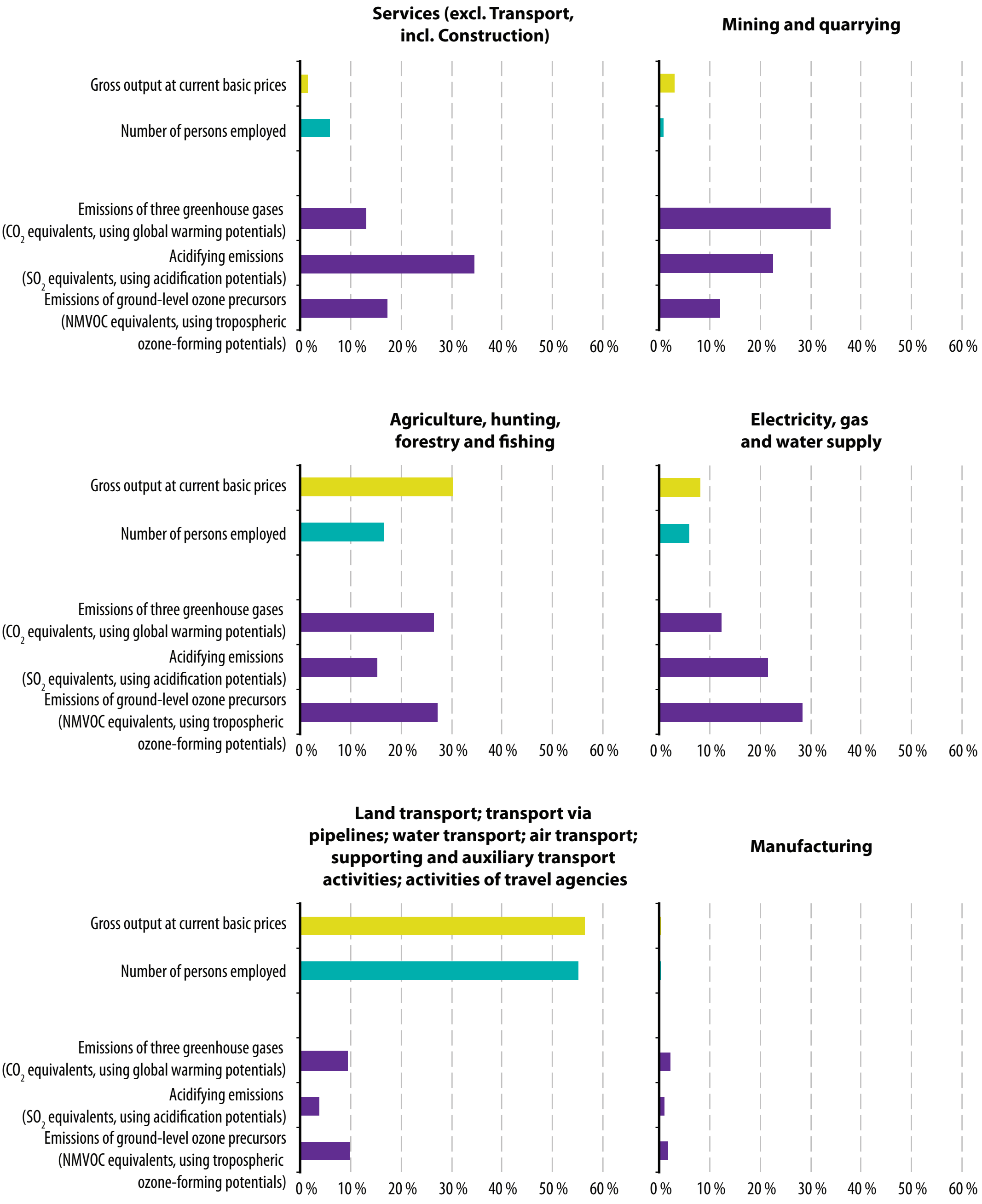


Emissions of ground-level ozone gases. Industries (excluding households). Per cent.
(Tropospheric ozone formation equivalents of gases NOx, NMVOC, CO, CH_4)



Source: Eurostat Air Emissions Accounts (env_ac_ainacehh)

Figure 5.4: Economic–environmental profiles of selected production branches/industries, EU-25, 2006 *(% of total industry production, i.e. excluding households)*



Source: EU KLEMS growth and productivity accounts (November 2009 release); auxiliary indicators to national accounts, Annual data — Eurostat (nama_aux_pem); Air emissions accounts by activity — Eurostat (env_ac_ainacehh).

The electricity industry employs only a fraction of the population, but is responsible for the largest contribution to the EU-25's direct greenhouse gases emissions and acidification emissions (primarily SO_2), due to the combustion of fossil fuels.

Although there has been a large focus on the contribution of greenhouse gases by transport services — including land, water and air transport — when a more integrated picture is used, the contribution of transport to the other more localised environmental problems of acidification and ground-level ozone formation are also shown. In this case, the emissions from maritime transport dominate the picture. This is different from the picture obtained from the national emissions inventories for the Kyoto Protocol, since emissions from international maritime and air transport are excluded. Another difference is the emissions from household-owned vehicles, which are excluded from these figures, reducing the GHGs even further. The economic–environmental profile for transport services shows that this industry contributes the most of any industry group to ground-level ozone precursor emissions, is about the same as the electricity, gas and water supply industry in terms of acidifying emissions and is ranked fourth of the six industry groups being examined in terms of greenhouse gas emissions.

The manufacturing industry is recognisable thanks to its sizeable contributions to both gross output and employment, combined with similarly significant contributions to the emissions of greenhouse gases and ground-level ozone precursors. Compared to the other economic activities, the manufacturing industry is fourth in terms of acidification emissions.

The service sector (here including construction, but excluding transport) shows a characteristically high level of contribution to the EU-25's total output and employment, while being responsible for only a fraction of the direct environmental pressures, when viewed from this production perspective.

The mining and quarrying sector also presents a characteristic profile: it contributes very little to each of the economic and environmental parameters considered. Increasingly, the EU imports metals and industrial minerals whose production potentially generates pressures on the environment (see the chapter on material flows accounts). These do not appear in the production perspective statistics used here. Only environmental pressures that are directly derived from the EU-25's industrial production can be shown.

This section presents six different industry groups at one point in time. Although comparing industries to each other is interesting and can provide information for policy-makers about which industries are contributing to the various environmental pressures, these profiles cannot be used to determine if the economy as a whole or the different industry groups are improving their performance over time. For this type of evaluation, time series of data are needed. The next section explores the emissions intensity or pressure intensity (78) of the economy.

Can production grow without emissions growing at the same rate?

By looking at the changes in production value output and the related air emissions over a number of years, it is possible to see whether European production systems are becoming less polluting over time relative to their economic activity.

Figure 5.5 shows the economic and environmental performance of EU-25 production from 1995 to 2006. Over this whole period the emissions intensities (79) for both greenhouse gases and acidification gases are decreasing (lower line in the graphs). Overall, industries in the EU-25 induced (directly) less environmental pressures

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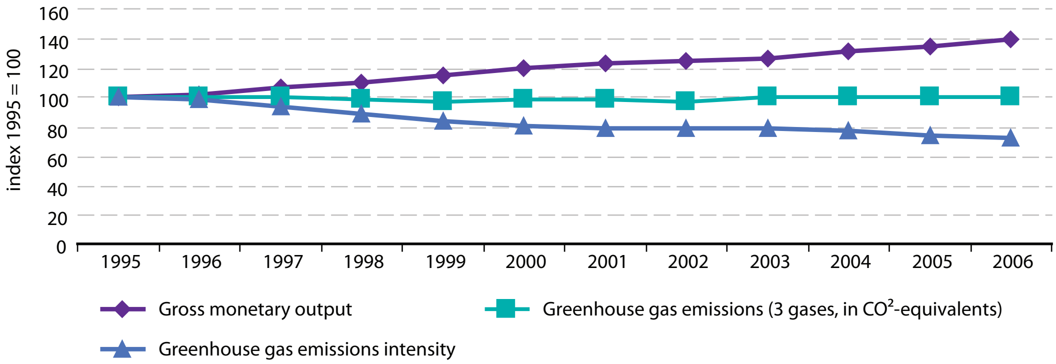
(78) **Pressure intensity** is the environmental pressure per unit of economic output. The inverse (output per emissions or other pressure) indicator is referred to as **eco-efficiency**.

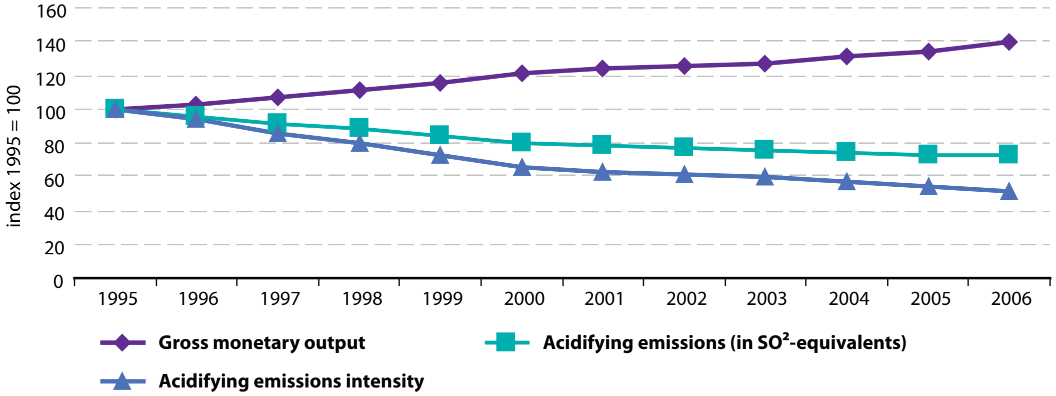
(79) Emissions intensity calculated by taking the ratio of emissions and dividing by the monetary gross output.

Figure 5.5: Gross monetary output, emissions of greenhouse and acidifying gases and emissions intensities for industries, EU-25 *(indexed 1995 = 100)*

Greenhouse gas emissions intensity and decoupling of greenhouse gas emissions of total industries from gross output



Acidifying emissions intensity and decoupling of acidifying emissions of total industries from gross output



Source: EU KLEMS growth and productivity accounts (November 2009 release) in 2000-constant prices; air emissions accounts by activity — Eurostat (env_ac_ainacehh)

for each unit of economic output in 2006 than they did in 1995.

If emissions intensities were the only information available these downward trends would be considered 'good.' However if the emissions trend and the economic trend are considered separately, the developments cannot be viewed so favourably. The reason the emissions intensity decreased so dramatically appears to be due to an increase in the monetary gross production rather than a decrease of air emissions.

This is the case for both greenhouse gases and acidification gases. The combined three greenhouse gas emissions (CO_2, CH_4, N_2O) decreased considerably less than the acidification gas emissions (SO_2, NOx, NH_3).

Another consideration is that, looking at the economy as a whole, the increased output of some industries, for example the service industries (which include financial services like banking and insurance), can hide some of the less-favourable developments which can be seen when looking at individual industries.

Comparisons between industries in different countries can also be revealing, especially when the products from these industries are very similar. Electricity and land transport are fairly uniform from country to country so the emissions profiles for these industries can illustrate the different choices regarding production systems in the different countries.

Countries show different environmental pressures for the same type of economic activities

The electricity, gas, steam and hot water supply industry ([80]) supplies electricity and heat to other industries and households. These products are the same (homogeneous) in all countries so comparing the environmental pressures arising from the production of these products in different countries can show some major differences between countries. These differences are due to different levels of technological development and uses of different types of energy sources.

Figure 5.6 ([81]) presents greenhouse gas and acidification emissions for the electricity, gas, steam and hot water supply industry as emissions per GWh of electricity and heat generated ([82]) in six European countries and the EU-27. The six countries were chosen because they illustrate different energy mixes, are more or less emission intensive, and because of data availability.

When evaluating power generation from an air emissions (greenhouse and acidification gases) perspective, hydropower, wind, solar and nuclear energy have the lowest level of air emissions per GWh of electricity produced under normal operations. Power plants using natural gas have lower emissions than those using coal or oil. For district heating plants that burn biomass the CO_2 emissions are not counted (according to the methodology developed related to the Kyoto Protocol).

Among the countries considered between 1995 and 2006, those with the lowest emissions of greenhouse gases per GWh of electricity and heat generated are Norway, Sweden and France (0.003–0.005 Gg/GWh, 0.04–0.07 Gg/GWh and 0.06–0.09 Gg/GWh, respectively) ([83]). These same three countries also show the lowest emissions of acidifying compounds per GWh (0.02 Mg/GWh, 0.08–0.16 Mg/GWh and 0.28–0.58 Mg/GWh, respectively) ([84]). Norway generates electricity almost exclusively from hydropower plants and heat from natural gas; this explains the very low environmental pressure intensities. Sweden generates electricity from both nuclear and hydropower (roughly half of the production from each type of power plant), and more than half of its heat comes from biomass whose CO_2 emissions from combustion were, by convention, excluded. France produces electricity mainly from nuclear power plants and about 60 % of heat generation comes from gas-fired power plants. These combinations of nuclear and gas explain the low environmental pressure intensities for these countries.

Denmark, Germany and Poland, on the other hand, present much higher emissions of greenhouse gases and acidifying compounds per GWh of electricity and heat generated. Of the three countries, only Denmark remains lower than the EU-27 average for greenhouse gas emissions intensity (0.44–0.50 Gg/GWh) with 0.47 Gg/GWh in 1996 down to 0.28 Gg/GWh in 2005. The use of coal for both electricity and heat generation explains the differences for the three countries mentioned above. In Germany

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([80]) NACE (rev. 1.1) E or 40.

([81]) All figures except Figures 5.6 and 5.7 use EU-25 as the EU aggregate because they use gross output data and these do not exist at the EU-27 level of aggregation. Figures 5.6 and 5.7 use EU-27 as the EU aggregate because they do not use gross output data.

([82]) Total gross electricity generation and total heat production were added to obtain the denominator (in GWh) of the intensity.

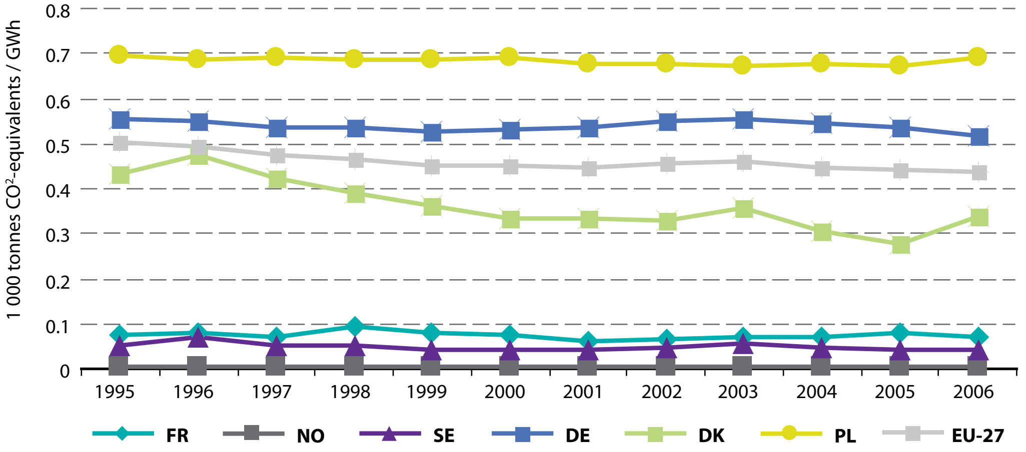
([83]) 1 Gg/GWh = 1 000 t/GWh

([84]) 1 Mg/GWh = 1 t/GWh

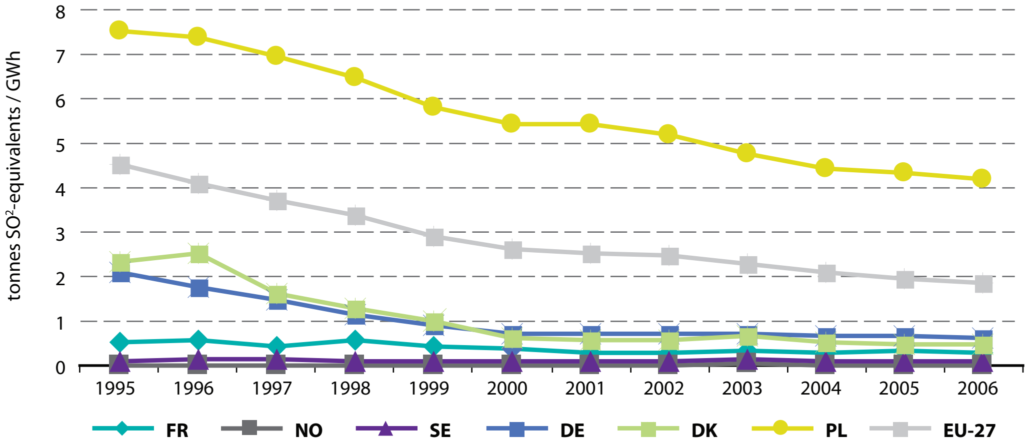
and Denmark some of the downward trends in emissions are due to the increases in the use of wind power generation and in switching to natural gas. Regarding acidification emissions, Denmark also decreased over the considered period (2.52 Mg/GWh in 1996 and 0.49 Mg/GWh in 2005) and remained below the also

Figure 5.6: Country comparisons of environmental pressures (global warming and acidification potentials), NACE industry E40 *(emissions per unit of electricity and heat generated)*

Greenhouse gas emissions intensity of electricity and heat generation



Acidifying emissions intensity of electricity and heat generation



Note: Greenhouse gas emissions (CO$_2$ equivalents) include three greenhouse gases CO$_2$, CH$_4$ and N$_2$O.

Source: Supply, transformation, consumption — electricity — annual data — Eurostat (nrg_105a); Total gross electricity generation and supply, transformation, consumption — heat— annual data — Eurostat (nrg_106a); Transformation output; Air emissions accounts by activity — Eurostat (env_ac_ainacehh)

decreasing EU-27 average (from 1.53 Mg/GWh in 1995 to 1.87 Mg/GWh in 2006).

With 0.56 Gg/MWh (1995) to 0.52 Gg/GWh (2006), Germany lay above the EU-27 average for greenhouse gas emissions intensity. In the case of acidification emissions intensities Germany performed almost equally to Denmark, below the EU-27 average. Poland on the other hand lay above the EU-27 average both in terms of greenhouse gas emissions intensity and acidification intensity. In the former case it is stable at 0.67 to 0.69 Gg CO_2 equivalents/GWh. In the latter, it decreased from 7.53 SO_2 equivalents/GWh in 1995 to 4.20 SO_2 equivalents/GWh in 2006.

The lower performance of Denmark, Germany and Poland with regard to both greenhouse gas intensities and acidification intensities is explained by the large share of coal-fired power and heat plants in the national electricity and heat production system in these three countries. End-of-pipe technologies, such as scrubbers, probably allowed Germany and Denmark to decrease their acidification emissions associated with electricity and heat generation down to a level closer to those of Norway, Sweden and France. Such an option does not exist (yet) for the emissions of greenhouse gases (carbon capture), hence the large difference between the two country groups.

Another comparison that can be made between countries with some degree of confidence is land transport (including the transport industry (NACE Rev. 1.1 I or 60) and households). Transport is a homogeneous service across countries, so comparisons are possible. Figure 5.7 (85) presents the trends for greenhouse gas and acidifying emissions for three countries from 1995 to 2006. The graphs also show changes in the vehicle fleet (for road transport) in the selected countries, for the period considered. Only the stock of vehicles for road transport (including trailers and semi-trailers, and motorcycles) is displayed. Locomotives and railcars for rail transport are not included since they represent a negligible fraction of the total number of vehicles for land transport. Due to a lack of data the graph for the Czech Republic only shows the period 2002–06.

The fleet of vehicles expanded by 17 % in Germany, 27 % in Italy and 20 % in the Czech Republic between 1995 and 2006 (and only 5 % between 2002 and 2006 for the Czech Republic). The environmental pressures, however, did not change in the same way for the three countries.

Greenhouse gas emissions from land transport decreased 8 % for Germany but increased 19 % in Italy. In the Czech Republic, these emissions increased by 32 % between 2002 and 2006. When the trend of one variable goes in one direction and a closely related variable does not move in the same direction the variables are considered to be ‘decoupled’. In this case, the greenhouse gas emissions from land transport in Germany appear to be decoupled from the expansion of the vehicle fleet from 2002 onwards. The growth rates of emissions are tracking the growth rate of the vehicle fleet in Italy, whereas greenhouse gas emissions are growing even faster than the vehicle fleet in the Czech Republic.

When looking at the emissions of acidifying gases, they have decreased dramatically in Germany (55 %) and Italy (52 %) over the decade between 1995 and 2006. The introduction and spread of efficient end-of-pipe technologies, such as exhaust pipe catalytic converters for gasoline vehicles and improved technology in diesel vehicles which produces lower levels of NOx and SO_2 emissions, have played a key role in mitigating the problem of acidification emissions associated with land transport. This pressure has been decoupled from the expansion of the stock of vehicles in Germany and Italy. No such dramatic change can be observed in the case of the Czech Republic (decrease by 4 % of

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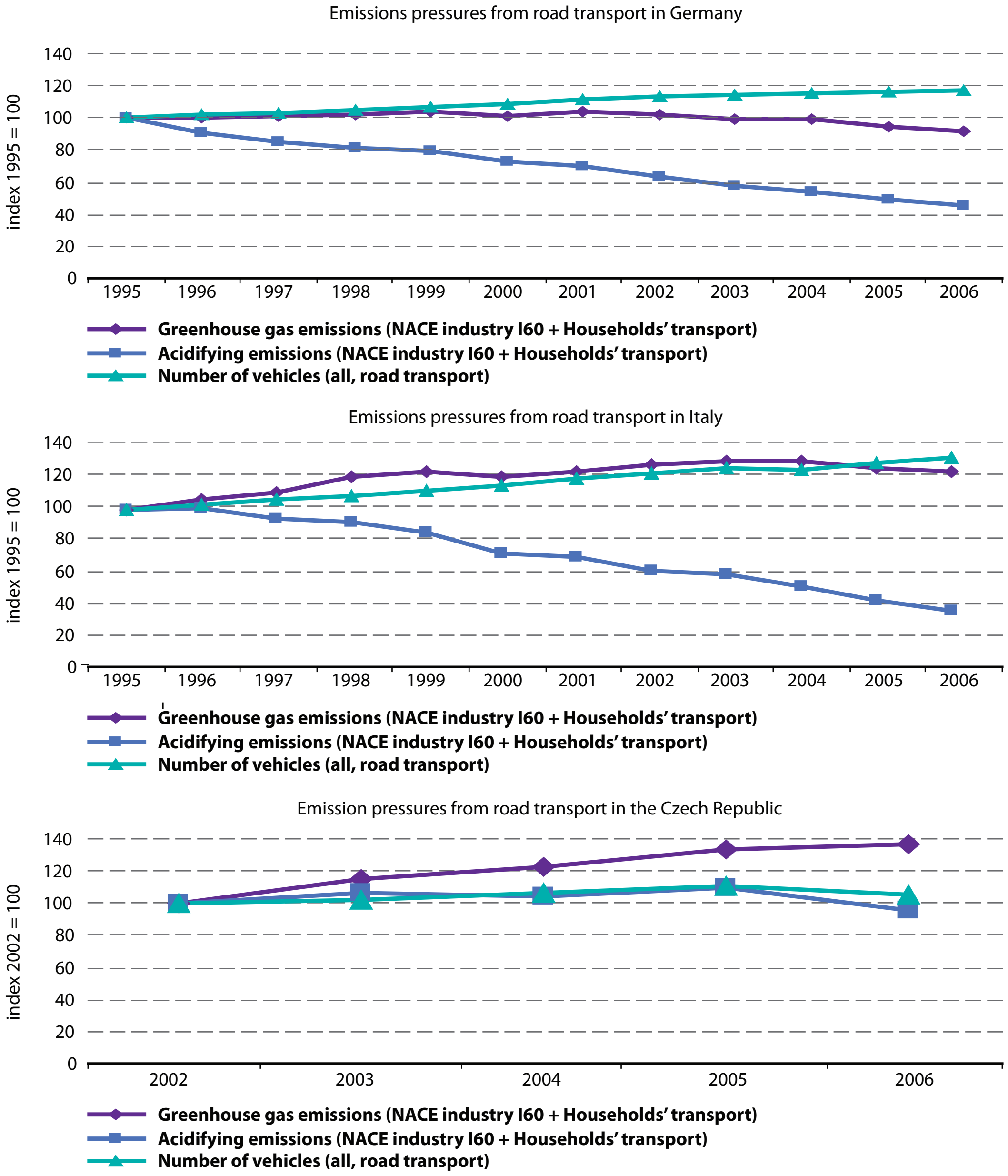
(85) All figures except Figures 5.6 and 5.7 use EU-25 as the EU aggregate because they use gross output data and these do not exist at the EU-27 level of aggregation. Figures 5.6 and 5.7 use EU-27 as the EU aggregate because they do not use gross output data.

Figure 5.7: Country comparison of total vehicle fleet and emissions pressure from land transport activities and transport from households (NACE industry I60 + private transport activities for households), Germany, Italy and the Czech Republic *(index 1995 =1 00)*



Note: Greenhouse gas emissions (CO_2 equivalents) include three greenhouse gases (CO_2, CH_4 and N_2O).

Source: Stock of vehicles by category at regional level — Eurostat (trans_r_vehst), all vehicles (except trailers and motorcycles) + trailers and semi-trailers + motorcycles (> 50 cm^3); air emissions accounts by activity — Eurostat (env_ac_ainacehh) the emissions of acidifying compounds from land transport between 2002 and 2004).

A comparison of other industrial sectors between countries can be difficult to interpret since they can include a wide variety of products and production processes which have very different emissions profiles. For example the chemical industry (NACE Rev. 1.1 DG or 24, Manufacture of chemicals, chemical products and man-made fibres) is very varied including activities as diverse as the production of pharmaceuticals and fertilisers (see the chapter on chemicals). These industries can sometimes be rather homogeneous within a country, but very often they specialise in one type of product or another. The problem is that the emissions arising from one type of process, such as fertiliser production, are somewhat different from those arising from the manufacture of pharmaceuticals. This exact situation is observed when examining the chemical industries in Norway and Denmark. In Norway, the emissions for the chemicals industry are related to the production of fertilisers and other basic chemicals, whereas in Denmark this industry includes primarily pharmaceutical enterprises with low air emissions per production value. It would not be correct, therefore, to label the industry in one country as more environmentally friendly than in another country, based solely on this type of indicator.

Reasons for changing emissions patterns in European Union economies

In the previous sections, decoupling between growth in economic output and changes in air emissions (aggregated as environmental pressures) has been illustrated when the trend for one variable is going in the opposite direction from a related variable. Identifying the underlying causes for these trends is difficult unless additional calculations, called decomposition analyses, are made. This section presents the results using one method of decomposition analysis that allows the isolation of the contributions of different factors which then add up to the changes observed in air emissions between 1995 and 2006. This analysis uses the economic and emissions data used for Figure 5.5 and identifies the underlying reasons for the patterns observed in the emissions of greenhouse and acidification gases.

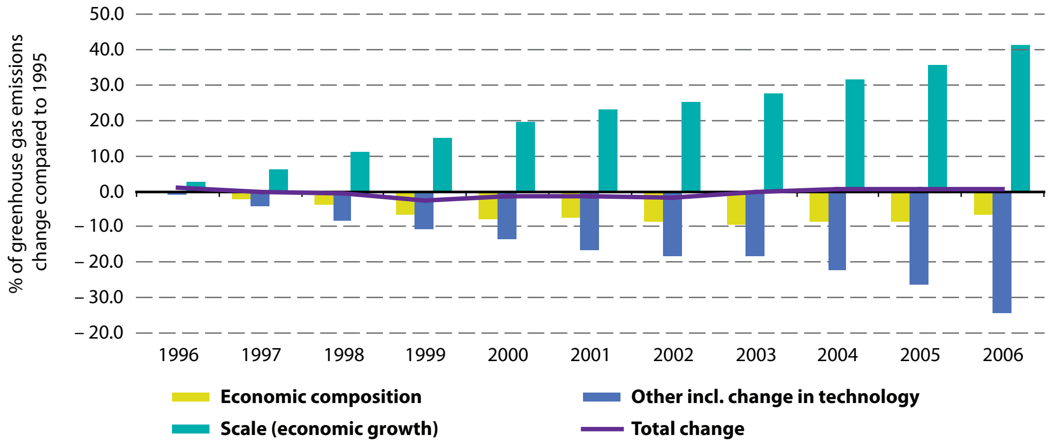
The decomposition method used here is usually referred to as 'index decomposition analysis' (IDA) and measures direct effects only (i.e. it does not consider the influence that changes in input or output of one sector can have on the input or output of other sectors). The IDA allows identification of the effects on the level of emissions due to three different factors: (1) scale of economic growth (i.e. changes in the total output volumes from the different industries), (2) changes in the economic composition (i.e. decreases in the manufacturing industries and increases in the services industries), and (3) other factors including changes in technologies and energy mixes which result in changes in emissions per unit of economic output.

Figure 5.8 presents the analysis of changes in greenhouse gas emissions (CO_2 equivalents for three gases, CO_2, CH_4 and N_2O) of the EU-25 and acidification emissions from all industries for the period 1995–2006, decomposed according to three factors: (1) scale (growth), (2) composition and (3) other factors/technology. The figure shows how much each factor contributed to increasing or decreasing emissions compared to 1995 levels.

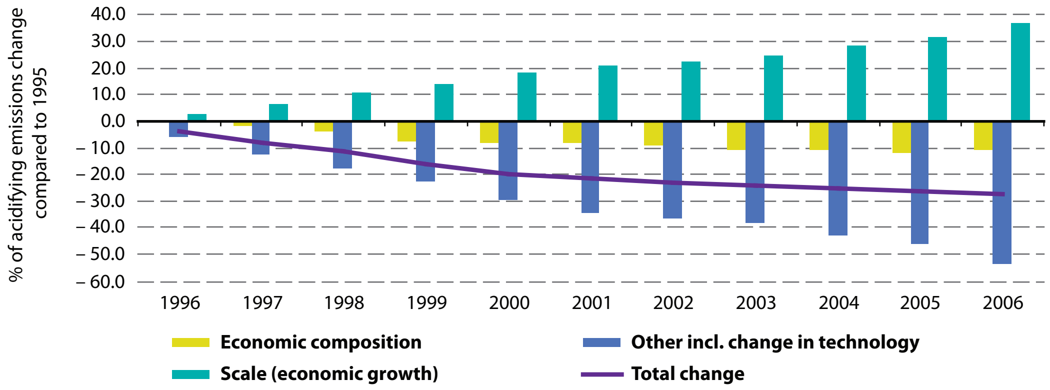
Between 1995 and 2006, the greenhouse gas emissions (measured in CO_2 equivalents for 3 gases) of the EU-25 (all industries) remained rather stable, in fact, only an increase of less than 1 % is observed. Due to the increase in economic output alone emissions would have increased by 41 %, but changes in fuel use, technology improvements, etc. captured in the other factors/technology component have counterbalanced this increase and have contributed to decreasing emissions by 34 %. The change in economic structure helped dampen the growth in direct greenhouse gas emissions by

Figure 5.8: Structural decomposition of changes for total industries — three factors: scale (economic growth), composition (of the economy) and other factors including technology, EU-25 *(%)*

Decomposition of change in greenhouse gas emissions from total industries in EU-25, between 1996 and 2006



Decomposition of change in acidifying emissions from total industries in EU-25, between 1996 and 2006



Note: Greenhouse gas emissions are in CO_2 equivalents and include only three greenhouse gases (CO_2, CH_4 and N_2O).

Source: EU KLEMS growth and productivity accounts (November 2009 release) in 2000-constant prices; air emissions accounts by activity — Eurostat (env_ac_ainacehh)

an additional 6 % over the decade. This contribution can be partially explained by the increase of a more service-based economy, although the industrial composition of the European Union (EU-25) did not exhibit major changes over the period 1995–2006. The overall change of less than 1 % increase in emissions from 1995 to 2006 is therefore explained by + 41 % (growth), – 6 % (economic composition) and – 34 % (other factors including technology).

The decomposition analysis of changes in acidification emissions in the EU-25 shows a similar pattern for the underlying factors influencing the overall decrease in the emissions by 27 % during the period studied. Economic growth by itself was responsible for a 37 % increase in acidification emissions. But this was counteracted by an 11 % decrease due to changes in the composition of the economy and a 54 % decrease due to other factors including technology.

Conclusions: Air emissions accounts in the European Union

Eurostat's air emissions accounts are a statistical information system that records emissions of greenhouse gases and air pollutants in a format compatible with the standardised system of national accounts which is used to portray economic activities. Air emissions accounts are directly linkable to economic production and consumption activities enabling integrated analyses. Air emissions accounts are provided for the latter purposes and cannot be used for target monitoring of international agreements such as the Kyoto and the Gothenburg Protocols. The European Environment Agency (EEA) is the body responsible for target monitoring the EU and Member State data on air pollutant and greenhouse gas emissions for policy purposes related to international protocols which have their specific and own inventory rules.

European production systems result in emissions of air pollutants and greenhouse gases. Four industry groups accounted together for 80 to 90 % of the direct emissions of greenhouse gases, acidifying gases and tropospheric ozone-forming precursors in the EU-25 in 2006. These industries correspond to the primary sector (agriculture, forestry and fishing), the electricity, gas and water supply industry, the manufacturing industries, and transport services. Although these industries contribute the majority of emissions, they only account for around 43 % of total monetary output, with manufacturing alone accounting for 30 %.

Economic–environmental profiles provide for selected industries an overview on their performance in both economic and environmental terms. The manufacturing industry is characterised by its sizeable contributions to both gross output and employment, combined with similarly significant contributions to the emissions of greenhouse gases and ground-level ozone precursors. The service industry (including construction, but excluding transport) shows a characteristically high level of contribution to EU-25 total production output and employment, while being the source for only a fraction of the direct emissions pressures.

Both total greenhouse and acidifying emissions intensities decreased noticeably between 1995 and 2006 in the EU-25. The reason for the emissions intensity decreasing so dramatically is mainly due to an increase in the monetary gross production rather than a decrease of emissions to air.

Countries show different environmental pressures for the same type of economic activities. It reflects the different choices made and the state of technology regarding production systems in different countries. For example, countries such as Denmark, Germany and Poland, whose energy mixes still rely heavily on coal, present higher direct greenhouse gas intensities in electricity and heat generation than countries like Norway, Sweden and France. To tackle acidifying emissions, countries have deployed end-of-pipe technologies allowing them to reduce, over time, their acidification emissions intensities associated with electricity and heat generation. Germany, Denmark and Poland managed to reach levels closer to those of Norway, Sweden and France.

An index decomposition analysis helps to identify the underlying causes for trends observed in greenhouse gas and acidifying emissions. Total direct greenhouse gas emissions more or less remained on the same level between 1995 and 2006 in the EU. This overall trend is composed of several underlying factors: + 41 % due to economic growth, – 7 % due to structural changes in the composition of industries and – 34 % due to other factors including technology. The following decomposition explains the 27 % decrease in acidifying emissions: economic growth + 37 %; changes in the composition of the economy – 11 %; and decrease due to other factors including technology – 54 %.

Further information

Eurostat database

Environment and energy, see:

Environmental accounts (env_acc) then Physical flow and hybrid accounts Economy (env_acp)

Databases

(1) Air emissions accounts by activity (NACE industries and households) (env_ac_ainacehh)
(2) Air emissions accounts totals bridging to emission inventory totals (env_ac_aibridg)

and finance, see:

National accounts: national accounts (including GDP) (na)

Annual national accounts: annual national accounts (nama)

Supply, use and input–output tables (naio)

Access workbooks by country (http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/workbooks)

Eurostat dedicated section

Environmental accounts (EA) (http://epp.eurostat.ec.europa.eu/portal/environmental_accounts/introduction)

Eurostat publications

Eurostat (2009), *Manual for air emissions accounts*, Luxembourg

Eurostat (2001), 'NAMEAs for air emissions: Results of pilot studies', Luxembourg

Further reading

ETC/SCP (2009), *Environmental pressures from European consumption and production*, Copenhagen

EEA (2005), *The European environment — State and outlook 2005*, Copenhagen

Eurostat and Statistics Denmark (2003), 'Analysis of changes in air emissions in Denmark, 1980–2001 — Time series — Bridge tables — Decomposition analysis', Luxembourg

Methodological notes

Air emissions accounts are reported every two years via questionnaires sent out to all EU Member States, Norway and Switzerland. The latest completed data collection at the time of this publication had occurred in 2008. Reporting countries are asked to provide data up the year $n-2$. Therefore, European air emissions are presented in this chapter up to the year 2006.

Air emissions accounts theoretically offer the possibility to compare direct emissions of 13 gases from 60 industries (plus three categories for households) across 29 countries (EU-27 plus Norway and Switzerland) between 1995 and 2006. In practice, data coverage can vary dramatically, for example between countries, but also along the time series for a given country and for the different gases.

Air emissions accounts for EU aggregates are estimated by Eurostat on the basis of the accounts reported by the Member States. The gaps in the reports are systematically filled in order to be able to derive complete accounts for EU aggregates. Eurostat estimates for single Member States are not publicly available in the Eurostat dissemination database but the overall EU aggregates are on New Cronos. The gap-filled data set was used for calculating EU-25 aggregates and for the graphs and analyses based on EU-25 data.

Gross monetary output data per NACE industry come from EU KLEMS growth and productivity accounts (www.euklems.net, November 2009 release). EU KLEMS data are available in PPP constant prices. Using gross output in current prices and volume indices, gross output was calculated in 2000-constant prices for use in time series. Data were available for the EU-25 but not for the EU-27 for the production of this publication.

Due to difficulties in the data reported by the Member States regarding the greenhouse gases SF_6, PFC and HFC, greenhouse gas emissions were calculated using the global warming potential for three gases only: CO_2, CH_4 and N_2O. The units for the greenhouse gas emissions are in CO_2 equivalents.

The latest year available for the air emission accounts for the production of this publication is 2006.

There is a partial overlap between the categories of environmental pressures 'acidification emissions', which use acidification potential factors in the calculation, and 'tropospheric ozone formation', which use trophospheric ozone-formation potential factors. The problem is that the emissions for nitrogen oxides (NOx) are included in the calculations for both categories. Once the NOx has chemically reacted into acidification or ozone gases it would not be available to react to the other environmental pressure. However, it is the 'potential' for contributing to these environmental pressures that is being considered with these types of calculations and not the emissions themselves.

Only direct emissions are available from the air emissions accounts. To obtain indirect emissions associated with consumption, input–output calculations are necessary. These types of calculations are currently not available from Eurostat but they will become part of the Eurostat work programme in the near future in connection with the Data Centre on Sustainable Consumption and Production.

List of the chemical substances mentioned in this chapter:

carbon dioxide	CO_2	non-methane volatile organic compounds	NMVOCs
methane	CH_4	hydrofluorocarbons	HFC
nitrous oxide	N_2O	perfluorocarbons	PFC
sulphur dioxide	SO_2	sulphur hexafluoride	SF6
nitrogen oxides	NOx		


ACI
NITR
HNO
AMMO
HYDRO
NH

6

Chemicals

Chemicals are present in virtually everything society uses on a daily basis. Chemicals have a number of benefits for human health and contribute to the overall quality of life, but may also present risks.

Production, trade and use of chemicals in Europe

Chemicals are an integral part of modern life and an industrial society, with over 100 000 different substances in use. Chemicals are part of the make-up of our physical world; and they are the building blocks from which we make most of our products. They are constituents of materials, part of preparations and products and are embedded in complex physical systems. Chemicals are used in a wide variety of products and are a major contributor to economic development. Industries producing and using these substances have a significant impact on employment, trade and economic growth worldwide. Considered by various economic sectors as an essential engine for change and innovation, chemicals and related industries can play a key role in developing sustainable patterns of consumption and production.

Sound management of chemicals throughout their life cycle is essential in order to avoid significant risks to human health and to the environment.

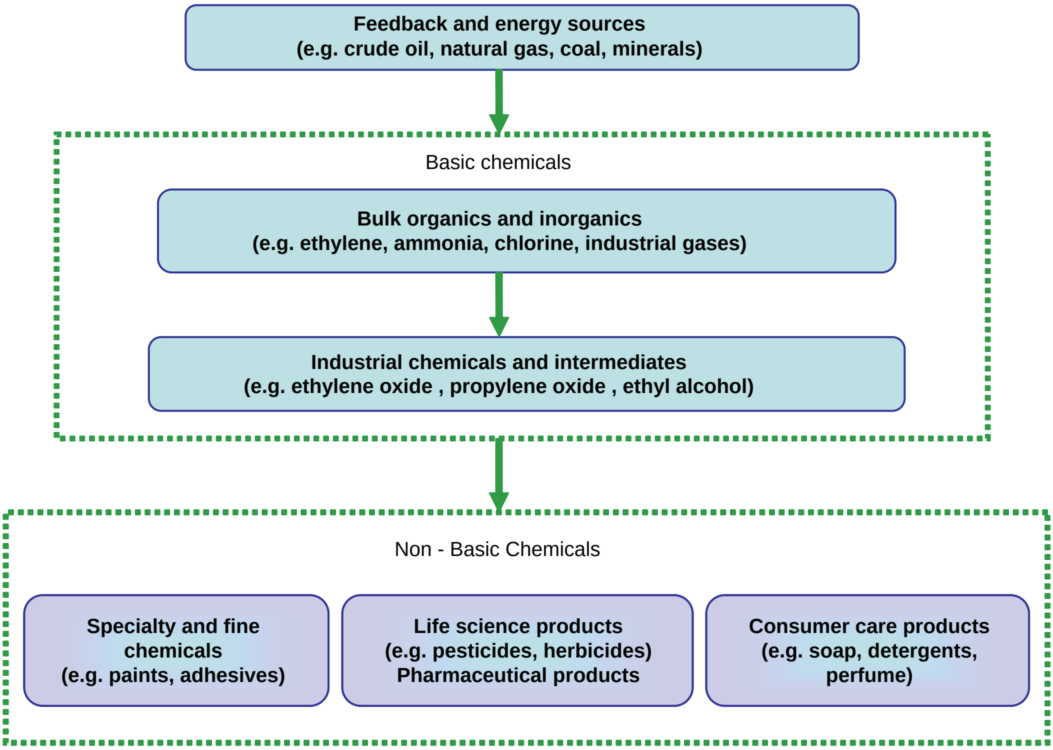
Pharmaceuticals and basic chemicals dominate the EU chemicals industry

The chemicals industry (NACE rev. 1.1 division 24) transforms raw materials, particularly oils and minerals, into a multitude of substances and preparations which are used as inputs by many downstream economic sectors and in a wide variety of consumer products.

The EU chemicals industry is one of the biggest industrial sectors. It generated around 11 % of the value added of the EU-27 manufacturing industry in 2007 (*source:* Eurostat (tin00055)). It is also an important source of

Photo: http://commons.wikimedia.org/wiki/File:Chemicals_in_flasks.jpg
Author: Joe Sullivan

Figure 6.1: The chemicals industry



employment in many regions of the European Union. In the EU-27, some 33 600 chemical companies employ a total staff of about 1.9 million people, equivalent to 5 % of the EU manufacturing industry's overall workforce (*source:* Eurostat (sbs_na_2a_dfdn)).

Figure 6.2 shows that, in terms of employment and production value, the EU chemicals manufacturing industry is dominated by the production of pharmaceuticals and base chemicals (86).

Employment in the EU chemicals industry decreased by 2 % annually over the period 1997–2007 (87).

While employment has decreased over the last decade, production steadily increased by 22 % between 2000 and 2007. This indicates a considerable increase in productivity in the period. According to structural business statistics (SBS), chemicals manufacturing, dominated by the manufacturing of pharmaceuticals and base chemicals, had the highest labour productivity in terms of value added per person employed in the EU-27 manufacturing activity (NACE divisions) in 2007.

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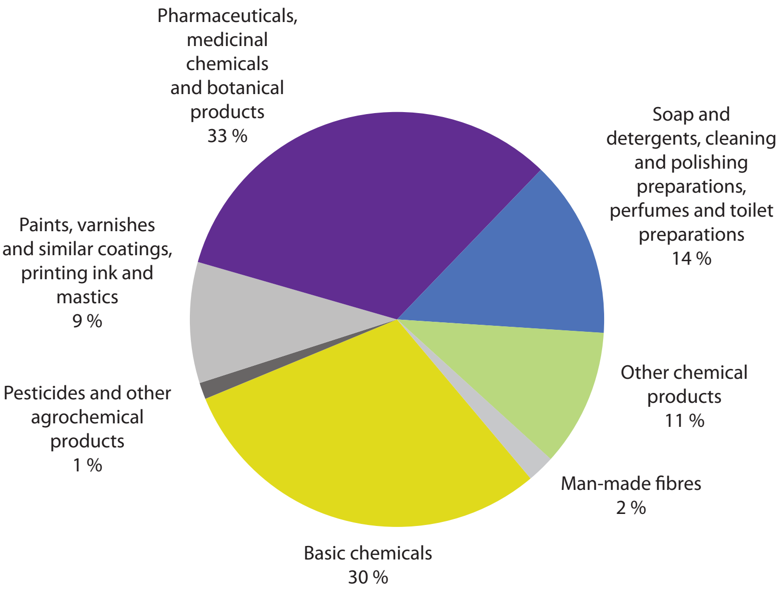
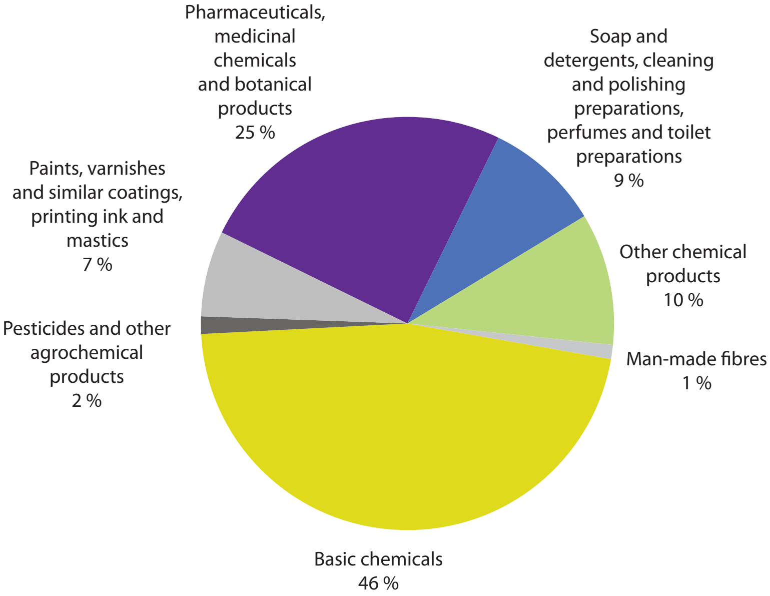
(86) Base chemicals cover petrochemicals and derivatives and basic inorganics. They are produced in large volumes which are sold to the chemicals industry itself and to other industries.

(87) *Source:* http://www.cefic.be/factsandfigures/downloads/chart6_1_2008.pdf

Figure 6.2: Employment in 2007 (top) and production value in 2008 (bottom) in the manufacture of chemicals and chemical products (NACE rev. 1.1 division 24) by subsector, EU-27 *(%)*





Source: Eurostat (sbs_na_2a_dfdn) and Europroms database

Production trend in chemicals

Figure 6.3 presents the chemicals industry's production in physical volume in the EU-15 and EU-27.

In the 'old' Member States (EU-15), between 1995 and 2007, the total production of chemicals in volume grew by 65 million tonnes (+ 26 %) to the highest value (313 million tonnes), and then decreased by 26 million tonnes (– 8.3 %) in 2008.

For the EU-27, available data from 2002 onwards shows an increase of 32 million tonnes (9.6 %) to the highest value in 2007 (362 million tonnes). In 2008 total production fell significantly, by 26 million tonnes (– 7.2 %), due to the international economic downturn.

The higher growth rates in the EU-27 for the period 2002–08 clearly show that the new Member States have been progressively increasing the volume of their chemical production more rapidly than the EU-15 in recent years.

Production is concentrated in western Europe

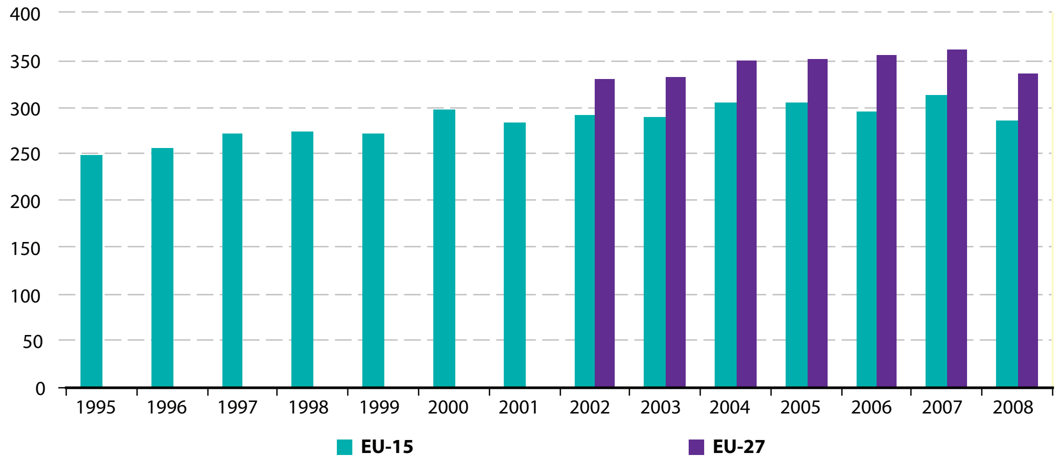
Four Member States in western Europe generate two thirds of the EU's chemical production. Germany was the largest producer in Europe, followed by France, Italy and the United Kingdom in 2008. Adding Spain, the Netherlands, Belgium and Ireland raises the overall share to 88 %.

Although new Member States are progressively increasing the volume of their chemical production, the production of chemicals is largely concentrated in western Europe.

In total, in volume, countries from the 12 new Member States produced 15 % (49 million tonnes) of the total volume of chemicals produced in the EU-27 in 2008.

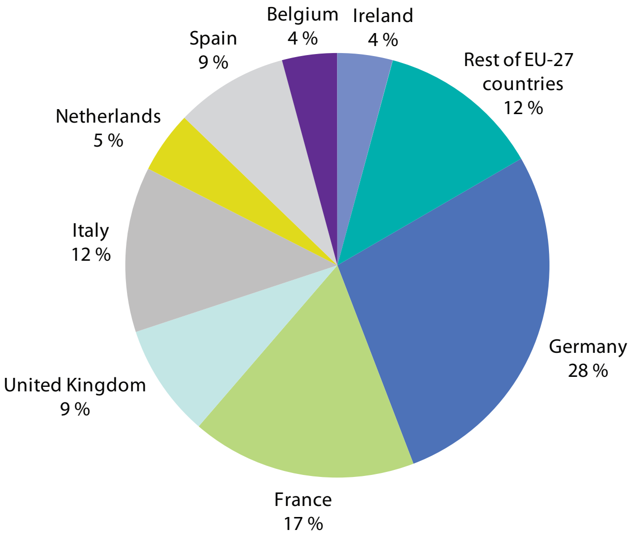
The chemicals industry in the 12 new Member States is structurally different from the one in the EU-15. For instance, base chemicals represent a much higher share than specialised chemicals and the new Member States have a large trade

Figure 6.3: Production of chemicals in physical volume, EU-15 and EU-27 *(million tonnes)*



Source: Eurostat Prodcom statistics

Figure 6.4: Chemical industry's production volume by country, EU-27, 2008 *(%)*



Source: Eurostat Europroms database

deficit in chemicals. Among them, Poland makes the highest contribution, representing 2 % of total EU chemicals production (*source:* Eurostat (ebd_all)).

Safety of chemical products and use of natural resources

The use of certain chemicals causes adverse effects on human health and the environment. This has led to the development of an increasingly dense and demanding regulatory framework and calls for the substitution of hazardous chemicals with safer alternatives.

At the same time, the chemicals industry has an important responsibility not only for the safety of chemical products but also for the move towards a sustainable use of natural resources. Fossil fuels, which are both the main sources of energy and the main feedstock for most chemicals, are limited. The chemicals industry accounts for 12 % of total EU energy demand and for one third of all EU industrial energy use (energy and feedstock or raw materials and, as most of the fossil fuels are used as feedstock, the embedded carbon in chemical products is not released as CO_2). However, the ambition of achieving a lighter carbon footprint has led to efforts in the chemicals industry to widen its feedstock base, particularly through broader use of bio-based renewable raw materials as replacement and complement for fossil feedstocks. While in principle a large number of chemical substances can be produced from renewable raw materials, industrial production needs a reliable flow of high quantities of feedstock of constant quality. The strong dependence on fossil feedstock, high energy use and high air emissions in the production of chemicals requires constant efforts to improve the efficiency of energy and resource use. Such efforts started many years ago and much has been achieved.

While overall chemicals production in Europe increased from 1995 to 2006 in both the EU-15 and EU-27, the chemicals industry's emissions of greenhouse gases, acidifying pollutants and emission of pollutants responsible for ozone formation decreased by 28 %, 47 % and 47 % respectively over the same period (see the chapter on air emissions accounts). This is mainly due to a move to gas as a principal energy source, to changes in the product mix and to the minimisation of resource and energy use by using excess heat from one process as an input to another, for example. Thus, centralised production of power and steam usually allows some segments of the chemicals industry to leave a lower carbon footprint.

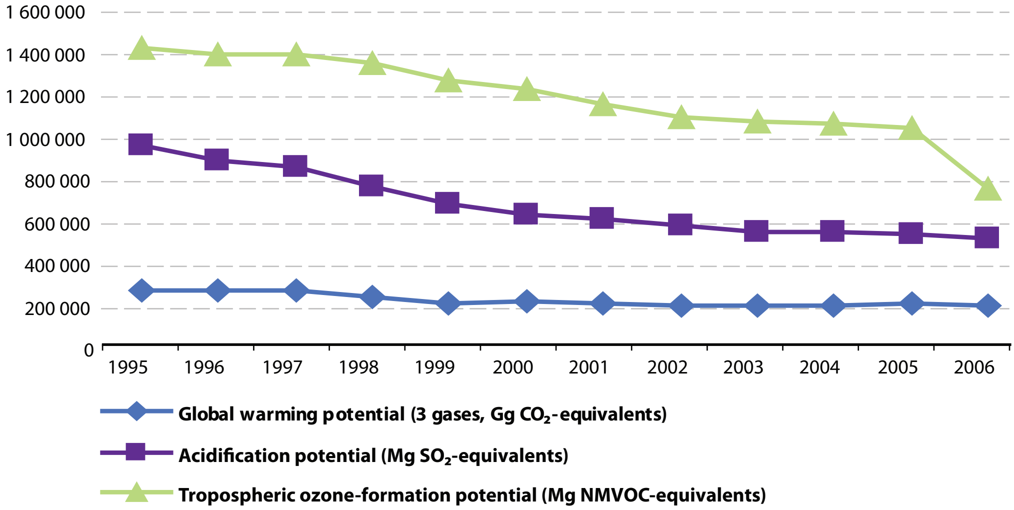
The EU-27 chemicals industry generated around 40 million tonnes of waste in 2006, which represents 11 % of the waste generated by the whole manufacturing industry. Around 20 % of the total waste generated by the chemicals industry in the EU-27 is hazardous waste (which can be compared with the around 7.2 % of hazardous waste generated by the manufacturing industry in the EU-27) (*source:* Eurostat (env_wasgen)).

Significant improvements in the safety of chemical installations have been achieved as evidenced by a strong reduction in accidents and emissions, improved management of products and increasing substitution of the most dangerous chemical substances with other less harmful ones.

The chemicals industry, as the biggest industrial user of energy, although mainly as feedstock, will have to continue efforts to reduce its energy and raw material consumption. In addition, it is necessary to reduce water pollution from the production and use of chemical products.

At the same time, progress in so-called 'green chemistry' offers the possibility of using less energy in production, generating energy differently and using it more economically in other

Figure 6.5: Air emissions from the chemicals industry, EU-27 *(Gg CO_2 equivalents, Mg SO_2 equivalents and NMVOC equivalents)*



Source: Eurostat — NAMEA, air emissions accounts (env_ac_ainacehh) sectors of the economy. In practice, materials produced by the chemicals industry enable the exploitation of these possibilities — silicon for solar panels, lighter materials for vehicles, insulation for buildings or chemical products used to ensure safe drinking water.

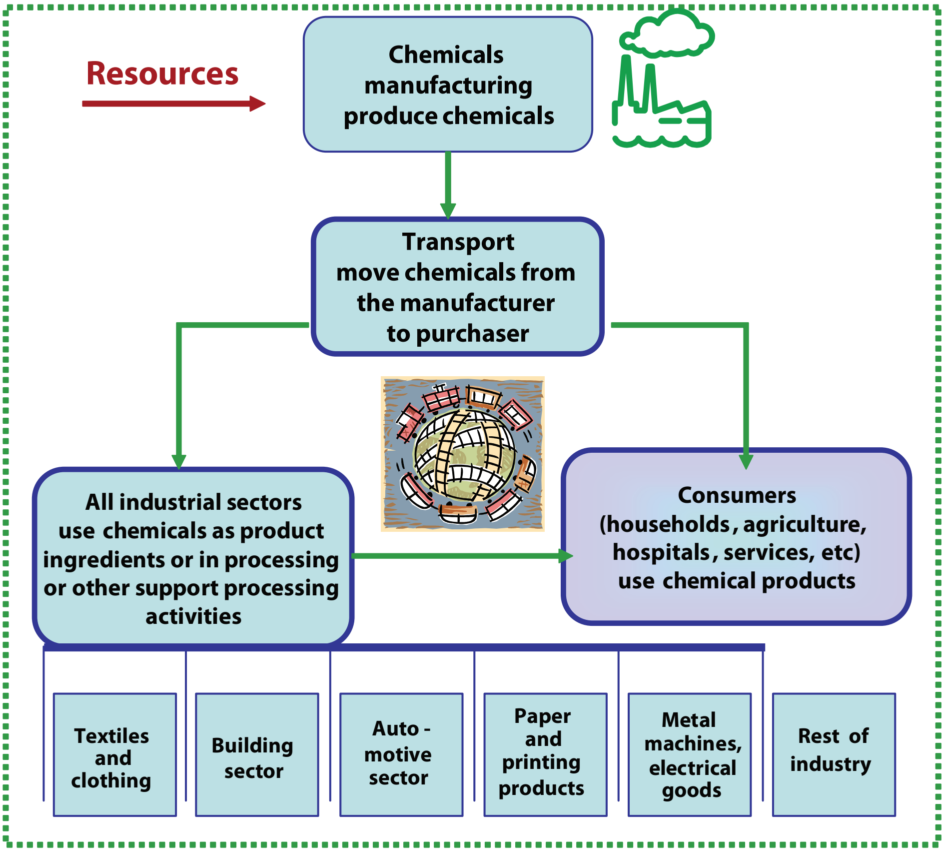
All sectors use chemicals

Most substances are produced by and used in the chemicals industry, but all economic sectors use chemicals. The chemicals industry produces a wide variety of solid, liquid and gaseous materials and most of these products are used in manufacturing industries, such as plastic processing, the automotive industry and construction, although a smaller number are used directly by consumers.

Most industries use chemicals as their key raw materials. For example, the automotive industry uses a large number of chemicals such as paints, lubricating oils, rubber tyres, plastic, and synthetic fibres; the making of mobile phones is feasible because of silicon-based chemicals and a durable plastic assembly; microwave ovens are made with silicon chips, plastic housings and fire-retardant plastic additives.

End-markets of chemical products thus include textiles and clothing, construction, the automotive industry, paper and printing products, and the metals, mechanical and electrical industries.

Figure 6.6: Production and use of chemicals



Consumer products include direct product sale of chemicals such as soaps, detergents, perfumes and cosmetics, solvents, pesticides, lye and washing powder.

Chemicals crossing EU borders

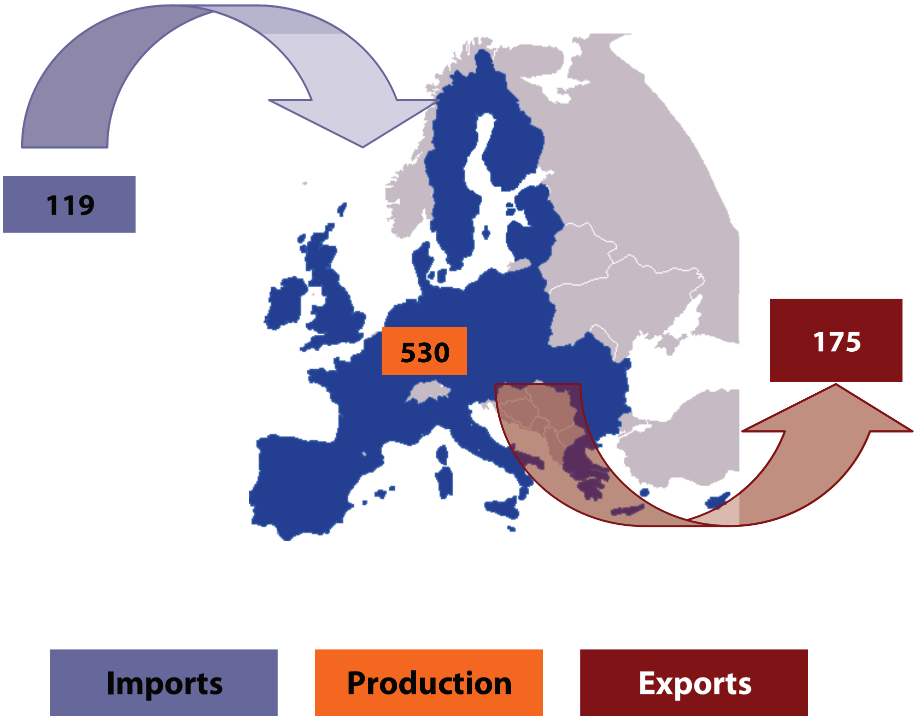
Long-distance transport is also quite a common practice in the chemicals sector. Chemical companies are often very specialised and a single company can supply the whole European market with a particular product.

The European chemicals industry has been, and remains, a strong player on the world market. A high share of the EU chemicals industry's production is traded across borders.

EU chemicals production, imports and exports were estimated at EUR 530 billion, EUR 119 billion and EUR 175 billion in 2007, respectively. As much as 33 % of chemicals production was exported outside of the EU-27 and imports represented 22 % of the production value of the chemicals industry in 2007, showing an export surplus.

At the international level, the production of chemicals is no longer limited to industrialised countries. It takes place in every region of the world, with an increasing presence in the emerging economies in Asia. For example, in 2006, China occupied the third and India the seventh place among the world's biggest chemical producers. Chemical production is on the increase in both countries. In petrochemicals, the feedstock-rich countries in the Middle East play an ever more important role. Global markets for chemical products are steadily growing and the

Figure 6.7: Extra-EU chemicals trade flow, EU-27, 2007 *(billion EUR)*



Source: Eurostat Europroms database

period 2000–07 saw a boom with China, India and Russia reaching nominal annual growth rates of production or trade of more than 20 %.

Traditionally, Europe has been dominant in chemicals production, a position which has been marked by an important export surplus.

Europe's sales have been growing continuously, but world chemical sales are growing faster. In the past few years, third countries such as China and India have built up large and increasingly sophisticated chemical production facilities. Notably, due to their feedstock advantages, countries in the Middle East attract very high investments in petrochemicals, and the EU's share of global chemicals production is decreasing in several segments.

Global growth in the chemicals sector is thus currently concentrated in emerging economies, mostly in Asia. In comparison, Europe's chemical markets are mature, with growth rates broadly in line with GDP growth.

All areas of life use chemicals

The chemicals industry provides the technical basis for both traditional sectors such as agriculture, construction, textiles, clothing and footwear, and technologically advanced ones such as automobiles or electronics. Progress in health is also largely linked to progress in chemistry as it provides active pharmaceutical ingredients for medicines. It also manufactures products for personal care and hygiene.

However, many of the chemicals we use are toxic to human beings and/or harmful to the environment and can cause adverse effects.

Harmful chemicals in the environment

How chemicals affect the environment

Over the past century humans have introduced a large number of chemical substances into the environment. Some are waste, some have been designed as structural materials and others have been designed to perform various functions such as healing the sick or killing pests and weeds. Obviously chemicals are very useful, but many are toxic and they harm the environment if they enter the air as emissions and water and soil as effluent.

Chemical fertiliser and nutrient run-off from farms and gardens cause the build-up of toxic algae in rivers, making them uninhabitable to aquatic organisms and unpleasant for humans. Some toxic chemicals find their way from landfill waste sites into our groundwater, rivers and oceans and induce genetic changes that compromise the ability of life to reproduce and survive.

Organochlorine compounds such as polychlorinated biphenyls (PCBs) were developed originally for use in electrical equipment as cooling agents and are very dangerous chemicals. During the manufacture and disposal of products containing PCBs, and as a result of accidents, millions of tonnes of PCB oil have leaked out. Although their manufacture in the European Union has been halted and they are being phased out, they are difficult to detect, are nearly indestructible and large quantities remain in existence and will remain in the environment for a long time. They accumulate in the food chain and significant levels of them have been found in marine species, particularly mammals and sea birds, decades after their production was discontinued.

PCBs are carcinogenic and capable of damaging the liver, nervous system and the reproductive system in adults. When PCBs are burned, even more toxic dioxins are formed. Potentially dangerous chemicals such as these are being introduced into the environment all the time. As in the case of PCBs their effect on living things may not be known until many years after their release.

In recent studies (88) some halogenated chemicals proposed as substitutes for problematic substances have been found as body burden in wildlife (e.g. hexabromobenzene (HBB), Bis(2,4,6-tribromophenoxy)ethane (BTBPE) and tetrabromo-bisphenol A (TBBA)) (Parks et al., 2010).

Production trend in environmentally harmful chemicals

Eurostat has recently developed an indicator on 'production of environmentally harmful chemicals' taking into account the potential environmental impact of the chemicals. Environmental 'impact classes' have been defined and the indicator has been calculated on the basis of production statistics.

The environmental indicator focuses on impacts to aquatic toxicity. It seeks to take into account the inherent ecotoxicity of the chemical substances, their potential for bioaccumulation and their persistence in the environment. For this purpose, substance-specific data on ecotoxicity, biodegradability and bioaccumulation potential have been used (89). It is mainly based on the official environmental classification of the substances. Certain R-phrases (90) related to chronic human toxicity are also included.

The indicator shows the trend for producing environmentally harmful substances and indicates to some extent the potential exposure of substances to the environment modelled by using the production quantities extracted from the Prodcom

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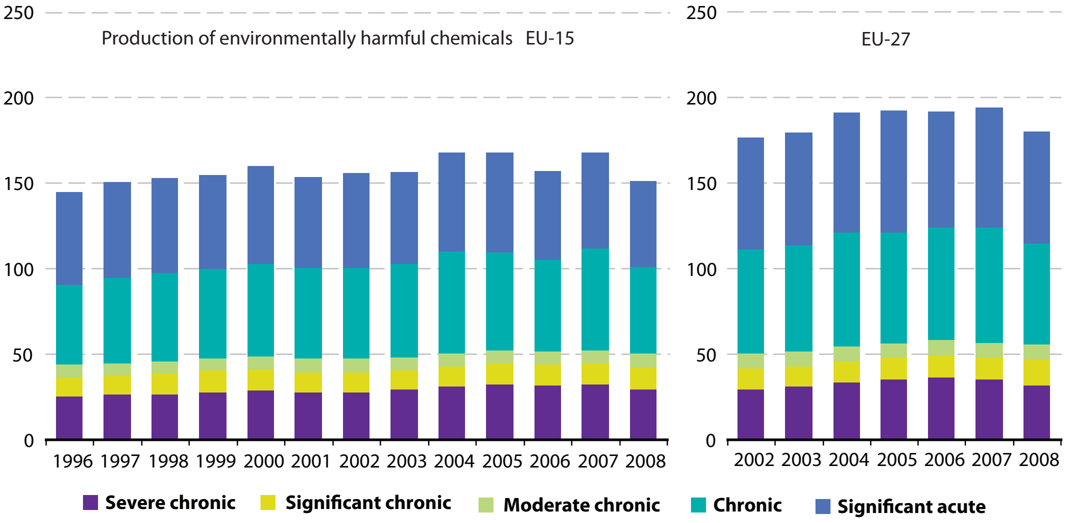
(88) J.-S. Park et al., 'Status and trend of classic and emerging brominated flame retardants in California wildlife and their exposure pathways', American Chemical Society meeting, 25 March 2010, San Francisco (http://www.sciencenews.org/view/generic/id/57666/title/Alternative_flame_retardants_leach_into_the_environment).

(89) Impact categories such as climate change, formation of photo-oxidants, acidifying substances and eutrophication are already covered by other existing indicators and are not included in the suggested indicator.

(90) R-phrases (short for risk phrases) are defined in Annex III to European Union Directive 67/548/EEC: 'Nature of special risks attributed to dangerous substances and preparations'. In future, R-phrases will be replaced by the hazard classes of the globally harmonised system (GHS), which is implemented in Europe by the CLP regulation.

Figure 6.8 : Indicator on the production in physical volume of environmentally harmful chemicals *(million tonnes)*



Source: Eurostat Prodcom statistics

database (which includes approximately 400 substances and groups of substances) and the current EU classification system (R-phrases).

The results of the combination of the environmental scores with the Prodcom database are presented in Figure 6.8.

The figure presents the aggregated production volumes of environmentally harmful chemicals, divided into five impact classes. The most harmful ones are 'severe chronic' followed by 'significant chronic', 'moderate chronic', 'chronic' and 'significant acute' chemicals. The indicator monitors progress in shifting production from the most environmentally harmful to less harmful chemicals.

In the EU-27, the share of the production of classified environmentally harmful chemicals in the EU total chemical production remained stable at 53–54 % from 2002 to 2008.

The longer trend in EU-15 'old' Member States shows a slight reduction in the production of classified environmentally harmful chemicals. The overall share decreased from approximately 56 % in 1996/97 to 53 % in 2007/08.

In the EU-15 the production of environmentally harmful chemicals (all five classes) increased by 16 % to the highest values in 2007 and fell by 10 % in 2008.

The chemicals industry in countries from the 12 new Member States produced in 2008 close to 15 % of the industrial chemicals (49 million tonnes) and 16 % of the environmentally harmful chemicals in the EU-27.

Patterns of production, trade and consumption of toxic chemicals

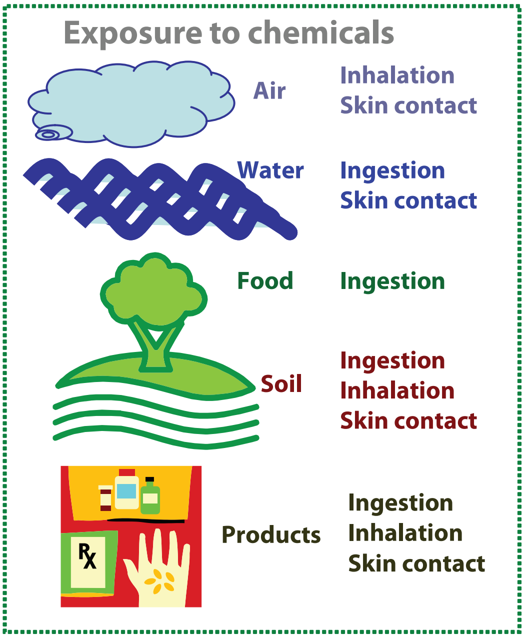
Problems posed to health

Chemicals are everywhere. Throughout our lifetime we are exposed to a variety of chemicals, contained in food, water, medicines, the air we breathe, cosmetics, healthcare products and other consumer products. Some chemicals can severely damage our health and/or pollute the environment. There is a worrying increase in health problems that can be partially explained by the use of chemical products and people's exposure to toxic chemicals.

A toxin is any substance that is capable of harming a person if ingested, inhaled or absorbed through any body surface.

Examples of such problematic substances are the so-called CMR substances: carcinogenic substances causing cancer (C), mutagenic substances (M) that can change gene functions, and substances that can harm reproduction (R). Some substances in this group can cause several of these effects. In the work towards a non-toxic environment CMR substances are given priority. Professional use of CMR substances has to

Figure 6.9: Exposure to toxic chemicals



fulfil strict legal requirements. Nevertheless, in many cases exposure of workers cannot be completely avoided and substitution by less hazardous matter remains an urgent objective for many substances. Although the use of almost all CMR substances in consumer-available chemical products is banned in the EU, some of them are still detected in human bodies and in the environment.

Endocrine disruptors are another example of chemicals of concern — substances that are found in low doses in literally thousands of products such as pesticides, compounds used in the plastics industry and in consumer products. These substances act like hormones in the endocrine system and disrupt the physiological function of hormones. The chemicals detected in human bodies include substances such as polychlorinated biphenyls (PCBs), bisphenol A, polybrominated diphenyl ethers (PBDEs) and a variety of phthalates, which are found in some soft toys, tools, flooring, medical equipment, cosmetics and air fresheners. Human biomonitoring studies have shown that several of these man-made chemicals can be found as contaminants in the human body. In a recent survey, metabolites of phthalates (DEHP, DnBP, DiBP and DiMP) have been detected in nearly all samples of children's urine, illustrating the pronounced exposure to phthalates. In addition, bisphenol A has been detected in nearly all samples ([91]) (UBA, 2009). Hexabromocyclododecane (HBCD), a substance which is persistent, bioaccumulative and toxic, is still used in large amounts in insulation materials ([92]) (ECHA, 2008).

Chemical products in the workplace

Around 16 % of workers in Europe reported handling hazardous products and 22 % as being exposed to toxic vapours (*source:* Third European survey on working conditions undertaken in 2000 by the European Foundation for the Improvement of Living and Working Conditions).

According to the 2007 figures from the International Labour Organisation (ILO), each year 74 000 workers die of the consequences of work-related diseases that are linked to exposure to dangerous chemical agents in the EU-27. The number of work-related diseases is considerably higher than the number of accidents. In particular, work-related cancers are among the main causes — if not the main one — of deaths in Europe related to working conditions (*source:* International Labour Organisation).

Production of toxic chemicals

Eurostat has developed an indicator that monitors progress in shifting production from the most toxic chemicals to less toxic classes and addresses an important objective of REACH: to reduce risks by the substitution of hazardous substances by less hazardous ones.

This indicator presents the trend in aggregated production volumes of toxic chemicals, broken down into five 'toxicity classes'. The most dangerous ones are the CMR chemicals ('carcinogenic, mutagenic and reprotoxic'), followed by chemicals classified as 'chronic toxic', 'very toxic', 'toxic' and 'harmful'.)

([91]) UBA, 2009, German environmental survey on children 2003/06 (http://www.umweltbundesamt.de/uba-info-medien/mysql_medien.php?anfrage=Kennummer&Suchwort=3355).

([92]) ECHA, 2008, SVHC supporting document, HBCDD (http://echa.europa.eu/doc/candidate_list/svhc_supdoc_hbccd_publication.pdf).

European legislation aims to minimise the health risks from dangerous substances in the workplace and places elimination and substitution at the top of the hierarchy of control measures for protecting workers from dangerous substances. The most important pieces of European legislation in this field are regulations on the protection of workers from the risks related to chemical agents (93), carcinogens (94) including asbestos or wood dust, and biological agents (95). They establish human exposure limits to hazardous substances through indicative occupational exposure limit values (IOELVs). They are not binding on Member States but must be taken into consideration in setting national occupational exposure limits. Some Member States have pre-existing national limits lower than the IOELV and are not required to revise these upwards. In practice, most Member States adopt the IOELV but there are some variances upwards and downwards. The previous 'Community strategy on health and safety at work 2002–06' called on the importance to 'set up a risk observatory' and to 'anticipate new and emerging risks' in order to tackle the continuously changing world of work and the new risks and challenges it brings. The new Community strategy for the period 2007–12 reinforces the European Risk Observatory's role and explicitly mentions the identification of new risks and dangerous substances as a research priority. In brief, a lot is going on at EU level in relation to chemicals in the workplace, which will hopefully help to protect workers better from exposure to dangerous substances.

The implementation of the REACH regulation should encourage industry to handle chemicals in a safe way and to develop safer substances as well as generate information on the hazards of chemicals and the means of managing the risks related to their uses, and hence contribute to the improvement of workers' protection.

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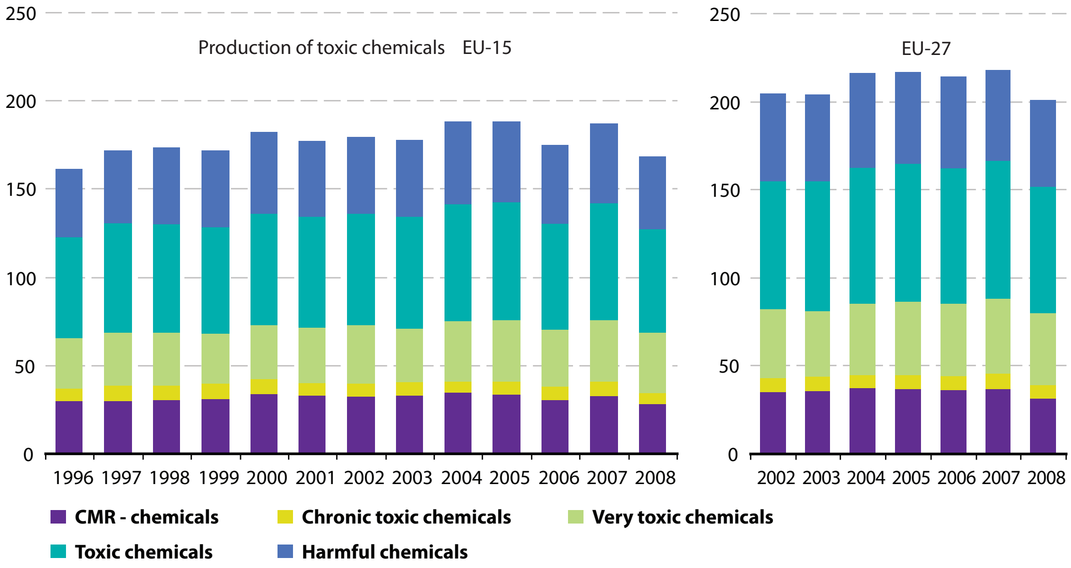
(93) Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work.

(94) Council Directive 90/394/EEC of 28 June 1990 on the protection of workers from the risks related to exposure to carcinogens at work and its amendments.

(95) Directive 2000/54/EC of the European Parliament and of the Council of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work.

Figure 6.10: Indicator on the production of toxic chemicals in physical volume *(million tonnes)*



Source: Eurostat Prodcom statistics

The indicator monitors progress in shifting production from the most toxic to less toxic chemicals. The production of toxic chemicals (all five classes) increased by 6.9 % between 2002 and 2007 to the highest value of 218 million tonnes and then fell by 7.8 % in 2008 in the EU-27.

The overall share of the volume of chemicals classified as toxic in the EU-27 total chemical production was 60 % in 2008 and 58.5 % in the EU-15.

The absolute production volume of carcinogenic, mutagenic and reprotoxic (CMR) chemicals fell by 3 million tonnes (– 8.6 %) between 2002 and 2008. The share of these chemicals in total production fell slightly from 10.6 % in 2002 to 9.5 % in 2008 in the EU-27.

In the 'old' Member States (EU-15) the absolute production volume of CMRs in 2008 went down to the level of 1995.

In 2008, the chemical industry in the 12 new Member States produced, with 49 million tonnes, 14.6 % of the industrial chemicals, but also 16.4 % of the toxic chemicals in the EU-27.

The growth of toxic chemicals production is following the trend of the total chemical production. Currently, there is little indication that the share of toxic chemicals is being significantly reduced or decoupled from growth in the chemicals industry.

The coming years will show if the trend towards a relative decoupling of toxic chemicals production from the growth of total output and gross domestic product can be confirmed.

Trade and transport of toxic chemicals

There is a steady flow of toxic chemicals through the economy.

Concerning intra-EU trade, toxic chemicals are traded and transported all over Europe, since chemical production is strongly interwoven. Cross-border transport can take place by road transport, by ship via inland waterways or sea, or by pipeline.

In the EU-27, the production of toxic chemicals increased from 204 million tonnes in 2002 to 218 million tonnes in 2007 (an increase of 26 million tonnes in the EU-15 from 1996 to 2007). At the same time, the cross-border transport of these chemicals increased.

Concerning extra-EU trade, over the period 2002–08, the EU-27 experienced a trade deficit of approximately 15 million tonnes, which amounts to approximately 5 % of the EU-27 toxic chemicals production.

Given the reality of the extensive global trade in chemicals and the need to develop national programmes to ensure their safe use, transport and disposal, it was recognised that an internationally harmonised approach to classification and labelling would provide the foundation for such programmes. A new system, called 'Globally Harmonised System of Classification and Labelling of Chemicals (GHS)', addresses classification of chemicals by types of hazard and proposes harmonised hazard communication elements, including labels and safety data sheets. It aims at ensuring that information on physical hazards and toxicity from chemicals is available in order to enhance the protection of human health and the environment during the handling, transport and use of these chemicals. The GHS also provides a basis for harmonisation of rules and regulations on chemicals at national, regional and worldwide level: an important factor for trade facilitation.

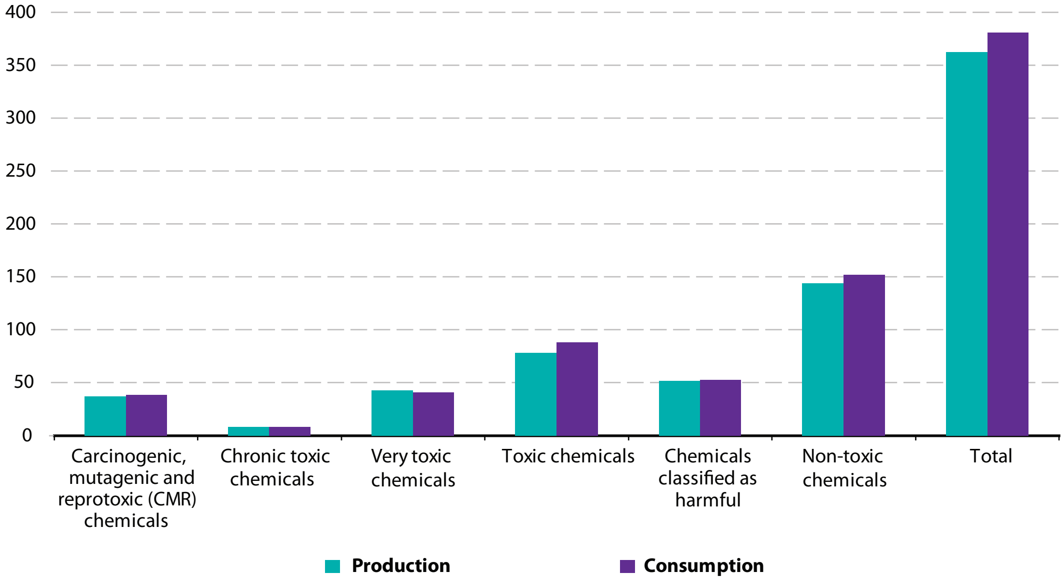
Figure 6.11 : The GHS pictograms

Consumption of toxic chemicals

Eurostat has calculated the 'apparent' consumption of toxic chemicals as, depending on trade, the EU toxic chemicals production volume may decline while the consumption may increase.

The figure shows that some toxic chemicals are produced outside the EU, but are imported and consumed inside the EU. For example, in 2007, the production volume in the EU-27 was smaller than consumption. Imports were 15 million tonnes higher than exports, adding this volume to consumption.

Figure 6.11 : Production and consumption of toxic chemicals in physical volume, EU-27, 2007 *(million tonnes)*



Source: Eurostat Prodcom statistics and COMEXT database

Monitoring and reduction of potential risks from chemicals

Risks of chemicals: European policy priorities since the late 1980s

The fourth Community action programme on the environment (1987–92) had as a priority the evaluation of the risks posed by chemical substances to the environment and human health. The action programme highlighted the need for legislation. Following this advice, the European Commission proposed a set of legal instruments such as the existing substances regulation (recently revoked and replaced by the regulation concerning the registration, evaluation, authorisation and restriction of chemicals (REACH) (96)).

The sixth environment action programme stated that dangerous chemicals should be substituted with the aim of reducing risks to man and to the environment. It requested the implementation of a new EU policy on chemicals. This new policy is REACH.

Potential risks of chemicals are also addressed by the headline objective for 'public health' established in the Community sustainable development strategy: 'By 2020, ensure that chemicals are only produced and used in ways that do not pose significant threats to human health and the environment.'

Streamlining and improving the legislative framework on chemicals

REACH entered into force on 1 June 2007, with the aims of improving the protection of human health and the environment from the risks that can be posed by chemicals, promoting alternative methods for the assessment of hazards of substances, enhancing competitiveness and innovation, and ensuring the free circulation of substances on the internal market of the European Union.

One of the fundamental changes brought about by REACH is the change of responsibility from public authorities to industry in demonstrating the safe manufacture and use of chemicals. All manufacturers and importers of chemicals must identify and manage risks linked to the substances they manufacture and put on the market. Every manufacturer and importer company has to submit to the European Chemicals Agency (in place since the 1 June 2008) a registration dossier for each substance produced or imported in quantities over 1 tonne per year. Once the registration dossier has been received, the agency checks that it is compliant with the regulation and evaluates testing proposals to ensure that the assessment of the chemical substances will not result in unnecessary testing, especially on animals. Where appropriate, authorities may also select substances for a broader substance evaluation. REACH also requires an authorisation system to ensure that substances of very high concern are adequately controlled and progressively substituted by safer substances or technologies or only used where there is an overall benefit for society by using these substances. In addition, EU authorities may impose restrictions

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(96) Council Regulation (EEC) No 793/93 of 23 March 1993 on the evaluation and control of the risks of existing substances has been revoked and replaced by Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the registration, evaluation, authorisation and restriction of chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC (OJ L 396, 30.12.2006). The European Chemicals Agency was successfully launched on 1 June 2008.

on the manufacture, use or placing on the market of substances causing an unacceptable risk to human health or to the environment. Also, manufacturers and importers must provide their downstream users extended safety data sheets (eSDS) with the information they need for the safe use of the substances. They contain as annexes exposure scenarios describing the required operational conditions and risk management measures. Downstream users have to check whether their uses are covered by these exposure scenarios. If not, they may have to do their own chemical safety assessments. In addition, for all substances placed on the market the hazard classification has to be notified to the European Chemicals Agency.

Work on potential risks of chemicals by Eurostat

Previous work carried out by Eurostat in the field dates back to the period from the mid-1990s to 2000 when some environmental pressure indicators (EPI) related to chemicals were developed (dispersion of toxic substances, consumption of pesticides, emissions of persistent organic pollutants, heavy metal emissions to water, heavy metal emissions to air and consumption of toxic chemicals).

One of the recent priorities of Eurostat has been the development of indicators on (toxic) chemicals in order to be able to measure progress towards the headline objective for 'public health' established in the Community sustainable development strategy. Since 2005, sustainable development indicators on public health have thus been collected including the 'index of production of toxic chemicals, by toxicity class'.

Furthermore, the European Council requested an indicator on the 'apparent consumption of chemicals, by toxicity class' and the European Environment Agency an indicator on 'production of environmentally harmful chemicals'. Currently, Eurostat is developing both indicators.

Simultaneously, the services of the European Commission and scientific experts expressed the need for developing a baseline before REACH came into force and an instrument to monitor the effectiveness of REACH. To do so Eurostat proposed the development of a set of risk-based (and not damage-based) indicators. A REACH baseline study was carried out with the aim of setting the baseline 2007 of the potential risk for consumers, workers and the environment. With the developed methodology, the calculations of the potential risks will be repeated for the 5-year assessment of REACH due in June 2012.

Developing a baseline and a monitoring instrument for REACH

The baseline study has set up an indicator set which will allow the effects of REACH to be monitored (ensuring a high level of protection of human health and the environment as well as enhancing innovation of safer chemicals). It presents a baseline of the (potential) risk caused by chemicals and of the quality of the underlying data which were available when REACH came into force in June 2007.

The indicator set is based on three different types of indicators linked to the objectives and central elements of REACH.

The indicator set is not restricted to monitoring only the risk itself; it also monitors changes in the quality of the public data on substances and their safe use. This means that the indicator set will allow for the measurement of whether there will be a decrease in risk and if our currently very limited knowledge of the properties

Figure 6.12: Possible future evolution of the risk caused by chemicals

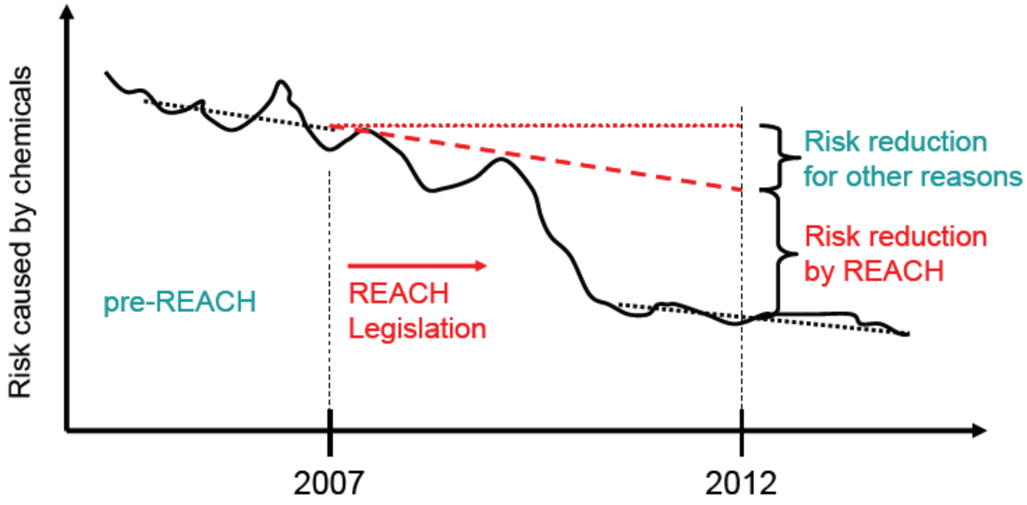
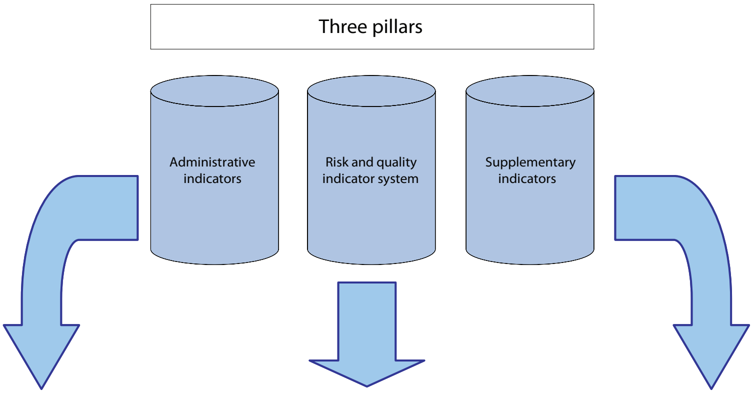


Figure 6.13: Indicators linked to the objectives and central elements of REACH

Central elements and objectives of REACH	Types of indicators		
	Administrative indicators	**Risk & quality indicator system**	**Supplementary indicators**
Registration of chemicals	✓		
Evaluation of chemicals	✓		
Authorisation and restriction of chemicals	✓		
Establishment of a central agency	(indirect)		
Protection of human health and the environment		✓	✓
Improvement of knowledge on properties and safe uses of chemical		✓	✓
Assessment of existing and new chemicals in a single, coherent system			✓
Increased transparency and consumer awareness			(✓)
Promotion of alternative methods to reduce animal testing			✓
Maintenance and enhancement of the competitiveness of the EU chemical industry	Not within the scope of the baseline study: The REACH baseline study does not address economic and legal aspects.		
Prevention of fragmentation in the internal market			
Conformity with the EU's international obligations under the WTO			

Figure 6.14: Baseline indicator set



Administrative Indicators follow the REACH process of registration, evaluation, authorisation and restrictions. They will provide figures on the number of substances registered, the number of chemical safety reports documented by the European Chemicals Agency or the number of dossiers being evaluated, etc.	This set directly tracks two major goals of REACH: reduction in the risks of chemicals for humans and the environment as well as improvement in the quality of publicly available data. These changes are assessed for a defined set of reference substances.	Supplementary indicators address specific objectives not covered by the other two indicator types (e.g. increased quality of safety data sheets and use of alternative methods to animal testing). They can support specific findings from the risk and quality indicator system.

of substances and their safe uses increases due to REACH.

These indicators are divided into three main types: administrative indicators, the risk & quality indicator system, and the supplementary indicators.

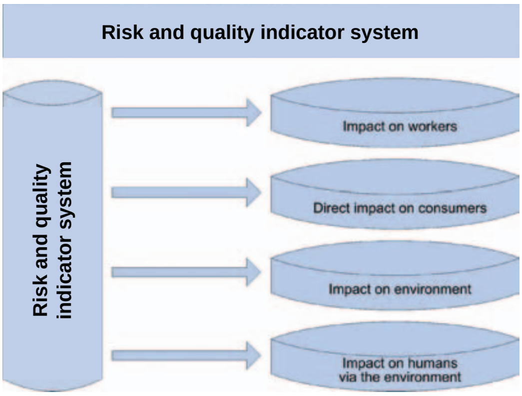
The core of the indicator set is the risk and quality indicator system which combines a risk-based approach with a procedure to deal with different data sources, modelling, and even data gaps. Every risk score comes with a quality tag.

This indicator system directly assesses the (nominal) risk caused by exposure to chemicals and characterises the quality of the data on which this risk assessment is based. These characteristics can be followed over time.

The risk and quality indicator system addresses risks to three impact areas: the environment, workers, and the general population. Impacts on the general population are divided into direct impact on consumers (resulting from the use of chemicals, e.g. paints or glues) and impact on humans via the environment (e.g. drinking water).

Since the calculation of the risk and the quality of its assessment is not manageable for all of the approximately 30 000 substances within the focus of REACH, a subset of 237 substances has been selected. This set is considered large enough to detect with sufficient sensitivity changes taking

Figure 6.15: The impact areas addressed by the risk and quality indicator system



place in the risks and the quality of the databases for chemicals.

An initial ‘snapshot 2007’ (situation before REACH was in place) has been taken to establish the baseline for the proposed indicators set. The results for this first snapshot are shown at different aggregation levels for workers, consumers, the environment and humans via the environment.

The risk and quality indicator system is accompanied by a set of indicators to monitor the REACH process (administrative indicators) and to monitor the progress made in the improvement of the knowledge required for a safer management of chemicals (supplementary indicators).

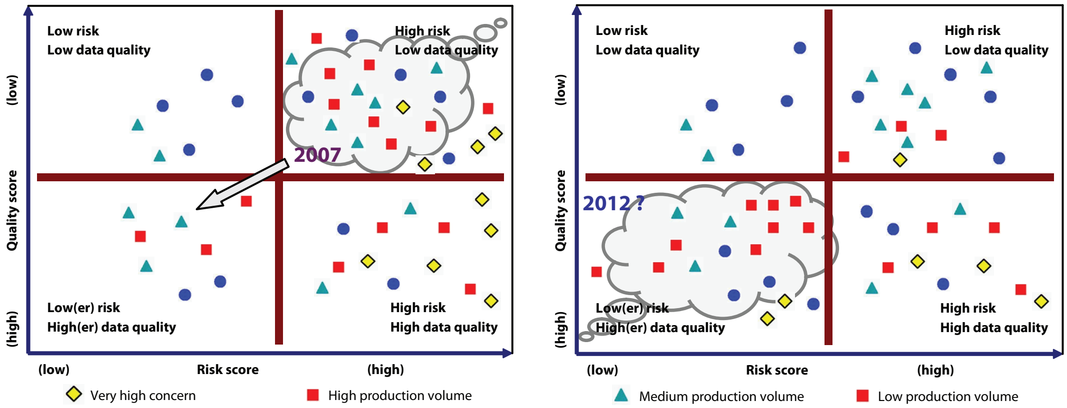
The administrative and supplementary indicators will be updated and maintained based on information provided by the European Chemicals Agency, and further possibilities will be explored to cover areas that are not sufficiently addressed as yet, such as the development of alternative testing methods to replace animal testing.

The figure illustrates what would be the desired result from 5 years of advanced protection of the environment and human health due to REACH and corresponding chemicals legislation: a movement of the bulk of the reference substances, mainly the high production volume substances, to the part of the figure where the exposures and toxicity are well known, indicating that risk has been reduced or no risk is expected.

In 2012, in the frame of the first report on the experience gained through the operation of REACH, a second ‘snapshot’ will be taken in order to see whether REACH has already reduced the (nominal) risk caused by chemicals by that time and to see how the quality of the underlying data has evolved. Further snapshots can be made later. Comparing the results should enable the success of the REACH regulation to be monitored and assessed.

The full baseline study report is available from Eurostat (see further reading at the end of this chapter). It presents the results at different levels of aggregation in a way that they can be understood by users with different levels of expertise.

Figure 6.16: Desired shift towards lower risk and better data



Conclusions: Chemicals in the European Union

One of the recent priorities of Eurostat has been the development of indicators on chemicals (index of 'production of toxic chemicals, by toxicity class', 'apparent consumption of chemicals, by toxicity class' and 'production of environmentally harmful chemicals') to monitor whether consumption and production patterns are shifting towards the use and production of safer chemical substances.

The European chemicals industry has become very specialised and operates in an interwoven network, leading to increased transportation of 'intermediate' and final chemical products.

The chemicals industry and chemical products are key elements in the development of society as well as key drivers for economic development and wealth.

Chemicals, through the different steps from their production to their handling, transport, and use, are also a potential danger for human health and for the environment. Workers in the chemicals industry and all other economic sectors, and people in general are confronted with the potential risks of chemicals on a daily basis.

Interest in the potential risks posed by chemicals to human health and the environment has constantly been a predominant concern both for the general public and for policy-makers.

The lack of toxicological data on a large number of chemicals which are deemed to be on the market as well as the potential long-term effects to humans and the environment resulting from exposure to low concentrations of chemicals have been continuously fuelling this interest.

In most industrial sectors a great number of substances are hazardous to the health of workers during their manufacture and use. It is therefore necessary to reduce the exposure of workers to these substances to the level needed in order to protect their health. With this aim, European legislation has established occupational exposure limit values for all substances to which workers are exposed. Across Member States a common set of European directives apply, aimed at preventing health and safety risks in the workplace.

The new EU chemicals policy (REACH) is part of the Union's wider sustainable development strategy. Its overriding goal is to respect sustainable development by not only ensuring both a high level of protection of human health and of the environment as well as the free circulation of substances on the internal market, but also to enhance competitiveness and innovation.

In addition, REACH will very likely lead to more complete testing of toxicological properties, to better data provided by alternative testing methods such as modelling, to improved reporting and to better information on exposure. In this way, the quality of the data (the completeness of the databases and to a lesser extent the quality of the individual data) is expected to improve and the uncertainty will, consequently, be reduced. This will be measured with a risk-based indicator set recently developed by Eurostat.

Further information

Eurostat publications

The REACH baseline study

'The REACH baseline study — A tool to monitor the new EU policy on chemicals', *Statistics in Focus* 48/2009

The REACH baseline study — A methodology to set the baseline for REACH and monitor its implementation, June 2009

Statistics Explained: Chemicals manufacturing at regional level

http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Chemicals_manufacturing_at_regional_level

Statistics Explained: Chemicals management

http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Chemicals_management

Further reading

European Commission, Directorate-General for the Environment — Chemicals

http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

European Commission, Directorate-General for Enterprise and Industry — Chemicals

http://ec.europa.eu/enterprise/sectors/chemicals/reach/index_en.htm

European Agency for Safety and Health at Work — Dangerous substances

http://osha.europa.eu/en/topics/ds/oel/

See also

European Chemicals Agency (ECHA)

http://echa.europa.eu

Methodological notes

In the European statistical system the chemicals industry is divided into two groups: the manufacture of chemicals and chemical products (NACE rev. 1, division 24) and the manufacture of rubber and plastic products (division 25). Within division 24, the following sectors are covered: basic chemicals (NACE group 24.1), pesticides and other agro-chemical products (24.2), paints, varnishes, printing ink and mastics (24.3), the manufacture of pharmaceuticals, medicinal chemicals and botanical products (24.4), soap, detergents cleaning and polishing products (24.5), other chemical products (24.6) and man-made fibres (24.7). Division 25 is composed of the manufacturing of rubber products (25.1) and of plastic products (25.2) and is not considered here. The NACE has changed and chemicals are now division 20.

Structural business statistics

Regional structural business statistics (SBS) are collected within the framework of a Council and Parliament regulation, according to the definitions and breakdowns specified in the Commission regulations implementing it. The data cover all the EU Member States and Norway. Structural business statistics are presented by sectors of activity, according to the NACE rev. 1.1 classification, with a breakdown to the two-digit level (NACE divisions). The SBS variable presented in this chapter is the number of persons employed, which is the total number of people who work (paid or unpaid) in the observation unit, as well as people who work outside the unit who belong to it and are paid by it. It includes working proprietors, unpaid family workers, part-time workers, seasonal workers, etc. Added value of NACE rev. 1.1 section DG (chemicals industry) presented in the chapter come also from the structural business statistics.

Prodcom and Europroms databases

The Prodcom data include the physical volume of production total/sold and the value of production total/sold. The Prodcom data are obtained by the national statistical institutes who conduct a survey of businesses.

Whereas Prodcom only refers to production data, Europroms refers to the combination of production and external trade data. The data are displayed by Prodcom heading, and the equivalent Combined Nomenclature (CN) headings are aggregated to provide the data equivalent to the Prodcom heading. The monthly trade is also aggregated to match the annual Prodcom statistics. For individual countries the trade with all partners, both intra and extra, is aggregated to provide the total external trade for the country. For EU totals, only extra partners are aggregated, so that trade with the rest of the world is reported.

Eurostat calculates EU totals at EU-15, EU-25 and EU-27 levels (depending on the year) from the national data.

Sustainable development indicator (SDI) production of toxic chemicals

Eurostat has developed a production index of toxic chemicals, broken down into five toxicity classes. The indicator is compiled for 168 toxic chemicals using production quantities collected pursuant to the Prodcom regulation (Council Regulation (EEC) No 3924/91 on the establishment of a Community survey of industrial production). The indicator presents the trend in aggregated production volumes of chemicals which have been classified as toxic substances according to EU legislation. The classes are derived from the risk phrases assigned to the individual substances in Annex 6 to the dangerous substance directive (Directive 67/548/EEC, as last amended in 2001). The toxicity classes, beginning with the most dangerous, are: carcinogenic, mutagenic and reprotoxic (CMR) chemicals; chronic toxic chemicals; very toxic chemicals; toxic chemicals; and chemicals classified as harmful. The substances making up this index comprise a wide range of uses: from intermediates — used for the production of even non-toxic chemicals, products and articles (with potential human exposure limited to workers during their production and subsequent synthesis, and exposure to the environment through potential releases during processing or transportation) — to household chemicals intended for consumer use.

Indicator on 'apparent consumption of chemicals, by toxicity class'

The reason for estimating this additional indicator is that toxic chemicals might be produced outside the EU but might be imported and consumed inside the EU and, in this case, the production index might be 'blind' for some chemicals. Additionally, the trend line of the production volume may decline but the consumption might increase. Without the export and import flows, an interpretation focusing on production volume only will lead to misinterpretation. An actual downward development in production might turn out to be an increase if export and import flows are taken into account. Therefore the indicator on the 'consumption of toxic chemicals' is an additional indicator which will support or disprove the findings in the production index.

The indicator uses the same approach as the indicator on 'production of toxic chemicals'. Instead of the production according to Eurostat's Prodcom database, the statistical definition of consumption is used (apparent consumption = production + import – exports).

For calculating the indicator, for each Prodcom position the corresponding positions in the foreign trade statistics (FTS) are identified and the import and export flows are extracted for 'extra-EU-27' trade. If more than one position in the FTS is available, all these FTS positions are aggregated to the corresponding NACE position. The extraction has been performed with the public foreign trade database (Comext). All cells containing a 'confidential, no data or other' are set to zero to allow further calculations.

The indicator on 'apparent consumption of toxic chemicals' covers the EU-27 from 2002 onwards, follows the characterisation methodology with the five toxic classes of the 'production of toxic chemicals' and covers the same NACE sectors 24.11 to 24.15 (NACE rev. 1.1) as in the production indicator.

Both indicators (on the producton of toxic chemicals and on the production of environmental harmful chemicals) have been calculated for the EU-15 and EU-27. For the EU-15 a time series from 1996 is shown. In principle, data is available from 1995 when NACE was introduced and Eurostat started gathering NACE data. As 1995 was the starting year, the coverage was not complete and estimates could not fully close the gap. Therefore the time series start from

1996. For the EU-27 the data is available from 2002 onwards. As the EU-15 is still the major producer, both time series are calculated.

Indicator on ‘production of environmentally harmful chemicals’

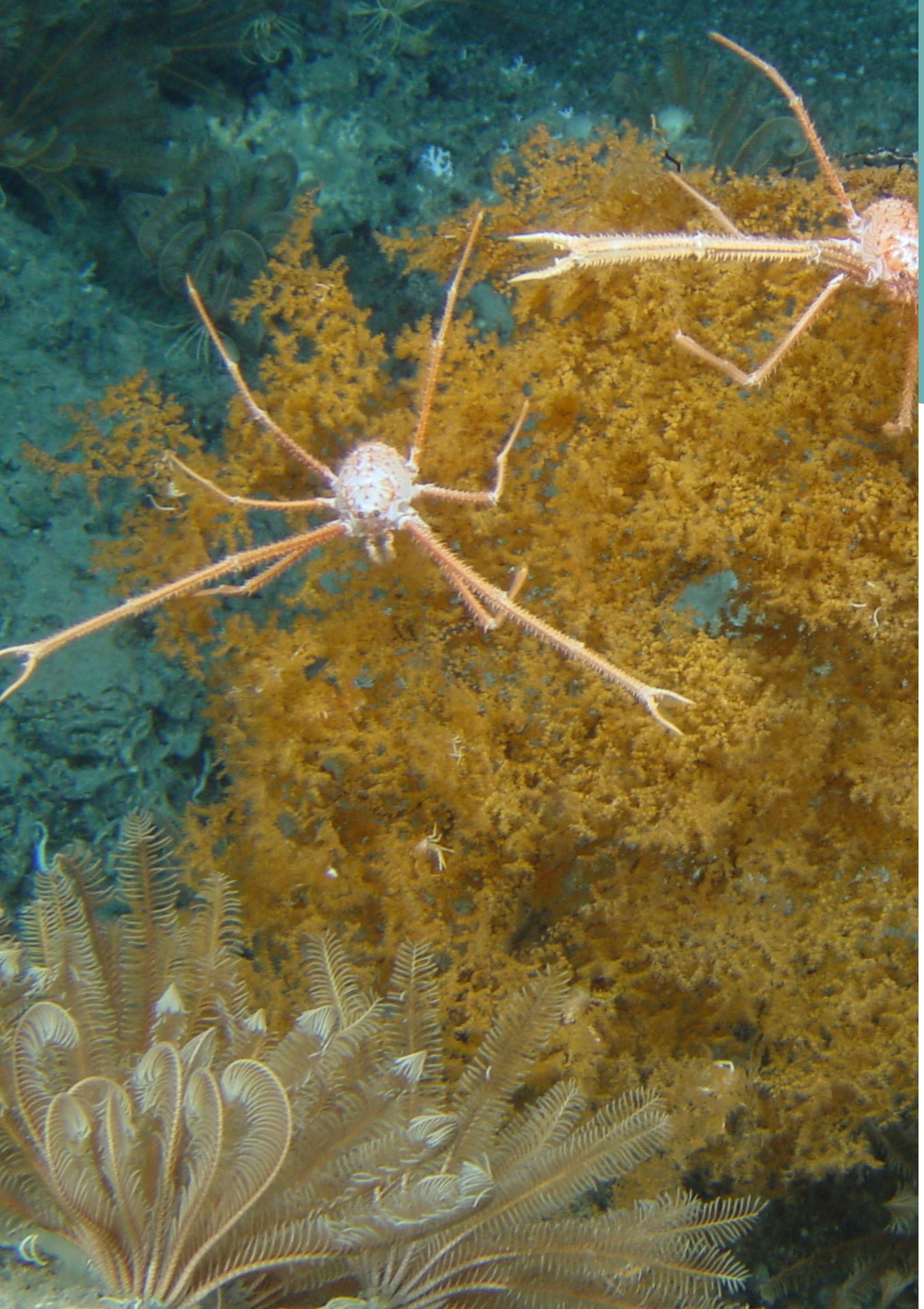
Eurostat has developed a production index of environmentally harmful chemicals, broken down into five classes. The indicator is compiled using production quantities collected pursuant to the Prodcom regulation (Council Regulation (EEC) No 3924/91 on the establishment of a Community survey of industrial production). The indicator presents the trend in aggregated production volumes of chemicals. The classes, beginning with the most harmful, are: severe chronic impact (on the environment); significant chronic impact; moderate chronic impact; chronic impact; and significant acute impact. The criteria refer to the results of the classification and labelling of the substances and their persistence and bioaccumulation. The starting point for developing the indicator was to use the same substances as the SDI production of toxic chemicals but focus on environmental impacts (aquatic toxicity, persistence, bioaccumulation). Impact categories such as climate change, formation of photo-oxidants, acidifying substances and eutrophication are already covered by other existing indicators so they are not included in this one.

The indicator has been calculated for the EU-15 and EU-27. For the EU-15 a time series from 1996 is shown. In principle, data are available from 1995 when NACE was introduced and Eurostat started gathering NACE data. For the EU-27, data are available from 2002 onwards.

Indicators and statistics developed in the frame of Eurostat’s work on the baseline study for the new EU chemicals policy (REACH)

Administrative indicators refer to the registration, evaluation, authorisation and restriction steps defined by REACH. They provide figures on the number of registrations, the percentage of substances registered, the number of testing proposals examined, the total number of registration dossiers evaluated, the percentages of registration dossiers evaluated, the number of substances evaluated, the number of chemicals included in the candidate list (Article 59 of REACH), the total number/percentages/specified for the four tonnage bands, the number of Annex XV dossiers related to candidate substances (Article 59(2) of and Annex XV to REACH), the number of substances included in Annex XIV, the number of decisions taken related to granting of authorisation Article 60(2): adequate control/Article 60(4): risk evaluation, socioeconomic analysis and substitution, the number of Annex XV dossiers for restriction proposals (and number of substances documented in the list of Article 69(5) of REACH) and the number of decisions on restrictions taken by the Commission according to Article 73 of REACH. These sets of figures are regrouped into three administrative indicators: progress in registration; progress in evaluation; and progress in authorisation and restriction.

Supplementary indicators such as availability of hazard data, changes in classification and labelling, availability of use and exposure data, and registration of new chemicals as well as the three administrative indicators (progress in registration, progress in evaluation and progress in authorisation and restriction) will be estimated by the European Chemicals Agency.



7

Biodiversity and land use

Biodiversity: what is it, where is it and how is it faring?

What is biodiversity and where is it found?

Biological diversity or biodiversity is life on Earth in all its variety. It is the number and variety of living organisms, from microorganisms in a drop of water to whales and giant sequoia trees. All viruses, fungi and plants, all insects (whether boon or plague), all the bacteria and microorganisms that live in or on us and even the pathogens that cause infectious diseases are part of biodiversity. Most of the different types of organisms (species) concerned are small or invisible to the naked eye (e.g. bacteria), and many are rare, short-lived or hidden, for example, in the soil.

It is impossible to determine the exact number of species on Earth or in any given area because new organisms are still being discovered. Some of them are ancient, while others are newly established. Evolution and natural selection are still at work, creating new species all the time. There are significant gaps in knowledge, especially regarding the status of tropical, marine and freshwater biota, plants, invertebrates, microorganisms and subterranean biota. For these reasons, estimates of the total number of species on Earth range from 5 million to 30 million. Irrespective of actual global species richness, however, it is clear that the 1.7 million to 2 million species that have been formally identified represent only a small portion of total species richness. More complete biotic inventories are badly needed to correct this deficiency (Millennium Ecosystem Assessment, 2005).

All of these species live in communities, in which every one of them has a role to play. The communities live in physically defined places (habitats) and have numerous interactions with other organisms. These interdependent communities constitute the countless different kinds of ecosystems, such as farmland, rivers, sea coasts, inter-tidal zones, hot

Opposite page: Recently discovered rich biodiversity at – 1 000 m off the Irish coast: squat lobsters on undescribed soft coral species, their highly restricted habitat. The lobsters are likely to be vulnerable to the impacts of deep-sea fishing both as by-catch and through habitat loss. These two are threatening the robot as the picture is taken. (© Le Guilloux et al., 2010)

springs, riparian forests, steppes and cities. Ecosystems are adapted to the local climate and geographical area. An arctic steppe is inhabited by very different animal and plant species than a south-east European one, although both have a rather dry climate and a long winter.

Every species has a function, particularly in the food web or chain of its ecosystem. Smaller species are usually food to many others. The larger a species is, the fewer predators it generally has. When looking at ecosystems as food webs, it becomes clear that the lower the number of species is, the less stable the system will be. Losing one species from an ecosystem with few species will cause the system to collapse more easily than losing one species from a large ecosystem with many species.

The higher predators in an ecosystem are important in regulating the species on the lower echelons of the food web, which would otherwise develop exponentially and become pests. This can be illustrated by a simplified food chain of three links: grass, rabbits and foxes. If there are too many rabbits, there will not be enough grass for all of them to eat. Many rabbits will starve and die. Fewer rabbits mean that grass will grow, but also mean less food is available for foxes, some of whom will starve. With fewer foxes, the rabbit population will increase again. This is a much simplified example; in reality, ecosystems and their food webs are far more complicated. We do not fully understand which species are interlinked and how, simply because of the large numbers of species that have never been studied.

Global biodiversity is in decline

Current biodiversity loss and extinction rate

Human actions are fundamentally, and to a significant extent irreversibly, changing the diversity of life on Earth. Most ecosystems and the biodiversity contained within them have become exposed to multiple pressures, such as habitat destruction and fragmentation, pollution, overexploitation and climate change. By interacting with both biotic and abiotic components of ecosystems, humans are altering the fragile balance between living organisms, thereby causing the most rapid extinction of species of all time.

The average extinction rate for marine organisms or mammals in the fossil record is 0.1 to 1 extinctions per million species years (E/MSY). Humans have increased the rate of species' extinction by 100 to 1 000 times the background rates that were typical over the history of the Earth, resulting in a current global average extinction rate around or above 100 E/MSY. It is estimated that up to 25 % of species in well-studied taxonomic groups are threatened by extinction (Rockström et al., 2009).

Europe is a huge, diverse region and has one of the most fragmented landscapes of all continents. In western Europe, more than 80 % of the land is under some form of direct management (European Environmental Agency, 2007). Consequently, European species are highly dependent upon semi-natural habitats created and maintained by human activity. These landscapes are under pressure from agricultural intensification, commercial forestry, urban sprawl, infrastructure development, land abandonment, acidification, eutrophication and desertification. Many species are affected by overexploitation, persecution or the collection of young from the wild (e.g. the illegal collection of falcons and other raptors for falconers). The impact of alien invasive species and climate change is set to become an increasingly serious threat. These pressures also affect the sea, where marine biodiversity is threatened.

Within Europe, the relative importance of different threats varies widely across countries and biogeographic regions. Although considerable efforts have been made to protect and preserve European habitats and species, biodiversity decline continues to be a major concern in the region.

Measuring trends of biodiversity loss

Measurement is needed because of widespread concern about biodiversity loss and the need to take effective action to reduce it. This requires a better knowledge of status and trends in species' populations. However, since biodiversity is too complex to be fully quantified and new species are discovered all the time, surrogate ways of measuring biodiversity are needed. We measure three main types of surrogates:

- changes in threatened species;
- population trends of common species linked to certain ecosystems (indicator species);
- changes in ecosystems and land use or land cover.

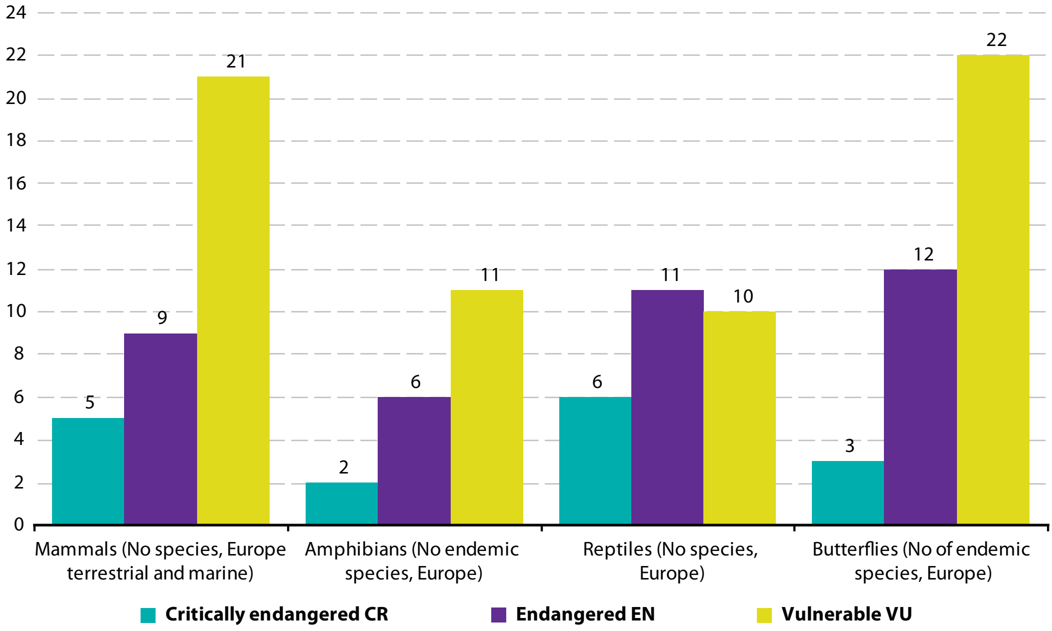
(a) Changes in threatened species

Documenting population trends is essential for assessing species' status. The trends towards extinction are measured by the Red List index as defined by the International Union for Conservation of Nature (IUCN). According to their conservation status and risk of extinction, species are classified in different categories of risk, ranging from 'least concern' to 'extinct'. Between these two extremes are 'near-threatened' species and 'threatened' species, the latter subdivided into 'critically endangered', 'endangered' and 'vulnerable'.

While some of the populations of Europe's species are increasing, others are in rapid decline. Among the monitored taxonomic groups, 15 % of mammals and dragonflies, 13 % of birds, 23 % of amphibians, 19 % of reptiles and 11 % of saproxylic beetles are threatened (European Red List, 2010). Figure 7.1 presents the number of threatened species according to their taxa and risk category.

Nearly one in six (15 %) of Europe's mammal species are threatened (35 species — Figure 7.1),

Figure 7.1: Number of threatened European species according to the IUCN European Red List criteria, 2010 *(number of species)*



Source: European Commission (IUCN 2010 European Red List).

and a further 9 % are close to qualifying for threatened status. More than a quarter (27 %) of mammals have declining populations. A further 32 % are stable, and 33 % have an unknown population trend. Only 8 % of species are increasing. Terrestrial mammal biodiversity is greatest in south-eastern Europe (the Balkan peninsula, Hungary and Romania) and in the mountainous regions of Mediterranean and temperate Europe.

Overall, nearly a quarter of amphibians are considered threatened (19 species). A further 17 % are considered near-threatened. More than half of amphibians (59 %) have declining populations. A further 36 % are stable, and only 2 % are increasing. Amphibian species richness is greatest at intermediate latitudes (France, Germany and the Czech Republic), as well as in the south and on islands.

Approximately one fifth of reptiles are considered threatened. A further 13 % are considered near-threatened. More than two fifths (42 %) of reptiles are declining and the same percentage is stable; only 3 % are increasing. Reptile biodiversity increases from north to south in Europe, with the highest species richness on the Balkan peninsula. The Iberian, Italian and Balkan peninsulas are all important areas of species richness, as are the Mediterranean and Macaronesian islands (Canaries, Madeira and Cape Verde).

The overwhelming majority of threatened and near-threatened amphibian and reptile species are endemic to both Europe and the European Union (which means that they are unique and are found nowhere else in the world), highlighting the responsibility that European countries have for the entire global populations of these species.

About 9 % of butterflies are threatened in Europe, and 7 % are threatened in the Member States of the European Union. A further 10 % are considered near-threatened. The highest diversity of butterflies is found in mountainous areas in southern Europe, mainly in the Pyrenees, the Alps and the Balkan mountains, where numerous species with very small ranges are encountered. Most of the threatened species only occur in parts of southern Europe.

(b) Population trends of common species linked to certain ecosystems (indicator species)

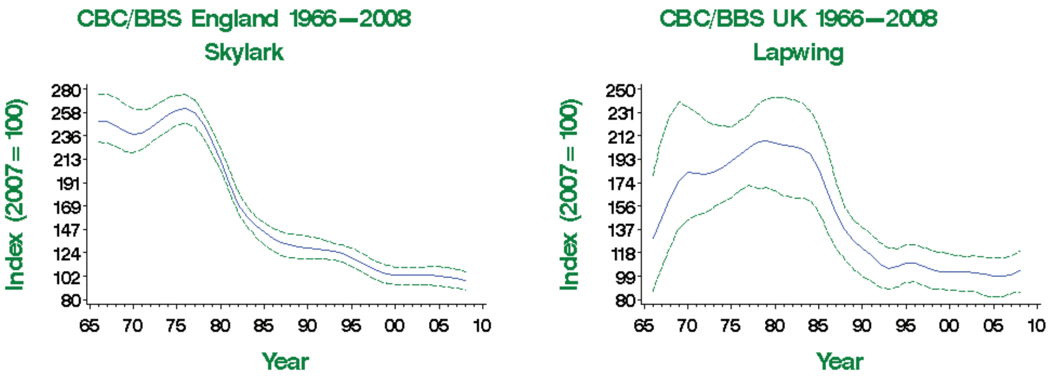
Common species that are known to be typical for certain ecosystems were the first ones whose decline was simultaneously noted by observers — usually people who remembered them from their childhood days. Most of the losses were observed in semi-natural ecosystems shaped by man, such as pastureland and arable fields, or in entirely man-made places, such as cities. The changes were first observed in the UK, but later also in all other European countries.

Species such as the much-loved skylark (*Alauda arvensis*) declined first in England, which prompted birdwatchers to extend observations to the rest of the UK. Other countries soon joined in (Denmark, Sweden and Finland), confirming the UK observations. The birds counted in the field were used to estimate the species' population in the whole country over the years, indexed to make a particular year equal 100 %, just as is done for economic indicators.

Figure 7.2 shows the population trends of the skylark (*Alauda arvensis*) in England and the lapwing (*Vanellus vanellus*) in the UK.

The worrying results of these studies in the UK and other northern European countries between the 1960s and 1980s prompted birdwatchers elsewhere to start counting birds using different sampling methods — usually privately organised and funded. From the outset, a direct link to changes in cropping practices was suspected (e.g. an increase in winter-sown cereals, providing less food for resident seedeaters), along with land drainage and loss of hedgerows. This was documented by the downward trends for many farmland species, such as the skylark (a seedeater that winters in the UK) and the lapwing (which has adapted to nesting in short crops, but needs wet areas nearby where it can raise its young once they are hatched).

Figure 7.2: Population trends of the skylark (*Alauda arvensis*) in England and the lapwing (*Vanellus vanellus*) in the United Kingdom, smoothed line with 85 % confidence limits, 1966–2008 *(index 2007 = 100)*



Source: British Trust for Ornithology, 2009.

This type of work has now developed into the best-organised and sustained field data collection network in Europe, the production of the ‘common bird indicators’ by the Pan-European Common Bird Monitoring Scheme (PECBMS). The indicators show the average yearly trends in abundance of selected sets of common bird species. They indicate changes in the overall condition of ecosystems, which are difficult and expensive to measure directly. Birds are excellent barometers for the health of the environment as they are generally well studied, occur in many habitats and respond to changes in their food plants and animals and in their physical environment. They also have a great resonance and symbolic value with the public and decision-makers.

Three series make up the common bird indicators. The ‘**all common birds**’ indicator measures the trend of 136 common species. It includes all species that are separately presented in the ‘**forest bird**’ (29 species) and the ‘**farmland bird**’ (36 species) indicators, plus a number of other common species. Combining so many species into three indicators means that each is a composite indicator. Separate indicators are produced for forest and farmland birds to show how common breeding bird species that depend on forests and on agricultural land for nesting or feeding are faring. For each trend line, common species whose population numbers are increasing are balanced out by common species whose numbers are in decline; the trends are not the same in all the countries covered. The overall results, however, show a decline in all three population trends for the EU.

The common bird indicators have been produced by the European Bird Census Council since 1980, but Eurostat only considers the data to be sufficiently representative for the EU as of 1990. By 1990, nine of today’s EU countries plus one region of Belgium had joined the scheme, while in 2009 twenty EU countries contributed data. Switzerland and Norway also produce these indicators.

The common bird indicators are used by policy-makers as official biodiversity indicators. The farmland bird indicator was adopted by the EU as a structural indicator, a sustainable development indicator and a baseline indicator for monitoring the implementation of the rural development regulation under the common agricultural policy (CAP). It includes the skylark and the lapwing in all the participating countries. Wild bird indicators have been adopted at national level in 15 European countries (PECBMS, 2009).

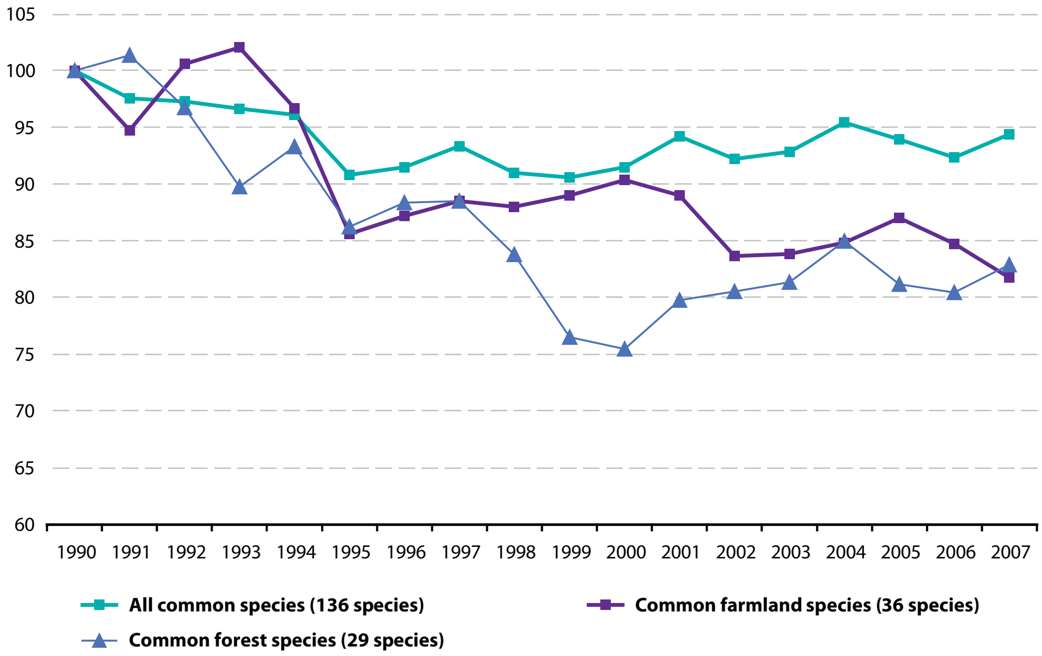
Figure 7.3 illustrates the EU's population trends for common forest and farmland birds along with those of all common birds in one figure. All three trends show decreases between 1990 and 2007, documenting biodiversity loss. Forest and farmland specialists are declining far more than the 'generalist' species that make up the remaining 71 species of the 'all common birds' indicator. This indicator shows a decrease in bird numbers by approximately 10 % between 1990 and 2007. Both the farmland bird indicator and the forest bird indicator show decreases of approximately 20–25 % in the same period. The possible reasons are discussed in part 2 of this chapter.

(c) Changes in ecosystems and land use or land cover

In the absence of information on species, it is possible to use the loss of certain ecosystems to estimate species' loss because of the evident link between ecosystems and species. Between the middle of the 19th century and today, technological development has made it possible to change the natural world and shape it according to our wishes. This led to huge losses of the following types of ecosystems, of which the first five are types of land cover, while the last is a type of land use:

- natural stretches of rivers great and small,
- river floodplains and riparian forests,
- marshland away from rivers or lakes,
- peat bogs,
- natural sea coasts,
- unfertilised pastureland and other extensively used farmland.

Figure 7.3: Trends in the common bird indicators for the European Union *(index 1990 = 100)*

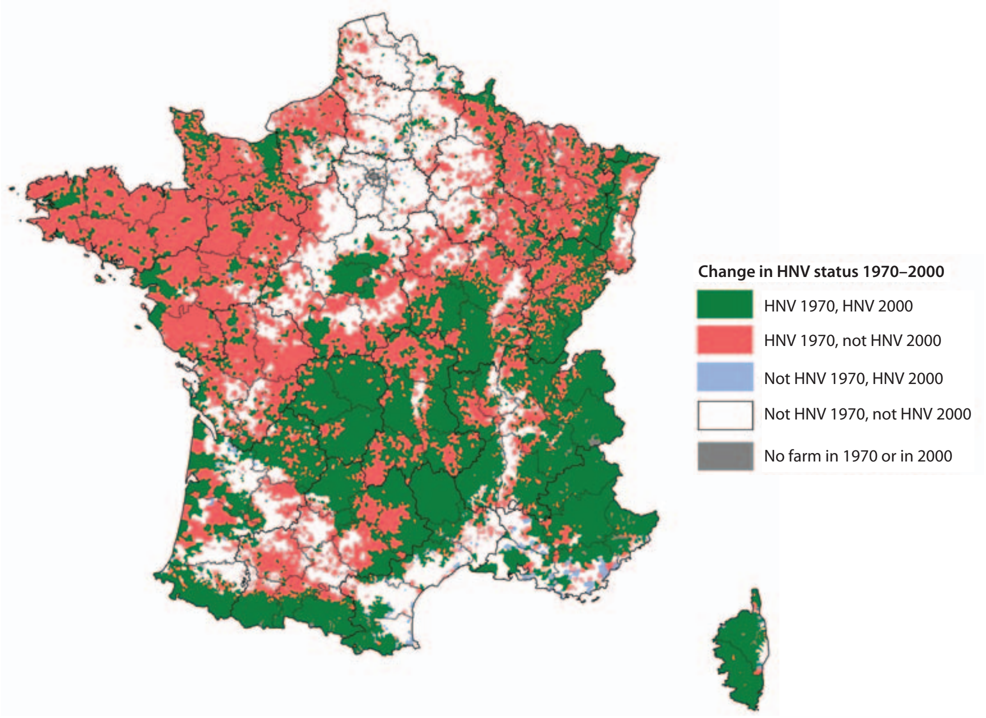


Source: Eurostat (env_bio2), EBCC/RSPB/BirdLife/Statistics Netherlands.

Example: Since the 16th century man has been changing the natural course of the rivers in the Danube river basin, mainly for flood defence, hydropower generation and navigation. All these changes affect the ecological quality of the rivers. Changes in the depth or width of a river typically reduce flow rates, interrupting natural sediment transportation as well as the migration routes of animals. The Danube itself is regulated along 80 % of its length. By cutting off the river from its floodplains, the frequency and duration of floods is changed, and former floodplains are degraded in ecological terms. Dyke systems have been built to prevent floods along the Danube ever since the 16th century. Only about a fifth of the Danube's floodplains from the 19th century still remain (*source:* International Commission for the Protection of the Danube).

As an illustration of the last bullet point above, Figure 7.4 shows how much high nature value (HNV) farmland was lost between 1970 and 2000 in France. It is based on a combination of agricultural statistics and survey data (e.g. on the presence and length of hedgerows and forest boundaries). These kinds of data can be used as a surrogate for biodiversity data in the case of agriculture because it was possible to distinguish between different types of farming. High nature value farming is associated with a higher biodiversity, presence of certain landscape elements, greater crop diversity, less intensive methods than those used by conventional farming or the presence of species of conservation concern. On the basis of these elements, every municipality in France was given an HNV score for 1970 and again for 2000.

Figure 7.4: Change in high nature value status of farmland in France, 1970–2000



Source: JRC-IES, European Commission, 2009. Made by Solagro, June 2009.

Why is biodiversity loss a matter of concern?

At the most basic level, biodiversity is important as an element of environmental stability. Healthy ecosystems are part of our life-support machine and biodiversity is the basis for the health and stability of ecosystems. Ecosystems made up of many different species are more likely to remain stable when there is some damage or loss than ecosystems comprising fewer species. The loss of a species should make us aware — like a canary in a coal mine — that this is a warning signal for an ecosystem.

Healthy ecosystems are self-regulatory because all organisms in them play different roles — comparable to different 'professions' — that complement each other and interact with other, neighbouring, ecosystems. The interlinkages between species in ecosystems mean that no species can become a pest in a functioning system. It is humans who change the dynamic balance by promoting certain species over others, for example our food crops over other plants that we consider to be weeds.

In any ecosystem, complexity is high — far higher than in any system created by man, such as the system of financial markets. We do not even begin to understand all the different relationships inside ecosystems. And yet our life and well-being are completely dependent on this unknown number of species of animals, plants, fungi and microbes that produce food, medicines and material for clothing, manufacturing and construction.

Human societies are also dependent on species that provide indispensable ecosystem functions, such as the biogeochemical processes without which waste would accumulate and the productivity of ecosystems would decline. These functions have become known as ecosystem services. They are commonly grouped into four broad categories (Millennium Ecosystem Assessment, 2005): provisioning, such as the production of food and clean water; regulating, such as the control of climate and disease; supporting, such as nutrient cycling; and cultural, such as spiritual and recreational benefits (Table 7.1).

There is scientific consensus that ecosystem productivity declines as species diversity diminishes (Tilman et al., 1996; Yachi and Loreau, 1999). Therefore, biodiversity loss also reduces

Table 7.1: Classification of ecosystem services provided by biodiversity

<table>
<tr><th>Provisioning services
<i>Products obtained from ecosystems</i></th><th>Regulating services
<i>Benefits obtained from regulation of ecosystem processes</i></th><th>Cultural services
<i>Nonmaterial benefits obtained from ecosystems</i></th></tr>
<tr><td>• Food
• Fresh water
• Fuelwood
• Fibre
• Biochemicals
• Genetic resources</td><td>• Climate regulation
• Disease regulation
• Water regulation
• Water purification
• Pollination</td><td>• Spiritual and religious
• Recreation and ecotourism
• Aesthetic
• Inspirational
• Educational
• Cultural heritage</td></tr>
<tr><td colspan="3">Supporting services
<i>Services necessary for the production of all other ecosystem services</i></td></tr>
<tr><td>• Soil formation</td><td>• Nutrient cycling</td><td>• Primary production</td></tr>
</table>

Source: (Millennium Assessment, 2003).

ecosystem services, consequently bringing about socioeconomic losses. These services play a central role in growth, jobs and human wellbeing (European Parliament, 2006).

Some of these ecosystem services have been globally enhanced, creating negative impacts on others. By making agriculture more intensive, the provisioning services (i.e. crops and livestock) have been enhanced, thereby reducing the ability of agricultural ecosystems to produce climate regulation, energy, fresh water and soil protection services.

It is therefore essential that ecosystems and species be managed in a sustainable manner. Overexploitation of wild resources may be less important as a threat to biodiversity in Europe; however, unsustainable management in economic activities that depend on ecosystem services can have disastrous effects. A key response to biodiversity loss would therefore be to take biodiversity concerns into account in our economic activities. Pollination, for instance, is not only essential for all terrestrial ecosystems, but secures 35 % of global crop production, thereby playing an important role in food security. Over 85 % of all plants are pollinated by animals and are entirely dependent on pollinators (e.g. bees or other insects) for pollen transmission and sexual reproduction.

Functioning ecosystems mitigate floods and other natural disasters. An example is the floodplains (polders) of the lower Oder valley, which contained the huge summer floods of 1997 to a great extent, while other areas where floodplains had been converted to other uses and the river was confined by dykes were flooded. One conclusion of a study on how to avoid such a situation in the future was that technical measures would not be sufficient and that floodplains should be provided where possible (Internationale Kommission zum Schutz der Oder gegen Verunreinigung, 1999).

Finally, we should not overlook the fact that most people get enjoyment and recreation from observing wild animals and plants and visiting wild places. More such places would mean that we could find recreation not only in distant countries, but also on our doorsteps. With the last enlargement of the European Union, the difference in species richness and population numbers between the old and the new Member States is quite striking for any observer, the new Member States being generally much richer in species and numbers at the same geographical latitude.

The main causes of biodiversity loss

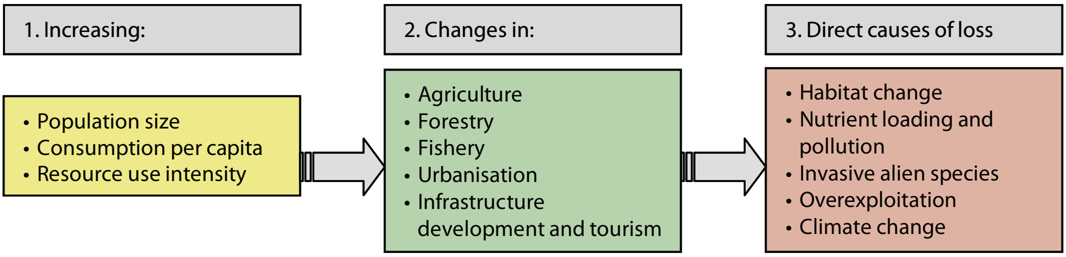
Direct and indirect causes of biodiversity loss

Generally speaking, biodiversity loss is due to increasing human pressure on our environment, which is caused by a net increase in population size, an increased consumption per capita and increased resource use intensity (part 1 of Figure 7.5).

Europe's population is increasing through a combination of natural growth (i.e. more people are born than die) and net migration (i.e. more people settle in the EU than leave). However, the population grew by only 11.25 % between 1975 and 2008 and now stands at approximately 498 million inhabitants. At the same time, this population has changed its consumption habits (see the chapter on households), and uses more resources than ever before.

The above trends, as well as economic, technological and social change, have led to changes in agricultural, forestry and fishery practices and to increased urbanisation, more infrastructure and intensive tourism activity (part 2 of Figure 7.5). All of this led directly to the loss of biodiversity through five widely recognised threats: habitat change, nutrient loading and pollution, invasive alien species, overexploitation of resources and climate change (part 3 of Figure 7.5).

Figure 7.5: Causes of biodiversity loss



Source: Adapted from Secretariat of the Convention on Biological Diversity (2006) and EEA (1998).

In order to show how changes in our lifestyles and practices (part 2 of Figure 7.5) are affecting biodiversity, the following section is devoted to a general description of these changes and examples of why they are causes of biodiversity loss.

As the most important cause of biodiversity loss, habitat change, is linked to pressures from urbanisation, development of transport infrastructure, tourism and agricultural and forestry practices, it is briefly described here, but also further developed in the part of this chapter devoted to land use.

Habitat change is the commonly used term to refer to two distinct phenomena: habitat destruction and habitat fragmentation. Habitat destruction directly impacts biodiversity by destroying the habitats where species live. Habitat fragmentation restricts wildlife movement and can lead to overcrowding, overexploitation of resources and population isolation, putting the survival of species at risk. Habitat change relates directly to the ecosystems and land use changes described earlier.

Changes in agricultural practices — the impact of nutrient loading and changes in cropping patterns

For centuries, much of Europe's agricultural biodiversity arose as an adaptation of species to extensive, small-scale agricultural land use. Many species evolved jointly with the selection by humans of crop varieties from wild plants. They are now so well adapted to crops (but not to pesticides) that they are called 'weeds of cultivation'. An example is the cornflower (*Centaurea cyanus*). The former diversity in agricultural landscapes included a variety of habitats ranging from extensively grazed pastures to small strips of arable fields bordered by hedgerows, and wetlands and meadows used for extensive grazing by domestic fowl. Manure from livestock kept in sheds over the winter was a scarce commodity, to be spread on arable land rather than on pastures. Crop rotation meant that there was always some fallow land.

Today, the increased pressure on agricultural land to produce more food or energy crops has led to intensive agricultural practices that involve changes in crops, rotation rates, preference of silage from fertilised meadows to haymaking from unfertilised grassland, destruction of hedgerows and increased inputs to farmland, such as energy, fertilisers, water and chemicals. The specialisation of farms as either cereal or livestock farms in the last decades has led to the concentration of each in certain areas. Intensive livestock production for meat and dairy products leads to large quantities of liquid and solid manure, and in many regions, there is not enough arable land to spread it on. It is then widely spread on pastures and meadows, where the scale of overfertilisation is documented by the ubiquitous presence of the yellow-flowering dandelion (*Taraxacum* sect. *Vulgaria*) in lush green fields. Such overfertilised grasslands massively outnumber unfertilised meadows with their colourful wild flowers and grasses — these have almost disappeared from many parts of western Europe.

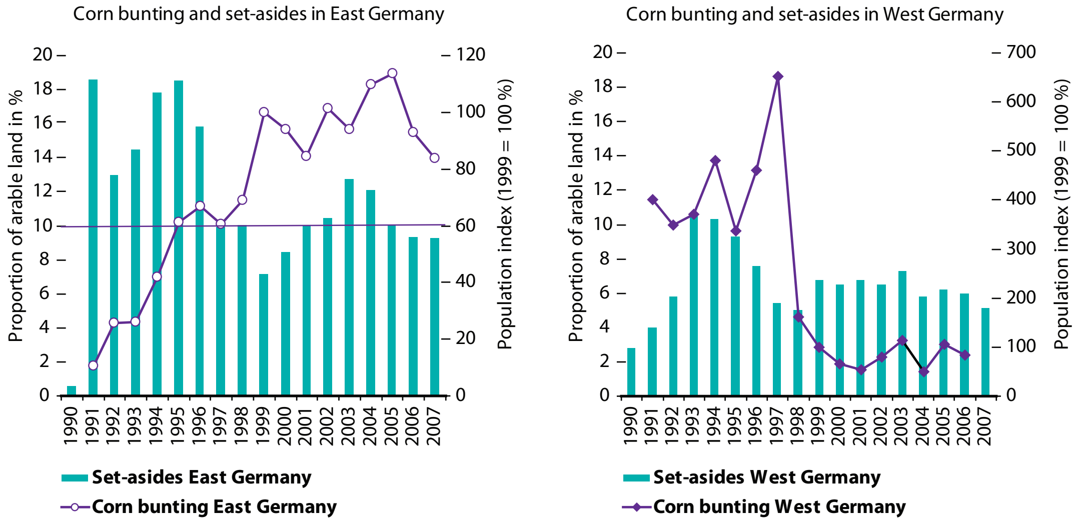
Cropping patterns have also changed. Increasingly, the main crop of wheat is sown immediately after the autumn harvest, which means that there are no stubble fields and no leftover grain as food for winter seedeaters. This has particularly affected the western parts of Europe with relatively mild winters where many birds attempt to spend the winter.

Extensively grazed pastures are disappearing due to intensive use of fertilisers and manure or due to land abandonment in less favoured regions. Hedgerows are destroyed to increase the area of cropland and yields are increased with fertilisers. Wetlands and meadows are drained and transformed into intensive pasture when they are not dried out due to intensive water uptake for irrigation.

In these intensively managed agricultural areas, in addition to manure, fertilisers — particularly nitrogen and phosphorus — are widely used to optimise production. These nutrients are usually absorbed by plants for their growth but may, if the application rate is too intense or climatic conditions are unfavourable, be leached out as run-off from agricultural soil to end up in surface or ground water. This causes a phenomenon called eutrophication, which can lead to toxic algal blooms that kill fish (see the chapter on agri-environmental indicators).

The impact of many of these changes to agricultural practices on biodiversity is particularly clear when there is a chance to compare adjacent regions that are farmed in completely different ways. Figure 7.6 shows how the introduction of set-aside agricultural land (15–20 % of arable land, a measure by the European Union to decrease agricultural production) and the

Figure 7.6: Population trends of the corn bunting (*Emberiza calandra*) *(index 1999 = 100)* and development of set-aside agricultural land (%) in eastern and western *Länder* of Germany



Source: Flade, M. (submitted).

reorganisation of agriculture in the former German Democratic Republic between 1991 and 1996 greatly increased the population of a bird typical of extensively used farmland, the corn bunting (*Emberiza calandra*). Set-aside land is in effect fallow land and this was valuable for species adapted to extensively used farmland. After the decrease of set-aside land to 10 % of arable land, population trends of this bird increased in the east only in a special protected area, but recovered from 2004 onwards, when organic farming was introduced in the east on a large scale. In contrast, west German populations decreased sharply when set-aside land started to be used for the production of energy crops around 1998.

Changes in forestry

Of all the ecosystems in the EU, forests are home to the largest number of species. The natural value of forests varies widely, depending on the type of management. Forests primarily managed for timber production are less natural — even under sustainable management practices — than forests not used for production.

Europe's overall forest cover is increasing (see the chapter on forestry), but only a very limited percentage has never been commercially exploited. There is a lot of fragmentation — in part also due to privatisation in parts of eastern Europe — and shortening of rotation periods on many plots or, elsewhere, road construction. This means that species that prefer open forests increase in numbers, while those that need dense old forests decrease, as is the case in Latvia, where many typical forest birds are becoming rarer (Peterhofs, 2010).

Valuable forest habitats (e.g. riparian forests, mixed-species forests, forests with uneven-aged trees) are disappearing due to intensification of timber production, afforestation with exotic species that can become invasive and forest fires. Afforestation with fast-growing European species that are unsuited to the local climate and terrain (e.g. spruce *Picea abies* and Scots pine *Pinus sylvestris*) and have shallow root systems can lead to catastrophic losses of large areas in windstorms.

An invasive species is defined by the IUCN as a non-indigenous plant or animal species that adversely affects the habitat it invades. One of the most common examples of invasive forest tree species is the black cherry (*Prunus serotina*) in Europe. Native to North America, this tree was introduced by foresters in the early 19th century for wood production. It soon started to spread, competing with indigenous trees on poor sandy soils in many parts of western Europe (Daisie European Invasive Alien Species Gateway, 2007).

Various *Eucalyptus* species introduced to the Iberian peninsula have become a problem because of their ability to tap ground water at much deeper levels than other trees. There is an ongoing eradication campaign, particularly in national parks such as Monfragüe.

Non-native trees are usually of no value to animal species that are adapted to native species. They often have competitive advantages over native tree species (e.g. eucalyptus) or faster growth (black cherry) that allow them to crowd out native species.

Afforestation is often done on land considered to have no value, but this can be a fallacy. Unfertilised grassland or so-called wasteland on unproductive soils is today in very short supply. It is this kind of land where many threatened species have their last remaining habitats. Afforestation is cited immediately after agricultural intensification as a threat to the 431 prime butterfly areas identified in Europe (Van Sway and Warren, 2006).

Changes in fisheries — the impact of overexploitation

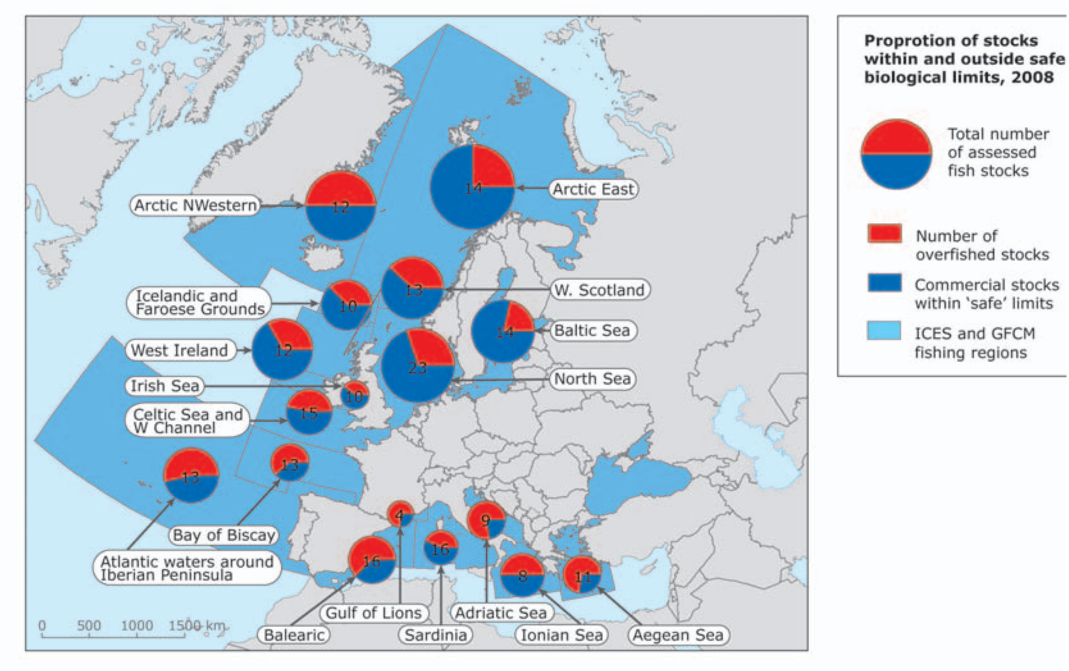
The last century saw an increase in fish exploitation, which in the 1990s led to reduced fish catches and a compensatory expansion of aquaculture, imports of fish for consumption and increased use of non-European waters by European fisheries. There are nowadays growing concerns with regard to the livelihoods of fishermen, the sustainability of commercial catches and the state of ecosystems from which they are extracted (FAO, 2004).

Urgent measures are needed to stop overfishing, especially by industrial-scale operations, to prohibit destructive fishing practices and to end illegal (e.g. with dynamite), unregulated and unreported fishing (Secretariat of the Convention on Biological Diversity, 2006). Fishing pressure is seriously harming marine biodiversity in many parts of the world, often with potentially significant impacts on food security.

In order to address these problems in European Union fishing waters, the existing common fisheries policy was reformed in 2002. Eurostat is responsible for collecting data on captures, landings and aquaculture of fish. These data are transmitted to the International Council for the Exploration of the Sea (ICES), whose scientists combine them with their own samples of population stocks and advise the EU on stock assessment issues. Based on the latter and on short-term information collected for the purpose of monitoring fishing quotas, the EU takes legal decisions — regularly reviewing the situation — to discontinue the fishing of certain species if necessary. However, enforcement of the EU's policy has proved to be insufficient, leading to the revision of the 2002 reform. The EU is currently working on new measures to better coordinate all the parties concerned.

The stocks of commercial fish in EU fishing waters are regularly assessed not only by ICES but also by the General Fisheries Commission for the Mediterranean (GFCM). However, not all stocks are currently assessed and the percentage of non-assessed stocks ranges from 3 % (West of

Figure 7.7: Status of fish stocks in the International Council for the Exploration of the Sea (ICES) and General Fisheries Commission for the Mediterranean (GFCM) fishing regions of Europe, 2008

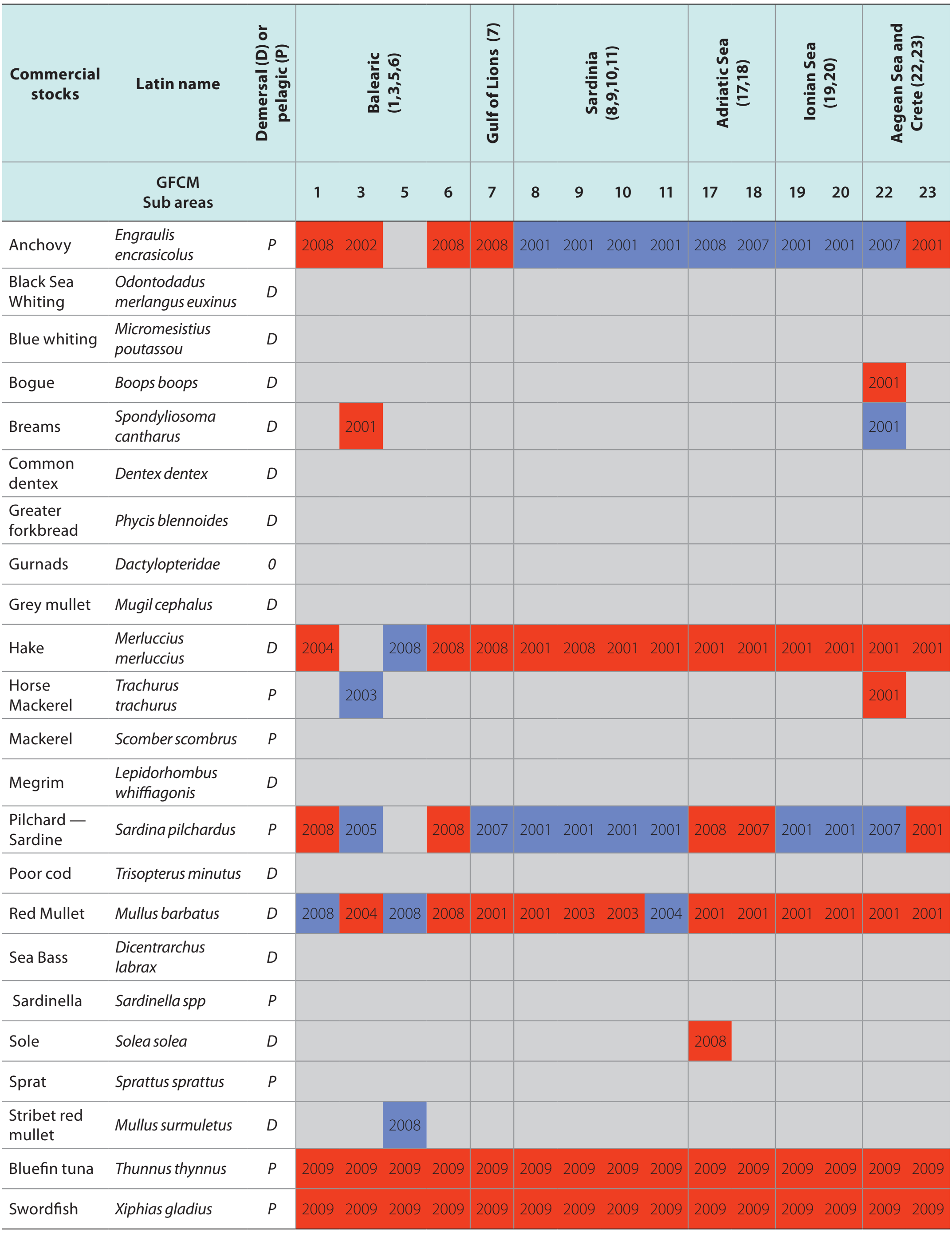


NB: The chart shows the proportion of assessed stocks that are overfished (red) and stocks within safe biological limits (blue). Numbers in circles are the number of stocks assessed within the given region. The size of the circles is proportional to the magnitude of the regional catch.

Source: EEA.

Table 7.2: State of commercial fish stocks in the north-east Atlantic and Baltic Sea (this page) and in the Mediterranean (next page), 2009

Commercial stocks	Latin name	Demersal (D) or pelagic (P)	Baltic Sea	North Sea	West Scotland	Irish Sea	West Ireland	Celtic Sea and Western Channel	Bay of Biscay	Iberian peninsula	Arctic — East	Arctic — North Western
Albacore	*Thunnus alalunga*	*P*							🟥 1	🟥 1		
Anchovy	*Engraulis encrasicolus*	*P*							🟥 1	🟦 1		
Anglerfish	*Lophius spp*	*P–D*		🟦 1	🟦 1	▨	🟦 1	🟦 2	🟥 1 🟦 1	🟥 2	▨	
Blue whiting	*Micromesistius poutassou*	*D*		🟦 1	🟦 1		🟦 1		🟦 1	🟦 1	🟦 1	🟦 1
Bluefin tuna	*Thunnus thynnus*	*P*					🟥 1		🟥 1	🟥 1		
Brill	*Scophthalmus rhombus*	*D*	🟦 1									
Capelin	*Mallotus villosus*	*P*									🟦 1	🟥 1
Cod	*Gadys morhua*	*D*	🟥 2	🟥 2	🟥 1	🟥 1	🟥 1	🟥 1			🟦 1 🟥 1	🟦 1 🟥 1
Conger	*Conger spp*	*D*							▨			
Chub mackerel	*Scomber japonicus*	*P*								▨		
Dab	*Limanda limanda*	*D*	🟦 1									
Flounder	*Platichthys flesus*	*D*	🟦 1									
Haddock	*Melanogrammus aeglefinus*	*D*		🟦 1	🟥 2	🟦 1	🟦 1	🟦 1			🟦 1	🟦 1
Hake	*Merluccius spp*	*D*		🟦 1	🟦 1	🟦 1	🟦 1	🟦 1	🟥 1	🟥 1		
Greenland halibut	*Reinhardtius hippoglossoides*	*D*									🟦 1	🟥 1
Herring	*Clupea spp*	*P*	🟦 5	🟦 1 🟥 1	🟦 1	🟦 1	🟥 1	🟥 1			🟦 1	🟦 1
Horse mackerel	*Trachurus trachurus*	*P*		🟦 1	🟦 1	🟦 1	🟦 1	🟦 1	🟦 1	🟦 1	🟦 1	🟦 1
Ling	*Molva molva*	*D*							▨			
Mackerel	*Scomberomorus spp*	*P*		🟦 1 🟥 1	🟦 1	🟦 1	🟦 1	🟦 1	🟦 1	🟦 1		
Megrim	*Lepidorhombus whiffiagonis*	*D*			🟦 1	▨	🟦 1	🟦 1	🟦 1	🟦 1		
Norway pout	*Trisopterus esmarkii*	*D*		🟦 1	▨							
Plaice	*Pleuronectes platessa*	*D*	🟦 1	🟦 3		🟦 1	🟦 1	🟥 1				
Pouting	*Trisopterus luscus*	*D*							▨	▨		
Red fish	*Sebastes marinus*	*D*									🟥 2	🟥 4
Saithe	*Pollachius virens*	*D*		🟦 1	🟦 1	▨	▨				🟦 1	🟦 1
Salmon	*Salmo salar*	*P*	🟥 1	🟥 1	🟥 1	🟥 1	🟥 1	🟥 1	🟥 1	🟥 1	🟦 1	🟦 1
Sandeels	*Ammodytidae family*	*D*		🟥 1	▨							
Sardine	*Sardina pilchardus*	*P*						▨	▨	🟦 1		
Seabreams	*Pagrus auratus*	*D*								▨		
Sole	*Solea solea*	*D*		🟦 3		🟥 1	▨	🟦 1 🟥 1	🟥 1			
Elasmobranchs		*D*		▨	▨	▨	▨	▨	▨	▨	▨	▨
Sprat	*Spratus spratus*	*P*	🟦 1	🟦 1	▨	▨		▨				
Swordfish	*Xiphias gladius*	*P*						🟥 1	🟥 1	🟥 1		
Turbot	*Psetta maxima*	*D*	🟦 1									
Whiting	*Merlangius merlangus*	*P*		🟥 1	🟥 1	🟥 1	▨	🟥 1	▨			



Commercial stocks	Latin name	Demersal (D) or pelagic (P)	Balearic (1,3,5,6)				Gulf of Lions (7)	Sardinia (8,9,10,11)				Adriatic Sea (17,18)		Ionian Sea (19,20)		Aegean Sea and Crete (22,23)	
	GFCM Sub areas		1	3	5	6	7	8	9	10	11	17	18	19	20	22	23
Anchovy	*Engraulis encrasicolus*	*P*	🟥 2008	🟥 2002		🟥 2008	🟥 2008	🟦 2001	🟦 2001	🟦 2001	🟦 2001	🟦 2008	🟦 2007	🟦 2001	🟦 2001	🟦 2007	🟥 2001
Black Sea Whiting	*Odontodadus merlangus euxinus*	*D*															
Blue whiting	*Micromesistius poutassou*	*D*															
Bogue	*Boops boops*	*D*														🟥 2001	
Breams	*Spondyliosoma cantharus*	*D*		🟥 2001												🟦 2001	
Common dentex	*Dentex dentex*	*D*															
Greater forkbread	*Phycis blennoides*	*D*															
Gurnads	*Dactylopteridae*	*0*															
Grey mullet	*Mugil cephalus*	*D*															
Hake	*Merluccius merluccius*	*D*	🟥 2004		🟦 2008	🟥 2008	🟥 2008	🟥 2001	🟥 2008	🟥 2001	🟥 2001	🟥 2001	🟥 2001	🟥 2001	🟥 2001	🟥 2001	🟥 2001
Horse Mackerel	*Trachurus trachurus*	*P*		🟦 2003												🟥 2001	
Mackerel	*Scomber scombrus*	*P*															
Megrim	*Lepidorhombus whiffiagonis*	*D*															
Pilchard — Sardine	*Sardina pilchardus*	*P*	🟥 2008	🟦 2005		🟥 2008	🟦 2007	🟦 2001	🟦 2001	🟦 2001	🟦 2001	🟥 2008	🟥 2007	🟦 2001	🟦 2001	🟦 2007	🟥 2001
Poor cod	*Trisopterus minutus*	*D*															
Red Mullet	*Mullus barbatus*	*D*	🟦 2008	🟥 2004	🟦 2008	🟥 2008	🟥 2001	🟥 2001	🟥 2003	🟥 2003	🟦 2004	🟥 2001	🟥 2001	🟥 2001	🟥 2001	🟥 2001	🟥 2001
Sea Bass	*Dicentrarchus labrax*	*D*															
Sardinella	*Sardinella spp*	*P*															
Sole	*Solea solea*	*D*										🟥 2008					
Sprat	*Sprattus sprattus*	*P*															
Stribet red mullet	*Mullus surmuletus*	*D*			🟦 2008												
Bluefin tuna	*Thunnus thynnus*	*P*	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009
Swordfish	*Xiphias gladius*	*P*	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009	🟥 2009

NB: Colour coding: blue = within safe biological limits; red = outside of safe biological limits; grey = no assessment in 2009; white = not found in the area. The numbers in the first table refer to the number of stocks and those in the second table to the year of assessment.

Sources: GFCM, ICCAT, ICES; compiled by EEA.

Scotland and West of Ireland) to 70 % for tuna and tuna-like species in the Mediterranean.

Of the assessed commercial stocks in the north-east Atlantic area, between 8 % (Baltic Sea) and 80 % (Irish Sea) are exploited outside of safe biological limits (SBL) (Figure 7.7). For the other areas in the north-east Atlantic, the percentage of stocks exploited outside of safe biological limits varies between 25 % and 55 %.

In the Mediterranean, the percentage of stocks exploited outside of SBL ranges from 44 % to 73 %, the Aegean and the Cretan Seas being in the worst condition.

Because all EU consumers could help reduce the pressure on unsustainably fished stocks, Table 7.2 gives information on fish that are caught outside of safe biological limits. The grey-shaded cells show those fish stocks that are currently not assessed.

We see that the number of non-assessed stocks is greater in the Mediterranean than in the North-east Atlantic. In the latter area, pelagic fish (those living well above the sea bottom and sometimes close to the surface) — such as herring and mackerel — are doing better than demersal fish (those living close to the sea bottom) — such as cod, plaice and sole. Similarly, in the Mediterranean, the small pelagic fish such as anchovy and sardine are doing better than the demersal hake, red mullet and bluefin tuna (Table 7.2).

Demersal fish are captured with dredge nets that are dragged across the seabed on wheels and greatly damage the habitats. Deep water soft corals have only recently been discovered to occur in the north-eastern Atlantic as far north as Scotland. Their habitats are vulnerable to the impact of demersal fishing through trawler gear pounding and crushing the delicate corals and all the biota living on them. Although trawlers try to avoid gear contact with hard corals because of the extensive damage they cause to the gear, soft corals are attached to boulders on sedimentary grounds that are not well detected by modern echo-sounder technology (Le Guilloux et al., in press).

Table 7.2 suggests that in the Mediterranean small pelagic species are not fully exploited anywhere, except for anchovy and pilchard in the Southern Alboran and Cretan Seas. There is cause for concern about the overexploitation of bluefin tuna. Fishery quotas have been set since 1998 and a comprehensive multiannual recovery plan was adopted by the International Commission for the Conservation of Atlantic Tunas (ICCAT) contracting parties in 2007, including time closure for fishing activities and mandated reduction in fishing capacity. A proposal to list Atlantic bluefin tuna on CITES was introduced at the Doha meeting of the parties in March 2010 by Monaco and supported by the United States and several European countries, but the proposal failed. In addition, many conservation measures are not fully enforced and illegal catching continues. Enforcement of existing measures is needed to prevent the extinction of this species.

Although overexploitation is a significant factor in the threats to marine biodiversity, there are also many other threats that are less well documented. They are mostly linked to the fact that the seas are the sinks in which run-off from sewers (often untreated) and agriculture ends up. All kinds of pollutants are flushed into the seas by the rivers, along with municipal waste. Coastal seas suffer from eutrophication just like fresh water does. Municipal waste coats and chokes many costal habitats. Just as bodies of fresh water have benefited from legislation to clean them up, the seas now require the same kind of attention.

The impact of urbanisation, infrastructure development, tourism and climate change

Europe's population continues to increase, and demand for land in and around cities is becoming acute. In Europe, cities were traditionally close-knit, developing around a small historical core. With the expanding rail and road network, cities began to spread into the countryside, a phenomenon called urban sprawl. As it is linked

to increased demand for energy and land, urban sprawl has major environmental impacts that threaten both the natural and the rural environment through the ever-greater expansion of the road network, the construction of new infrastructure and the increase in greenhouse gas emissions that cause climate change.

The development of the road network and infrastructure can itself be linked to habitat destruction and fragmentation. The network acts as a barrier that isolates populations and is responsible for the complete loss of certain species.

Climate change in the past century has already had a measurable effect on biodiversity and is projected to have a greater one in the future. A report from the IPCC (2002) cites changes to terrestrial (including freshwater) and marine ecosystems, and their projected impacts, either direct (through increases in air and water temperature and rising sea levels) or indirect (through the climate changing the intensity and frequency of disturbances such as wildfires).

One of the first impacts of climate change on biodiversity is a shift of populations from the south to more northerly latitudes and from lower to higher altitudes in the mountains. Directional dispersal is one of the easiest ways to escape climate change, but the ability of species to move their ranges is strongly dependent on habitat fragmentation that limits movement, except in birds. The effects of climate change can therefore first be observed for northern, high altitude and coastal areas, where there is nowhere to move to.

In Europe, the Alps and the Mediterranean coast are two of the most heavily visited tourist destinations. More recently, east European countries have become holiday destinations, with the attendant increase in construction, infrastructure and consumption of natural resources.

Habitat change — the link between biodiversity loss and land use or land cover change

According to the various scenarios of plausible futures explored in the Millennium Ecosystem Assessment, land-use change, due to its impact on habitats, is expected to remain the largest driver of biodiversity loss between 2010 and the middle of the century (Secretariat of the Convention on Biological Diversity, 2006).

A special section of this chapter is therefore devoted to land use and how land use change can affect biodiversity.

Land cover and land use change and biodiversity loss

Land use and the difference between land use and land cover

With on average 117.5 people living on each of the EU's 3 million square kilometres, it is easy to see why land use planning and management is such an important environmental issue for the European Union. The impact of the way we use our land on the environment can be direct, such as the destruction of natural habitats and landscapes, or indirect, such as the increase in the amount of traffic on our roads leading to more congestion, air pollution and greenhouse gases (see the chapter on households).

Most of the existing information on land cover and land use mixes land cover and land use. Natural and semi-natural vegetation are described in terms of land cover, while agricultural and urban areas are described in terms of land use (see the Corine Land Cover (CLC) classification).

However, these are two different issues: the distinction between land cover and land use is fundamental, though often ignored or forgotten. Confusion and ambiguity between these two terms leads to practical problems, particularly when data from the two different dimensions need to be matched, compared and/or combined. An example of a clear separation between land

WHAT KIND OF LAND COVER DATA ARE COLLECTED AT THE EU LEVEL?

There are two main approaches for the collection of land cover and land use data: field survey and analysis of remotely sensed imagery.

Corine Land Cover (CLC) is a European land cover dataset produced by photointerpretation of satellite images and ancillary information. It was started as part of the Corine programme (Coordination of Information on the Environment) that dates back to 1985. CLC inventory is currently the most used source for European land monitoring data. It has been implemented with expanding areal coverage for 1990 and 2000. The most recent version for reference year 2006 covers all EU countries, as well as EFTA, EU candidate and EEA cooperating countries in the western Balkans. Images acquired by earth observation satellites are used as the main source of data to derive land cover information. CLC land cover units are identified by use of supplementary *in situ* information. The first release of 'CLC-Changes' provided land cover changes between the first inventory (1990) and 2000. The new update for 2006 is a direct continuation of previous CLC mapping campaigns and provides 2002–2006 changes. The CLC2006 dataset was created by mapping changes of over 5 ha when compared to CLC2000 data (EEA, 2007).

LUCAS (Land Use/Cover Area Frame Survey) is a field survey, carried out on a sample of points spread over the entire territory of the European Union; data on land cover and land use are collected and landscape photographs are taken, enabling detection of changes in land cover/use and in European landscapes. The harmonised and well-tested area frame sampling methodology and the differentiated nomenclature for land cover and land use are considered to be the major strength of the survey. The LUCAS data collection exercise was initially devised for crops in the pilot phase (2001–07). The methodology changed significantly from 2006, including a shift in the scope from agriculture alone to all types of land cover and land use. Currently the aim of the LUCAS process is to collect all dimensions of land cover and land use statistics at the European level to monitor changes in agriculture, the environment and landscapes, to analyse soil quality and to provide a ground truth for many space-borne information collection activities (such as CLC and GMES — Global Monitoring for Environment and Security). Results for the 2009 campaign will be available later in 2010.

cover and land use is represented by the Land Use/Cover Area Frame Survey (LUCAS) nomenclature.

The Eurostat 'Manual of concepts on land cover and land use information systems' (European Communities, 2001) defines these terms as follows:

Land cover corresponds to a physical description of space, the observed (bio)physical cover of the earth's surface. This description enables various biophysical categories to be distinguished — basically, areas of vegetation (trees, bushes, fields, lawns), bare soil (even if this is a lack of cover), hard surfaces (rocks, buildings), wet areas and bodies of water (lakes, watercourses, wetlands). Land cover is 'observed', meaning that observation can be made from various 'sources of observation' at different distances between the source and the earth's surface.

Land use corresponds to the description of areas in terms of their socioeconomic purpose: areas used for residential, industrial or commercial purposes, for farming or forestry and for recreational or conservation purposes, etc. Links with land cover are possible; it may be possible to infer land use from land cover and conversely. But situations are often complicated and the link is not so evident. Contrary to land cover, land use is difficult to 'observe'. For example, it is difficult to decide if grasslands are 'natural' (or semi-natural) or if they are used for agricultural

purposes. The information coming from the source of the observation may be sufficient, e.g. indications on the presence or absence of cattle, or may require additional information, for example from the land owner or the farmer.

Trends in land use change to illustrate biodiversity loss

Changes in land use and land cover date back to prehistoric times and are the direct and indirect consequences of human actions to secure essential resources. In pre-agricultural times, most of the lowlands of Europe were covered in closed or semi-closed forest. The advent of agriculture changed vegetation patterns, creating valuable landscapes and high biodiversity sites, as long as these sites were extensively managed. Almost all biodiversity in western Europe is to a large extent dependent on extensive, small-scale agricultural land use. Remarkably few areas of high biodiversity value are truly natural.

The economic and technological revolutions further changed the face of most of Europe. Now, almost all areas are directly affected by human activities, and natural ecosystems have mostly been lost.

Land cover change patterns

In the previous sections, the impact of changing agriculture and forestry practices as well as urbanisation, infrastructure development and tourism as direct causes of the loss of biodiversity were described. Most of these changes can be observed by looking at land cover change patterns. These changes show how natural ecosystems have been reduced in the economically developed and densely populated north-west European areas, or in other scenarios such as land cover changes as a result of land abandonment or wetland drainage.

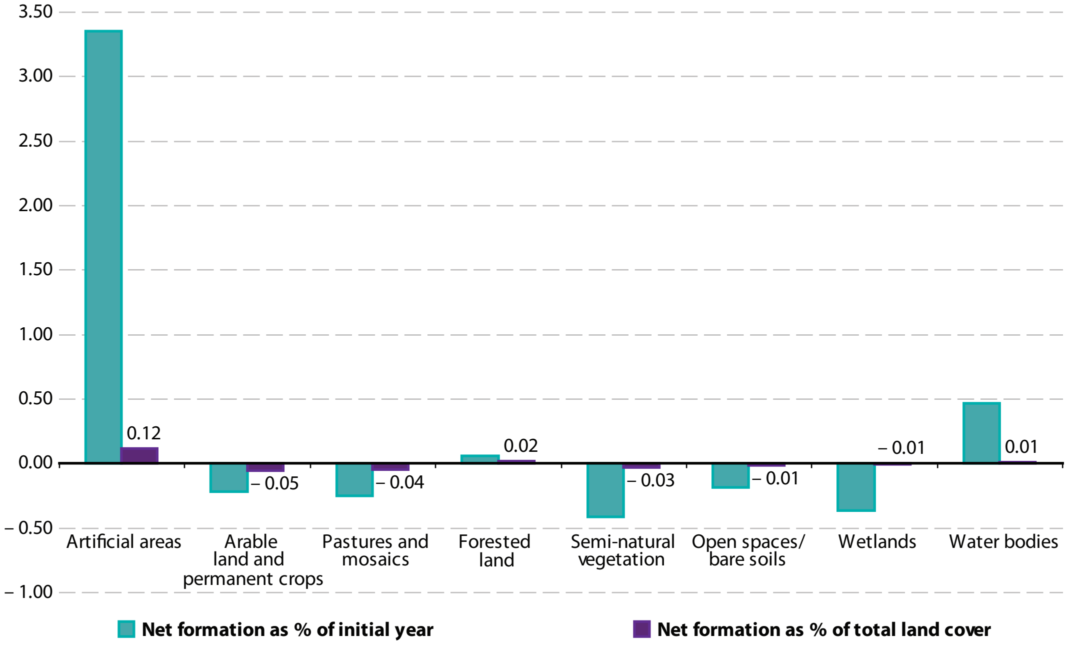
In 2006, the main cover types were arable land and permanent crops (25 % of total land cover),

Table 7.3: Land accounts for the eight aggregate land cover types, Europe (28 countries), 2000–2006 *(hundred hectares)*

	Artificial areas	**Arable land and permanent crops**	**Pastures and mosaics**	**Forested land**	**Semi-natural vegetation**	**Open spaces/bare soils**	**Wetlands**	**Water bodies**	**Total (hundred ha)**
Land cover 2000	*186 528*	*1 350 193*	*942 015*	*1 929 507*	*410 883*	*342 072*	*119 968*	*143 004*	*5 424 171*
Consumption of initial land cover	– 1 853	– 8 326	– 4 855	– 47 243	– 2 693	– 2 408	– 645	– 330	– 35 886
Formation of new land cover	8 111	5 410	2 493	48 357	1 012	1 763	211	997	35 886
Net formation of land cover	6 258	– 2 916	– 2 362	1 114	– 1 681	– 645	– 434	667	0
Land cover 2006	*192 786*	*1 347 278*	*939 653*	*1 930 622*	*409 202*	*341 427*	*119 533*	*143 671*	*5 424 171*

Source: Corine Land Cover 2006, EEA/ETC-LUSI.

Figure 7.8: Net formation of land cover (formation minus consumption) for the eight aggregate land cover types, 28 European countries, 2000–2006 *(% of land cover type in 2000 and % of total land cover in 2006)*



Source: Corine Land Cover 2006, EEA/ETC-LUSI.

forested land (36 % of total land cover) and pastures and mosaics (17 % of total land cover) (Table 7.3), according to Corine Land Cover. The number for forested area differs considerably from the 42 % (FAO data for 2005) in the chapter on forestry, but it is a different source and the countries covered by CLC in 2006 (96) are not identical to the 27 EU countries.

The most important changes in land cover between 2000 and 2006 in Europe for the 28 countries that provided CLC data are the increase in artificial areas (net formation of 3.35 %), and the decrease in semi-natural vegetation (– 0.41 %), open spaces and bare soils (– 0.19 %), arable land and permanent crops (– 0.22 %) and wetlands (– 0.36 %) (Figure 7.8).

The large increase in artificial areas is due to increased urbanisation and infrastructure development and has a direct influence on biodiversity. The direct consequence of this increase is the fragmentation and further destruction of existing habitats. The reduction of arable land and permanent cropland, pastures and mosaics and semi-natural vegetation is mainly due to changes in agricultural and forestry practices that have been described earlier in this chapter. The decrease in wetland areas is due to drainage in order to gain land for building, cropping or forestry, overexploitation through intensive irrigation systems and damming and rectification of water courses. One of the biggest problems is the drainage of peat bogs, which not only threatens specialised plants and animals, but also releases huge quantities of CO_2.

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(96) Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, France, Hungary, Iceland, Ireland, Latvia, Liechtenstein, Lithuania, Luxembourg, Macedonia, former Yugoslav Republic of, Montenegro, Netherlands, Poland, Portugal, Romania, Serbia, Slovakia and Slovenia.

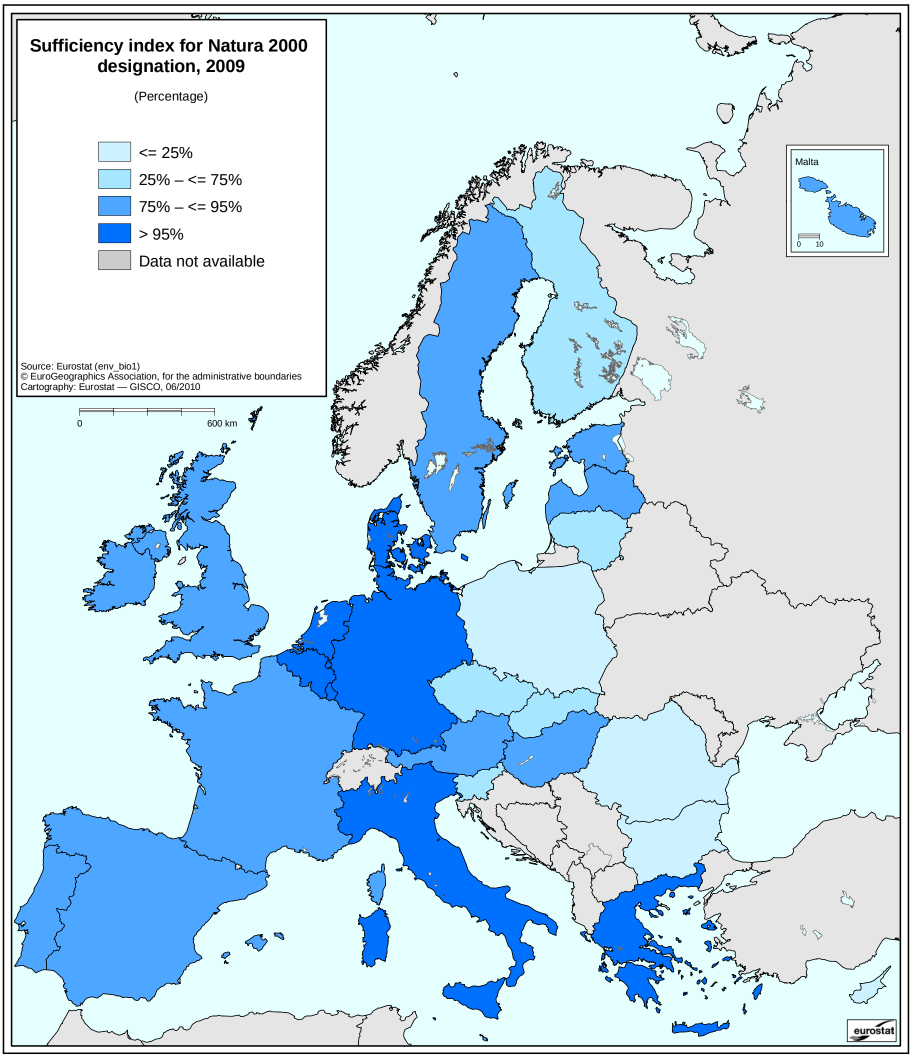
What can be done by the European Union and its Member States?

Setting up protected areas

One of the oldest ways of preserving biodiversity is to designate nature reserves and manage access to them in order to reduce human disturbance and pressures on endangered species, habitats and ecosystems. Some 14% of the land area is currently so designated by national measures in the 27 Member States of the European Union.

In parallel to nationally designated areas, Natura 2000 has developed into a vast network of protected sites that complement or overlap national ones, bringing a European approach to the protection

Figure 7.9: Sufficiency index for Natura 2000 designation, EU–27, 2009 *(%)*



Source: Eurostat (env_bio1)

of birds, 1 180 species of other taxa and 231 habitat types of special European concern. The Natura 2000 network designates sites where human activities are ongoing, thereby showing how important it is to act in a sustainable manner that is compatible with wildlife and habitat conservation.

Natura 2000 was created based on two major European Union directives commonly known as the habitats directive (97) and the birds directive (98). The habitats directive obliges the Member States to propose sites of natural habitat types and species for the Natura 2000 network in proportion to the area of such habitats and species present on their territory.

A sufficiency index measures progress in the implementation of the habitats directive. It calculates the sum, by biogeographical region and per country, of the proportion of habitats and species that are sufficiently represented in the list of sites proposed by Member States, in relation to the number of species and habitats on the European Union's reference lists of habitat types and species for each biogeographical region. Scientific seminars are organised to determine whether habitats and species of a region are sufficiently represented in the proposals. The index for a Member State is calculated by summing up the indices for each biogeographical region in the country, weighted by the proportion of the region's area that lies within that country (see Figure 7.9.)

In 2009, 17.6 % of the area of the Member States was designated as part of the Natura 2000 network. Some countries fully complied with the habitats directive (e.g. Belgium, Denmark, Italy, the Netherlands, Greece, Germany, Luxembourg and Spain) while others were only partially compliant (e.g. Bulgaria, Romania, Poland and Cyprus).

Taking biodiversity into account in other policies

Aside from the 17.6 % of the European Union's land area that is designated and holds threatened species and valuable habitats, it is essential to develop good connections between Natura 2000 and any other protected sites. Biodiversity is not only a matter of concern in protected areas but should also be part of normal development outside these areas. A distinction is therefore often made between a protected area per se and an ecological network. While the first aims at preserving core sites, the second provides buffer zones around them and links between the sites.

The protection and creation of ecological networks can only be done by taking biodiversity into account in all other policy fields, e.g. agriculture, forestry, water management, fisheries and spatial planning. This is especially relevant because rare species are now mostly well protected by the Natura 2000 network, while it is common species that are in decline, as shown by the common bird indicators.

In addition to the two main European Union directives that gave rise to the Natura 2000 network, steps have been taken by the European Union to decrease pressure on biodiversity. In 2006, the EU set out a detailed action plan (99) to halt biodiversity loss by 2010 and to address the challenge of taking biodiversity into account in other policies. This target was not achievable in the available time. In early 2010, the EU agreed on a headline target of halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them as far as feasible. It is setting up a new strategy to reach that target.

Biodiversity in agriculture and forestry

In order to take action in the wider countryside, the EU included biodiversity protection under Axis 2 of the rural development regulation (2007–13) (100), dedicated to 'improving the environment and the countryside', as well as under the new common agricultural policy (CAP). The CAP has included biodiversity since 1992 with the aim of increasing and promoting

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(97) Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.
(98) Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds.
(99) Commission communication (COM(2006) 216 final) of 22 May 2006 'Halting the loss of biodiversity by 2010 — and beyond — Sustaining ecosystem services for human well-being'.
(100) Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development.

the use of good farming practices and organic farming and of supporting biodiversity on less favoured farmland. The EU also adopted a Community programme to help preserve Europe's rare domestic breeds and crops.

The main aim of the Commission's forest action plan (6) adopted in 2006 is to support and enhance sustainable forest management and the multifunctional role of forests (see the chapter on forestry).

Reducing pollution and restoring freshwater ecosystems

The biodiversity action plan calls for a swift implementation of the water framework directive (7) (see the chapter on water) and the restoration of valuable rivers and wetlands, with a special focus on restoring water regimes.

Biodiversity in the seas and fisheries

The sustainable use of the EU's seas and oceans was promoted in 2007 in the marine strategy framework directive (8). It sets the target of achieving a good environmental status in all EU waters by 2020. The biodiversity action plan also calls for sustainable use of marine resources under the common fisheries policy.

Biodiversity in spatial planning

The pressure on the land through new demands for housing, transport, infrastructure and recreation is rising. The biodiversity action plan calls for all relevant spatial planning in the EU to undergo a strategic environmental assessment (SEA) and an environmental impact assessment (EIA).

Conclusions: Biodiversity and land use in Europe

The EU's biodiversity is in decline, caused primarily by habitat change.

Loss of biodiversity is a matter for concern because with each loss the ecosystems that are the life-support machines of our planet become less stable. The productivity of our natural ecosystems declines as species' diversity diminishes. Therefore, biodiversity loss reduces the basis for the benefits we get from our natural ecosystems, the so-called 'ecosystem services', consequently bringing about socioeconomic losses because these services play a central role in growth, jobs and human well-being.

Biodiversity is too complex to be fully quantified. It is measured directly by looking at changes in threatened species, or in common species and habitats that are typical for certain ecosystems. It can be measured indirectly by looking at changes in ecosystems, land use and land cover.

The most important changes in land cover between 2000 and 2006 were the increase in artificial areas and the decrease in arable land, pastures and mosaics, semi-natural vegetation, open spaces and wetlands, with a corresponding loss of ecosystems. These trends were broadly the same as between 1990 and 2000.

Biodiversity cannot be preserved only in protected areas, but should be taken into account in normal development everywhere. Rare species are now mostly well protected by the Natura 2000 network and the birds directive, while it is often more common species and habitats that are in decline.

Eurostat is preparing to publish the results of its 2009 land use and land cover field survey — LUCAS 2009 — including comparable indicators on the fragmentation, richness and dominance of the landscape. At the same time, Eurostat is preparing the next survey, foreseen for 2012, in cooperation with other European Union institutions such as the European Environment Agency and its Topic Centre for Biodiversity. The possibility of collecting additional data focused on biodiversity is being discussed.

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(101) Communication from the Commission to the Council and the European Parliament (COM(2006) 302 final) of 15 June 2006 on an EU forest action plan.

(102) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

(103) Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for Community action in the field of marine environmental policy.

Further information

Eurostat main tables and database

Database by themes, Environment and energy, Environment (env), see: Biodiversity (env_biodiv)

Tables by themes, Environment and energy, see: Land use (t_env_land) and Biodiversity (t_env_biodiv)

Eurostat publications

Manual of concepts on land cover and land use information systems

http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-34-00-407/EN/KS-34-00-407-EN.PDF

Statistics in Focus No 33/2008: New insight into land cover and land use in Europe

http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-SF-08-033/EN/KS-SF-08-033-EN.PDF

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See also

Convention on Biological Diversity: http://www.cbd.int

Environment DG: http://ec.europa.eu/environment/nature/biodiversity

European Environment Agency: http://www.eea.europa.eu/themes/biodiversity

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Millennium Ecosystem Assessment: http://www.millenniumassessment.org/en/index.aspx

Methodological notes

The best protection for biodiversity at the European level is afforded by two pieces of legislation: the birds directive (Council Directive 79/409/EEC) and the habitats directive (Council Directive 92/43/EEC). The habitats directive created a network of protected areas of national and international importance. They are called Natura 2000 sites, and include special areas of conservation and special protection areas. The latter are defined in accordance with the birds directive.

Annual data are available on Eurostat's dissemination database; these data are collected by other bodies, but their quality is checked by Eurostat. They cover the protected areas under the habitats directive, the population trends of common birds and fish catches from stocks considered to be outside of safe biological limits.

Other data are collected by IUCN (the Red List index for European species; threatened and protected species; change in status of species). Efforts have also been devoted to developing headline indicators, e.g. the 26 Streamlining European Biodiversity Indicators 2010 (SEBI 2010) of the European Environment Agency.

Definitions

The Convention on Biological Diversity (CBD) defines **biological diversity** as 'the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'.

A **habitat** is a place where an organism or a biological population normally lives or occurs.

The term **ecosystem** refers to the combined physical and biological components of an environment. An ecosystem is generally an area within the natural environment in which physical (abiotic) factors of the environment, such as rocks and soil, interact with (biotic) organisms, such as plants and animals. Ecosystems can be permanent or temporary and have no fixed boundaries: depending upon the purpose of the analysis, a single lake, a watershed or an entire region could be considered an ecosystem. Ecosystems generally comprise many different habitats.

Food chains and **food webs** represent the predator–prey relationships between species within an ecosystem or habitat.

In nearly all **food chains**, solar energy is used by producers to produce energy through photosynthesis (e.g. plants). The other organisms are called consumers and can either feed directly on producers (herbivores) or on other consumers (carnivores). One top consumer (i.e. predator) is usually found at the top of the food chain.

Most animals are part of more than one food chain and eat more than one kind of food (e.g. foxes do not only feed on rabbits). Several food chains can therefore be interconnected, thus creating a **food web**.

A species is **critically endangered** when the best available evidence indicates that it meets any of the criteria A to E for critically endangered (see IUCN Red List criteria

http://www.birdlife.org/datazone/species/terms/criteria.html) and it is therefore considered to be facing an extremely high risk of extinction in the wild.

A species is **endangered** when the best available evidence indicates that it meets any of the criteria A to E for endangered (see IUCN Red List criteria http://www.birdlife.org/datazone/species/terms/criteria.html), and it is therefore considered to be facing a very high risk of extinction in the wild.

A species is **vulnerable** when the best available evidence indicates that it meets any of the criteria A to E for vulnerable (see IUCN Red List criteria http://www.birdlife.org/datazone/species/terms/criteria.html), and it is therefore considered to be facing a high risk of extinction in the wild.

A species is **near threatened** when it has been evaluated against the criteria but does not qualify as critically endangered, endangered or vulnerable at present, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

Safe biological limits (fisheries): A fish stock is considered to be outside of safe biological limits (SBL) – or overfished – when its size has fallen below sustainable levels, i.e. when its size does not guarantee replenishment by reproduction. A stock is considered to be within safe biological limits if its spawning stock biomass (SSB) estimated at the end of the year is higher than the SSB corresponding to a precautionary approach level.

Sufficiency index: The index measures progress in the implementation of the habitats directive. It calculates the sum, by biogeographical region and per country, of the proportion of habitats and species that are sufficiently represented in the list of sites proposed by Member States, in relation to the number of species and habitats on the European Union's reference lists of habitat types and species for each biogeographical region. Scientific seminars are organised to determine whether habitats and species of a region are sufficiently represented in the proposals. The index for a Member State is calculated by summing up the indices for each biogeographic region in the Member State, weighted by the proportion of the region's area that lies within the Member State.

The International Union for Conservation of Nature (IUCN): http://www.iucn.org/what/tpas/biodiversity/


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8

Agri-environmental indicators

How important is agriculture and how does it affect the environment?

Agricultural trends and functions in the European Union

Agriculture is the production of food and goods through farming. Agriculture was the key development that led to the rise of human civilisation, with the husbandry of domesticated animals and plants (i.e. crops) creating food surpluses that enabled the development of more densely populated and stratified societies. It provides the basis of subsistence for human populations.

Farming is therefore the most dominant and dynamic type of land use, covering around 40 % of the land area in the EU-27 (104). The agricultural area is commonly divided into four main classes: arable land, permanent grassland, permanent crops and kitchen gardens. In 2007, they respectively represented 104, 57, 11 and 0.4 million hectares in the EU-27. Within the arable land class, cereals were the dominant crop (55.4 million ha), followed by fodder crops (105) (18.2 million ha) and industrial crops (106) (12.9 million ha). The main permanent crops were olive trees (4.27 million ha), vineyards (3.28 million ha) and fruit, berries and citrus (2.88 million ha).

Land area may be compared in hectares, but the numbers of heads of different animal species need to be converted into livestock units (LSU) before any comparison can be made. The LSU is related to the feed requirements

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(104) Utilised agricultural area (UAA) out of total land area (2007). The UAA is defined as the area taken up by arable land, permanent grassland, permanent crops and kitchen gardens. It does not include wooded area or forests. The UAA excludes non-utilised agricultural land, woodland and land occupied by buildings, farmyards, tracks, ponds, etc. Neither will land under grazing use but not registered in agricultural censuses be covered.

(105) Fodder crops are crops that are cultivated primarily for animal feed.

(106) Industrial crops are crops grown to produce materials for industrial processes and products.

of each individual animal category. Livestock species are often divided into two categories: grazing livestock (horses, cattle, sheep and goats) and granivores (pigs and poultry). The feeding of the first group uses mainly fodder (grass, hay, silage, etc.) whereas the second group is fed on cereals and pulses. In 2007, the EU-27 LSU was 132.6 million, of which 58.7 % (77.8 million) was grazing livestock.

In absolute terms, total trade in agricultural products amounted to almost EUR 153 billion in 2007, split between EU imports from third countries of EUR 77.4 billion and exports of EUR 75.1 billion. The EU is currently the largest global importer and exporter of agricultural products. It is also the primary importer from developing countries. For many years, the EU has been a net food importer. Even if today the EU's overall trade is in fairly close balance, the EU still remains a substantial importer for many product groups.

For instance, the EU is a net importer of raw products, amongst which tropical products (e.g. oilseeds and oils, fruit and vegetables) are the most significant contributors. On the other hand, the EU trade in both livestock and cereals is quite balanced, while the dairy sector registers a trade surplus. Aside from its essential role for food production, other functions are intrinsically linked to agriculture, relative to the creation and maintenance of suitable habitats for biodiversity, structural and functional features of the landscape and support of a diverse rural community.

Farming has, in past centuries, contributed to creating and maintaining a unique countryside in Europe. Agricultural land management has been a positive force for the development of the rich variety of landscapes and habitats, including a mosaic of woodlands, wetlands and extensive tracts of open countryside. Traditional or extensive farming systems still play the same role today but the majority of intensive farming systems exert negative impacts on biodiversity.

In order to reduce the pressure of intensive farming systems on biodiversity, sound agricultural management practices (e.g. efficient use of inputs and slurry, prevention of negative effects, management of low-intensity pasture systems, integrated farm management, preservation of hedgerows and woods) should be promoted as they tend to have a substantial and positive impact on the conservation of the EU's wild flora and fauna.

The ecological integrity and the scenic value of landscapes make rural areas attractive for the establishment of businesses and residences, and for tourism and recreation.

The EU's agricultural areas are a vital part of its identity and are home to a significant part of its population. Improving the quality of life in rural areas (i.e. areas with low population densities) and encouraging diversification of the rural economy is therefore of great importance.

Interactions between agriculture and the environment

Agriculture exerts pressures on the environment that are both beneficial and harmful and can result in positive and negative environmental impacts. The positive or negative nature of these interactions changes according to the agricultural practices that prevail in given geographic areas. In the last few decades, these practices have changed quite significantly, contributing to increased yields (e.g. quantities of cereals per hectare or milk per cow) and therefore stressing the food production role of farming. These changes can be classified into two main categories: the specialisation and intensification of certain production methods (e.g. with the use of more chemicals and heavy machinery) and the marginalisation or abandonment of traditional land management (e.g. where agriculture is less profitable).

Agricultural practices have a direct impact on soil, air, water, biodiversity and landscapes as well as an indirect impact on climate change and waste production and accumulation. Several examples can be provided to illustrate these impacts. For instance, agriculture emits greenhouse gases and consumes fossil fuels for farm operations, thus having an impact on air

quality. The run-off from agricultural land contributes to 50–80 % of the total nitrogen load in water and has remained constant over the last 30 years (EEA, 2005). Globally, agriculture accounts for 70 % of the consumption of freshwater resources. On average, 42 % of total water abstraction in Europe is used for agriculture, and agriculture accounts for 50–70 % of total water abstraction in south-west European countries (UNEP, 2004). Intensification and land abandonment have led to the destruction of valuable semi-natural habitats that are essential both for biodiversity and landscape preservation.

Figure 8.1 gives a simplified example of the trade-offs involved in the decision to intensify agricultural practices in order to increase food production. The example shows that the increasing focus on food provision entails a greater loss of other services. In some cases, this change may be essential and the benefits will outweigh the losses of other services. In others, the main benefits from increased food production may go to a different private interest than the former beneficiaries of the other services.

THE COMMON AGRICULTURAL POLICY — HOW SUCCESSIVE REFORMS INTRODUCED ENVIRONMENTAL POLICY MEASURES

The common agricultural policy (CAP) finds its roots in 1950s western Europe, whose societies had been pressured by years of war. The emphasis of the early CAP was on encouraging higher agricultural productivity to ensure that consumers had a stable supply of affordable food and that the EU had a viable agricultural sector.

The high budgetary costs, the distortion of some world markets and the increasing concerns about the environmental sustainability of agriculture called for a strong reform of the CAP. For instance, production limits were set to help reduce surpluses (e.g. milk quotas in 1983) and agri-environment measures (AEM) were introduced.

AEM are designed to encourage farmers to protect and enhance the environment on their farmland. Farmers commit themselves, for a five-year minimum period, to adopting environmentally friendly farming techniques. AEM are currently the main instrument for the integration of environmental goals into the CAP. Rural development regulation (107) is quite flexible and allows agri-environmental programmes to be designed at national, regional or local levels. Thus they can be adapted to local or regional farming and environmental conditions, which are very diverse throughout the EU. As a consequence, there is a wide range of AEM in different Member States.

Farmers are no longer paid just to produce food. They have to respect environmental, food safety, phytosanitary and animal welfare standards. The latest CAP reforms confirmed this shift towards increasing environmental concerns. For instance, three priority areas are identified in the CAP:

- biodiversity and the preservation and development of 'natural' farming and forestry systems and traditional agricultural landscapes;
- water management and use;
- dealing with climate change.

This is achieved by:

- targeting aid at rural development measures promoting environmentally sustainable farming practices, like agri-environment schemes;
- enhancing compliance with environmental laws by sanctioning the non-respect of these laws by farmers through a reduction in support payments from the CAP.

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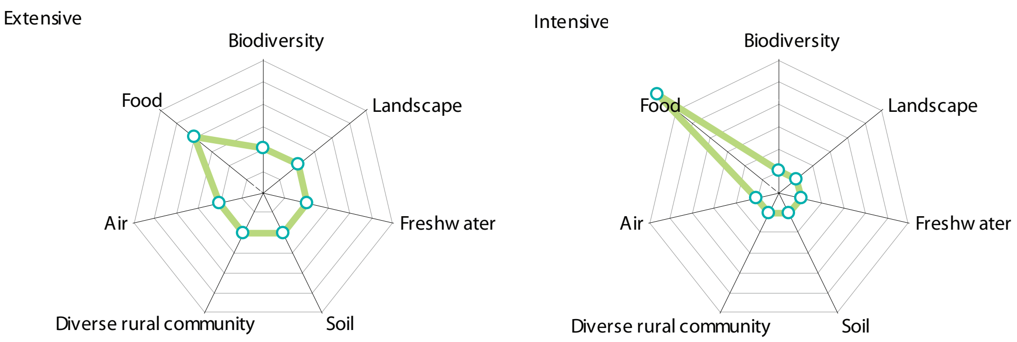
(107) As set out in Council Regulation (EC) No 1698/2005.

Source: 'The common agricultural policy explained' (European Commission, Agriculture and Rural Development DG, http://ec.europa.eu/agriculture/envir/).

Figure 8.1: Agriculture type and trade-offs of ecosystem service provision.



NB: Adapted from: 'The economics of ecosystems and biodiversity — TEEB for national and international policymakers', Chapter 1, p. 22.

In order to monitor and potentially reduce the negative impact of agriculture on the environment, several policy documents (5) have stressed the need for integrating environmental concerns into the common agricultural policy (CAP), and the successive reforms of the CAP have acted in that direction (see box).

These developments of the CAP call for tools to measure the evolution of agricultural production systems and land use patterns at regional level and of their effects on the environment. Agri-environmental indicators answer these requirements as they help to depict the relationship between agriculture and the environment.

Measuring interactions between agriculture and the environment

Historical development of agri-environmental indicators (AEI)

In order to answer the need for improved monitoring of the links between agriculture and the environment, the European Commission published two communications (109), which identified a set of 35 AEI, presented an analytical framework for their development, elaborated indicator concepts and identified potential data sources.

To improve, develop and compile the 35 identified indicators at the appropriate geographical level, the IRENA operation ('Integration of environmental concerns into agriculture' policy) was launched in September 2002. This project created 35 indicator fact sheets and a joint report between the directorate-generals involved and the EEA. On the basis of that operation and further discussions, the Commission published another policy document on agri-environment indicators (110).

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(108) The Cardiff European Council (June 1998) — environmental dimension should be integrated in all Community policies; the Helsinki European Council (December 1999) — strategy for integrating the environmental dimension into the CAP; renewed EU sustainable development strategy (European Council June 2006) — reaffirmation that the sustainable development has to be integrated into policymaking at all levels).

(109) Communications from the Commission to the Council and the European Parliament COM(2000) 20 'Indicators for the integration of environmental concerns into the common agricultural policy' and COM(2001) 144 'Statistical information needed for indicators to monitor the integration of environmental concerns into the common agricultural policy'.

(110) Communication from the Commission to the Council and the European Parliament COM (2006) 508 'Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy'.

This document identifies a streamlined set of 28 indicators that should be developed and maintained in the long run.

The 28 AEI are not all ready to be published as there are still a number of limitations to overcome (111) .

This chapter aims at giving a general introduction to the 28 indicators suggested by the communication, as well as presenting detailed data for a subset of the most developed indicators. AEI are classified into four main groups: indicators of farm management practices, indicators of agricultural production systems, indicators of pressure and risk to the environment, and indicators of the state of natural resources.

Even if the positive or negative pictures depicted by most of these indicators can be directly attributed to farmers, it is important to stress that indicator trends are also strongly linked to the general economic context. Indeed, these trends depend not only on internal factors acting directly at farm level (e.g. trends towards specialisation and intensification of agricultural holdings, changing attitudes of farmers and introduction of new technologies) but also on external factors (e.g. international trade patterns, changes in consumer preferences and trends in the access to production factors such as land or labour).

Farm management practices

Farm management practices (112) are decisions and practical measures defining the management of farms. They include input use and production technologies such as crop rotation, soil treatment methods and coverage of soil with vegetation, as well as types and capacities of storage facilities for organic fertilisers. Farm management practices therefore have a direct impact on various soil degradation processes, such as erosion, reduced organic matter content in soil, soil compaction and different types of pollution.

For instance, the best farm management practices enable the preservation and improvement of permanent soil fertility, prevent soil erosion and compaction, increase efficiency in the use of plant nutrients, decrease the risk of environmental pollution by plant protection products and fertilisers and are economically advantageous. In livestock manure, the best practices ensure sufficient storage capacities, to decrease the risk of soil and water pollution. Very small dung pits, dunghills and other storage facilities are indeed forcing farmers to apply manure in an excessive and unplanned manner, regardless of the needs of the plants and environmental conditions.

This set of indicators characterises the management practices in the different Member States, with the aim of pointing out progress towards the sustainability of farming. They help show whether sustainable production methods are applied in the field.

Seven indicators are included in this section, two of which are described in more detail. The general level of development is quite good for this set of indicators, one of them being already operational (energy use) and six being well defined but missing substantial data (farmers' use of environmental advisory services, mineral fertiliser consumption, pesticide consumption, manure storage, soil cover and tillage practices). A short introduction to each indicator not presented in this section is given here.

Farmers' training level and use of environmental farm advisory services: the indicator presents educational levels of holders and managers of agricultural holdings based on completed formal education and agricultural training. Their favourable age and educational structure is one of the biggest factors contributing to more efficient management of agricultural

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(111) The level of development of these indicators differs. Some are already operational, their concepts and measurement are well defined and data are available at national and, where appropriate, at regional levels. Other indicators are well defined but lack regional or harmonised data or their modelling approaches are weak. There are also indicators that still need substantial improvements.

(112) Definition from: H. P. Piorr and U. Eppler (University of Eberswalde) in the framework of the PAIS project (Proposal on agri-environmental indicators), financed by Eurostat (from 2000 to 2004)

holdings, because well-educated, innovative and aware farmers find it easier to adapt to the modern economic circumstances (cost analysis, assimilation of technical progress etc.), environmental considerations (water use, pesticide and fertiliser management) and social conditions (consideration of the rural context, new direct markets etc.).

Mineral fertiliser consumption: this indicator is described in depth in this section.

Consumption of pesticides: this indicator is described in depth in this section.

Energy use: total energy use comprises the direct use of gas oil, petrol and electric energy related to heating and the use of machinery, and the indirect use of energy for the production of mineral fertilisers, farm machinery and buildings. A reduction in total energy use at farm level reduces the environmental impacts of farming.

Soil cover: the indicator presents the share of the year when the arable area is covered by plants or plant residues. The longer an arable area is left without plant or plant residues, the more vulnerable it is to nutrient leaching and to wind and water erosion.

Tillage practices: proper tillage practices, employed separately or in combination with crop rotation, can be very effective in reducing soil losses. Zero tillage is a way of growing crops from year to year without disturbing the soil through tillage. This can increase the amount of water in the soil and decrease erosion. It may also increase the amount and variety of life in and on the soil. This indicator measures the share of arable areas under zero or conservation tillage.

Manure storage: manure is organic matter (from both animal and plants) used as organic fertiliser in agriculture. Animal dung has been used for centuries as a fertiliser for farming, as it improves the soil structure so that it holds more nutrients and water and becomes more fertile. Animal manure also encourages microbial soil activity which promotes the soil's trace mineral supply, improving plant nutrition. It also contains some nitrogen and other nutrients which assist the growth of plants. Responsible storage is necessary to protect the local environment from the harmful effects that 'run off' from manure can have if it is allowed to enter watercourses.

Mineral fertiliser consumption

Fertile soils are rich in nutrients, essential components which play a key role in plant metabolism and growth. Crops take the nutrients they need from the soil, and these nutrients need to be replaced in order for plants to continue their development. Traditional farm management practices replaced the nutrient stocks by practising crop rotations and regular fallow periods, together with the spreading of animal manure. Today, inorganic fertilisers are, together with manure, the main sources used to restore nutrients to the soil and to increase crop yields. Excessive application of nutrients can, however, pose a threat to the environment.

Nitrogen (atomic symbol: N), along with phosphorus (P) and potassium (K), are the primary nutrients considered in fertiliser formulas. Only nitrogen and phosphorous mineral fertiliser are taken into account in this indicator.

Nitrogen is one of the main chemical elements required for plant growth and reproduction. Mineral fertilisers are applied to agricultural soils in a form which can be absorbed by plant roots. Nitrate (NO_3) is an extremely soluble molecule which does not bind or form insoluble compounds with the soil particles or other elements that it encounters when moving through the soil. During heavy rainfall episodes, nitrate is therefore particularly vulnerable to run-off, affecting the quality of surface water, and leaching (113), affecting the quality of groundwater.

Phosphorus is a key element in plants to ensure good rooting, blooming and fruit production. Several phosphate fertilisers can be used to

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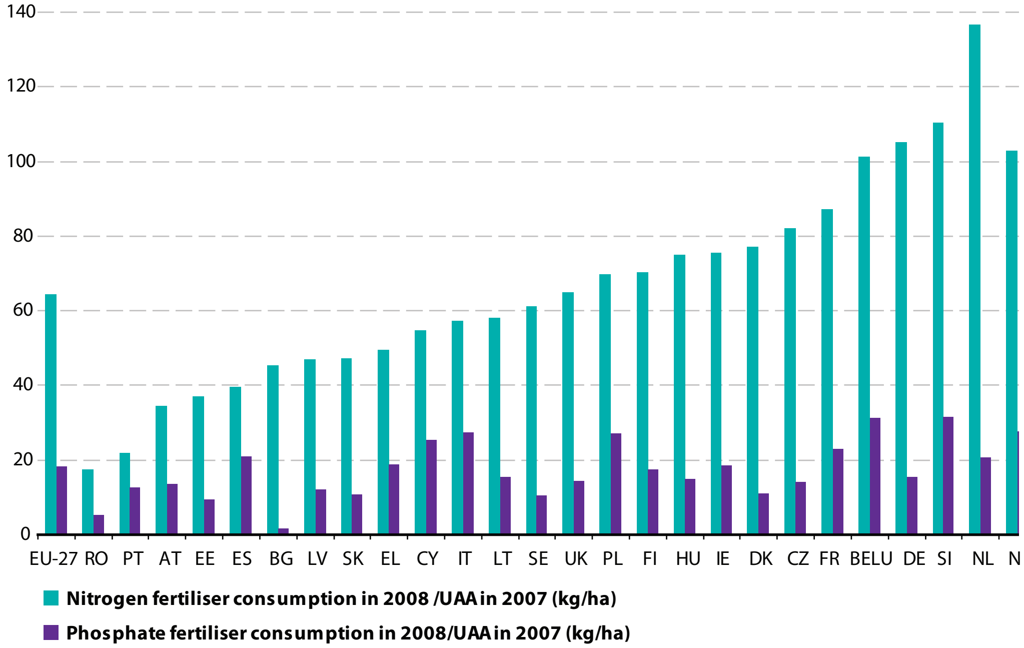
(113) The process of leaching occurs when nitrate is carried beyond the soil root zone by large amounts of percolating water.

meet the phosphorus requirements of crops. In the soil solution, phosphate, unlike nitrate, does not leach easily with the downward movement of water as it binds with soil components. Even though this phosphorus is tightly bound to the soil, downward movement of these materials into the soil profile and potentially to surface water through drainage or lower to ground water can still occur.

The amount of nitrogen and phosphorus from mineral fertilisers applied per hectare of utilised agricultural area is presented here (Figure 8.2). Dividing mineral fertilisers applied by the utilised agricultural area (UAA) allows for a comparison of mineral fertiliser input between countries, but this indicator presents some shortcomings, as it includes UAA which is not fertilised. Moreover, different soils are not equally subject to leaching and run-off, and pollution risks also depend on the type of crop and production yields. A higher fertiliser consumption per hectare of UAA therefore only indicates a higher risk of pollution but not its actual occurrence.

On average, the EU-27 used 64 kg/ha of nitrogen and 18 kg/ha of phosphorus in 2008 (Figure 8.2). Member States have different application rates of nitrogen and phosphorous fertiliser for different crops. In particular, wheat, barley, grain maize, potato, sugar beet, oilseed rape, vegetables and industrial crops have high application rates of N fertiliser. The Netherlands is the country that made the highest use of nitrogen per hectare in 2008 whereas Belgium, Luxembourg and Slovenia used more phosphorus per hectare of UAA than the other Member States.

Figure 8.2: Nitrogen and phosphorous mineral fertiliser consumption, 2008 *(kg/ha UAA)*



NB: UAA data comes from FSS 2007 sample survey, and is combined with estimated fertiliser consumption for 2008.
BELU: Belgium and Luxembourg.

Source: Eurostat (env_ag_fert (10), ef_ov_lusum).

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(114) Note that these data are industry estimates (*source*: EFMA).

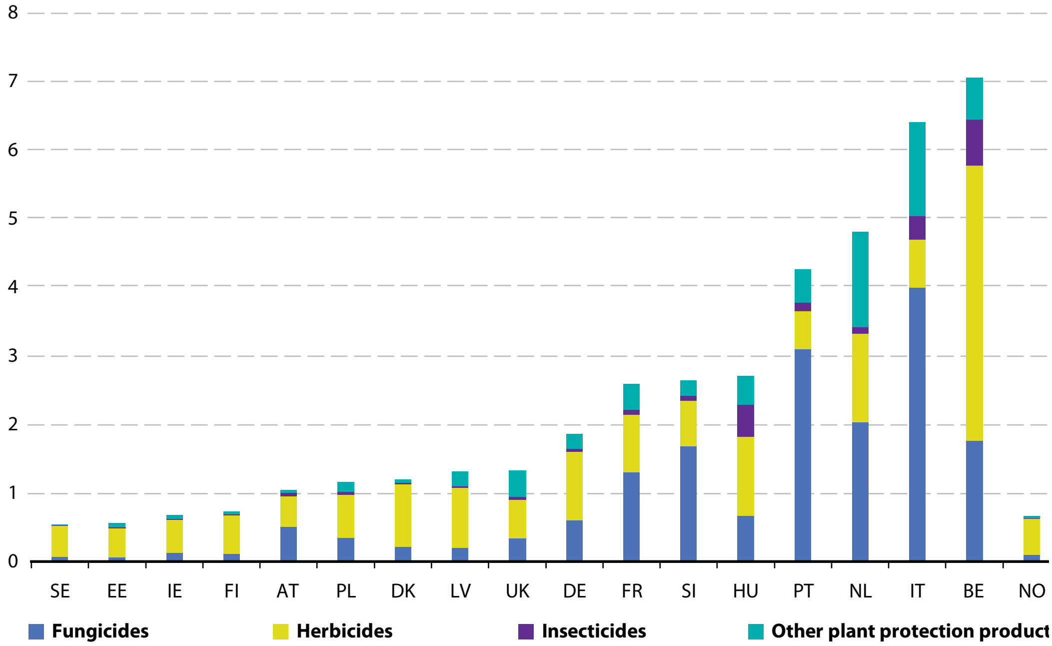
Caution should be taken when analysing the trends of these indicators by Member State as different crops, production systems, climatic conditions and soil types may lead to very different amounts of fertiliser needs. A given quantity of fertiliser applied in very different conditions can therefore either result in full uptake by plant roots or leaching to groundwater. Moreover, mineral fertilisers are not the only form of fertiliser available. Organic fertilisers (i.e. naturally occurring fertilisers, such as manure and slurry) are indeed also used by farmers to provide nutrients. Regions with high livestock densities therefore need less mineral fertiliser than regions where arable cropping dominates.

Indicators such as gross nitrogen balance or risk of pollution by phosphorus are therefore better at allowing meaningful comparisons among Member States by estimating the potential surplus of nutrients applied to the fields. These indicators are briefly described in the section on 'pressures and risks to the environment'.

Pesticide consumption

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. Therefore, depending on the pest in question, the term pesticide refers to insecticides (if the pest is an insect), herbicides (if the pest is another plant), fungicides (if the pest is a fungus) and various other substances used to control pests. In the EU-15 in 2003, fungicides accounted for 52 % of the total pesticide consumption, herbicides represented 34 %, insecticides accounted for 4 % and other plant protection products represented 10 %.

Figure 8.3: Quantities of active ingredients of fungicides, herbicides, insecticides and other plant protection products sold, 2006 *(kg/ha of UAA)*



NB: BE and AT: 2005 data.

Source: Eurostat (env_ag_salpest, ef_ov_lusum)

The use of pesticides plays an important role in agricultural production by ensuring less weed and pest damage to crops and a consistent yield. Their use, however, can have several negative impacts on human health (through pesticide residues in food) and the environment. The main environmental impacts of pesticides are water quality degradation and terrestrial and aquatic biodiversity reduction through toxic effects on non-target species. The contamination of the environment by pesticides may result from spray drift, volatilisation, surface run-off and subsurface loss.

Strongly restricted, DDT is one of the most famous examples of the negative impacts pesticide use can have. DDT is a well-known synthetic insecticide that has been strongly criticised for its persistence along the food chain, accumulation in body fat and toxicity to a wide range of animals in addition to insects. For instance, it is highly toxic to aquatic life, and a reproductive toxicant for certain bird species, and thus a major reason for the decline of several now-endangered birds.

Not all pesticides are as hazardous as DDT. In fact, risks vary from one pesticide to another according to intrinsic characteristics of their active ingredients and use patterns. Use patterns include quantities applied, time and method of application, type of crop and type of soil.

The total quantity of pesticides sold, expressed in kilograms of active ingredient per hectare of utilised agricultural area, is presented here.

Herbicides and fungicides account for the greatest part of the tonnes of active ingredients of pesticides sold in most countries (Figure 8.3). Belgium sells the largest quantities of pesticides per hectare of utilised agricultural area, followed by Italy, the Netherlands and Portugal. Norway, Estonia and Sweden sold the lowest amounts of pesticides per ha of UAA in 2006.

Again, caution should be taken when comparing data between Member States. Climatic conditions and production systems may, for instance, reduce the need for pesticide use and the amount used may vary among different crops and soil types. The indicator of pesticide risk is therefore better at allowing meaningful comparisons among Member States. This indicator is briefly described in the section on 'pressure and risk to the environment'.

Agricultural production systems in the EU

Agricultural production systems are defined as the way crops are grown and livestock are bred, and reflect long-term patterns and trends.

Crop production can, for instance, be performed by monoculture (one cultivar planted on a large acreage several years in a row) or polyculture (intercropping, multiple cropping or rotating crops). This term therefore includes the level of intensification and specialisation of agriculture at farm level, and its dependency on new agricultural chemical technologies (fertilisers and pesticides), mechanisation, plant breeding (hybrids and GMOs) and irrigation systems. It also refers to alternative production approaches such as organic farming.

Eight indicators are included in this section. Six of them are already operational and are described more in depth (cropping patterns, livestock patterns, irrigation, intensification/extensification, specialisation and area under organic farming). The remaining two (agri-environmental commitments and production of renewable energy) are well defined but still need some improvement in data quality. A short introduction to each indicator not presented in this section is given here.

Cropping patterns: this indicator is described in depth in this section.

Livestock patterns: this indicator is described in depth in this section.

Irrigation: this indicator is described in depth in this section.

Intensification/extensification: this indicator is described in depth in this section.

Specialisation: this indicator is described in depth in this section.

Agri-environmental commitments: as previously mentioned in the box, agri-environmental measures are designed to encourage farmers to protect and enhance the environment on their farmland. This indicator measures the share of utilised agricultural area under agri-environmental commitment.

Area under organic farming: this indicator is described in depth in this section.

Renewable energy production: biomass produced by agriculture is a renewable source of energy that is particularly in focus in current and medium-term EU policies. Biomass can be converted into high-quality fuels, such as biodiesel (from vegetable oils), bioethanol (a petrol substitute from starchy and sugary crops) or biogas (from manure and energy crops) that can be used to produce electricity and heat. This indicator measures the share of primary energy from agricultural crops and by-products as a percentage of total energy production.

Cropping patterns

Cropping pattern is defined as the spatial representation of crop rotations, or as the list of crops that are being produced in an area and their sequence in time (Martínez-Casasnovas and Martín-Montero, 2004). Cropping patterns provide insight into environmentally important trends in farming in the European Union. The utilised agricultural area can be divided into three main types of agricultural land use: arable area, permanent grassland and permanent crops. Kitchen gardens are also included by convention in the total utilised agricultural area, even if they only represent small areas in the total UAA.

In the EU-27 in 2007, arable land represented 104 million hectares (60 % of UAA), whereas permanent grasslands represented 57 million ha (33 %) and permanent crops only 11 million ha (6 %) (Table 8.1).

Between 2003 and 2007, the area under permanent crops decreased the most (– 2.20 %), arable land decreased by 0.4 %, whereas permanent grassland increased (+ 0.63 %). Between 2005 and 2007, the area under arable land decreased (– 0.36 %), whereas the area under permanent crops and permanent grassland increased (+ 0.83 % and + 1.44 %, respectively).

Both the repartition of the main land use types and the trends vary widely among Member States. Figure 8.4 shows the repartition of the four components of the utilised agricultural area in each Member State in 2007. It clearly suggests

Table 8.1: Repartition of the three maincomponents of the utilised agricultural area in the EU-27, 2007, 2005 and 2003 *(1 000 ha)* and percentage change between 2007 and 2005, 2007 and 2003 and 2005 and 2003 *(%)*

EU 27 (1 000 ha)	Arable land	Permanent crops	Permanent grassland and meadow
2003	104 792	11 210	56 433
2005	104 717	10 872	55 984
2007	104 341	10 963	56 791
Δ 2005–03 (%)	– 0.07 %	– 3.01 %	– 0.80 %
Δ 2007–03 (%)	– 0.43 %	– 2.20 %	0.63 %
Δ 2007–05 (%)	– 0.36 %	0.83 %	1.44 %

Source: Eurostat (ef_lu_ovcropaa (12).

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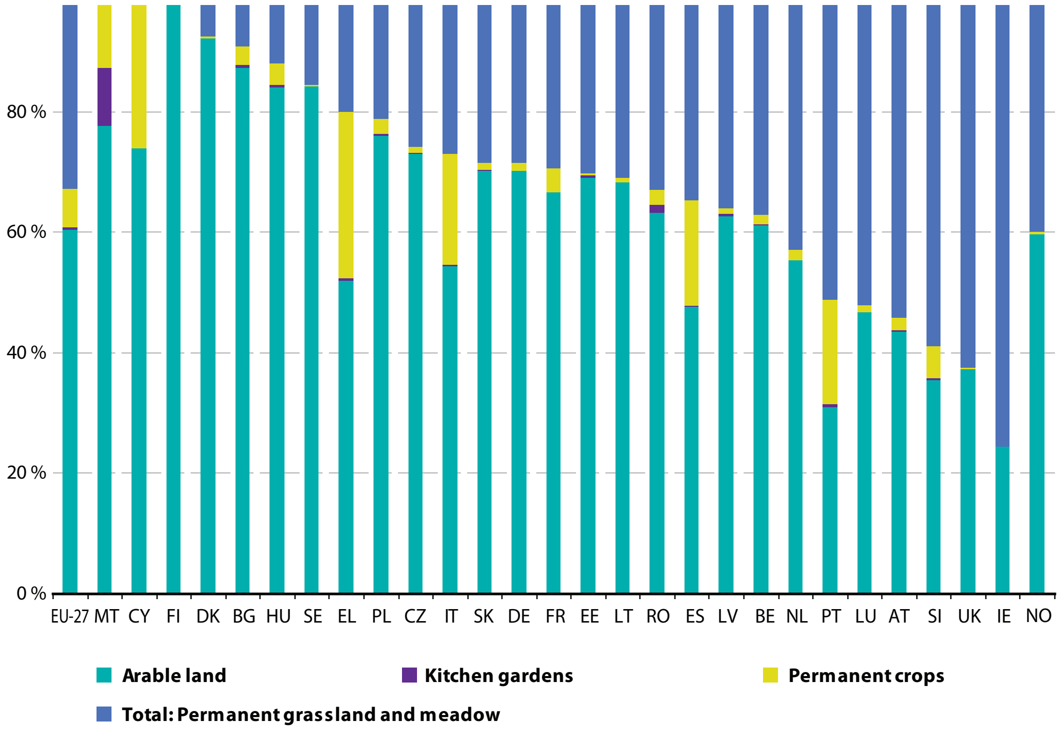
[115] Note that kitchen gardens are non-significant in many countries which therefore do not survey this characteristic.

Figure 8.4: Main agricultural land uses, 2007 *(% of total UAA)*



Source: Eurostat (ef_lu_ovcropaa)

that Mediterranean countries (e.g. Greece, Italy, Spain and Cyprus) have a much larger share of permanent crops than other countries. This can be explained by the favourable climatic conditions of these countries and the commercial importance of permanent crops such as olive trees, vineyards or other fruit trees. Some countries have large areas of permanent grasslands (e.g. Ireland and the United Kingdom, famous for their large sheep flocks), whereas others are characterised by a strong dominance of arable land in their UAA (e.g. Finland or Denmark).

Amongst these major land use types, permanent grasslands are generally considered to be the most important from a landscape and nature conservation perspective. Most of the time, however, this is only true for extensively managed permanent grassland that provides habitats for many wild plants and animal species.

Great reductions in the percentage (i.e. differences in percentage points) of permanent grassland by total UAA occurred between 2003 and 2007 (Figure 8.5) in Lithuania and Slovakia (– 8.1 and – 7.9 percentage points respectively), whereas this percentage increased greatly for Portugal and Bulgaria (+ 11.2 and + 5.5 percentage points respectively). The quality of these grasslands from a landscape and nature conservation point of view can be roughly assessed by looking at grazing livestock densities in these countries.

Figure 8.5: Change in the share of grassland in the total UAA, 2003–07 *(difference in % points)*

Source: Eurostat (ef_lu_ovcropaa)

Livestock patterns

Livestock patterns are defined as the list of livestock that are being grown in an area as well as their numbers and stocking densities. Livestock species are often divided into two categories: grazing livestock (horse, cattle, sheep and goats) and granivores (pigs and poultry). The feeding of the first group uses fodder (grass, hay, silage, etc.) whereas the second group feeds on cereals and pulses.

The intensification of livestock farming, linked to an increase in stocking densities, the use of external feedstuff and the increased stabling of cattle, in particular, exerts significant pressures on the environment. Intensification leads to the abandonment of pastoral practices (i.e. extensive grazing mostly by cattle and sheep), therefore endangering the valued semi-natural agricultural landscapes that were initially created and maintained by these practices. Moreover, intensive livestock farming raises the question of manure storage, nitrate pollution of surface water and emissions of greenhouse gases (e.g. methane).

Dividing total livestock units (LSU) by the utilised agricultural area (UAA) or dividing grazing livestock units by the fodder area (116) (i.e. what grazing livestock feeds on) provides rough estimates of the magnitude of environmental pressure generated by livestock in the different countries (Figure 8.6). In 2007, total livestock density in the EU-27 was 0.8 LSU per hectare of UAA, which represents a decrease of – 5 % compared to 2003. Grazing livestock by fodder area in the EU-27 was slightly more dense, with a density of 1.1 LSU per hectare of fodder area.

Significant differences can be shown between Member States. When looking exclusively at total livestock densities, Malta, the Netherlands and Belgium show densities higher than 2 LSU

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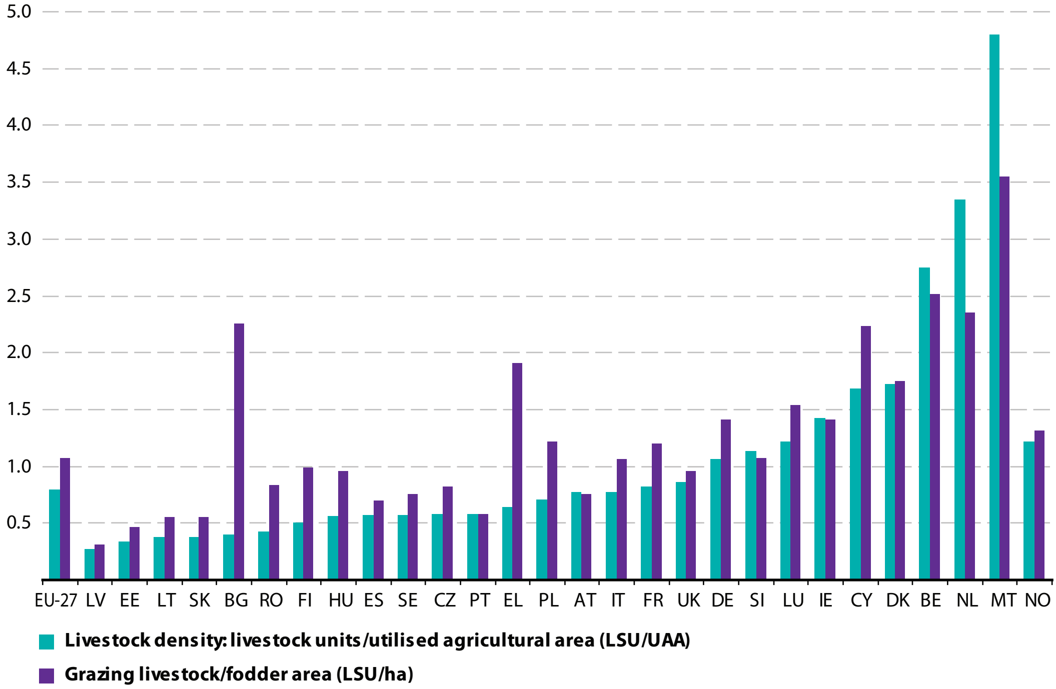
(116) Fodder area includes arable fodder crops and grass, fodder roots and brassicas, forage plants (including temporary grass, green maize, leguminous plants) and permanent grassland and meadows.

Figure 8.6: Livestock density by utilised agricultural area and grazing livestock density by fodder area, 2007 *(LSU/ha of UAA and LSU/ha of fodder area)*



Source: Eurostat (aei_ps_ld, ef_ov_lfst, ef_ls_gzforage)

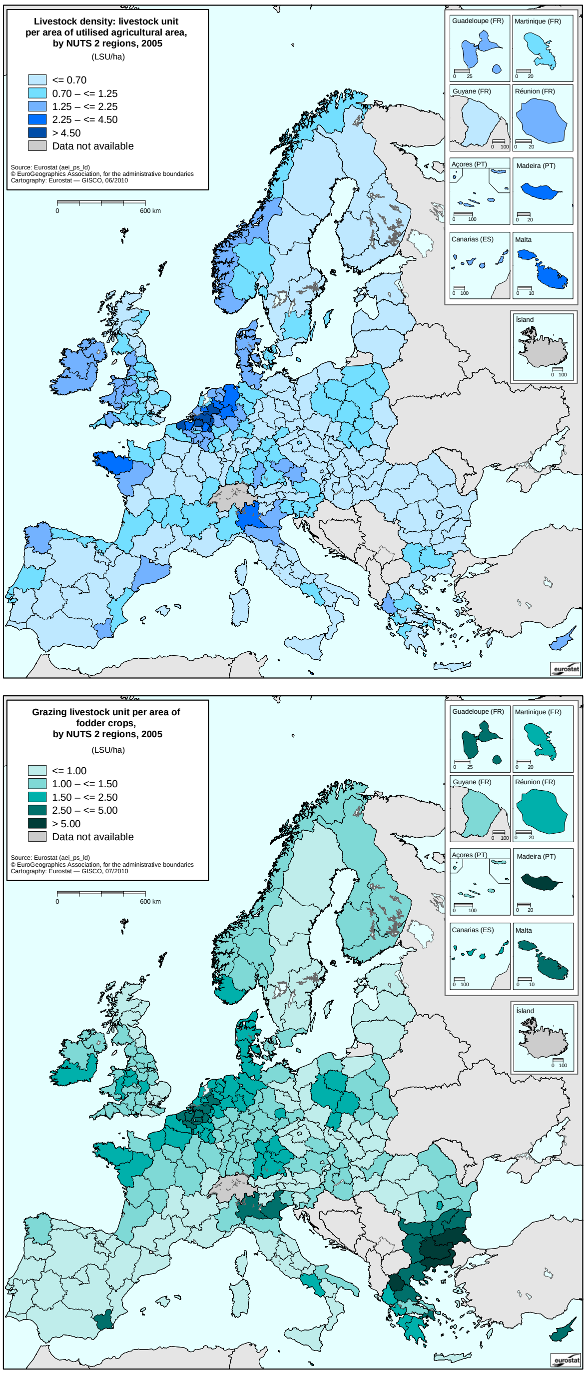
per ha of UAA. This could partly be explained by the fact that pig production is dominant in the Netherlands and in Flanders. The very high livestock density in Malta can be explained by the low share of UAA (10 330 ha) in the total country area (around 30 %).

Grazing livestock densities show quite different trends: countries with high densities are Malta, Belgium and the Netherlands, and also Cyprus, Bulgaria and Greece. Bulgaria and Greece are characterised by livestock densities lower than 0.6 and grazing livestock densities higher than 1.8. The relatively low share of permanent grassland in the total UAA as well as the importance of common and rough grazing in these countries (often not captured in agricultural statistics) might partly explain these patterns (Figure 8.4).

Regional differences in the above trends corresponding to the year 2005 can be observed in the livestock and grazing livestock densities maps (Figure 8.7). For instance, most of Ireland and Wales is characterised by high livestock densities but rather low grazing livestock densities compared to other Member States. This has to be related to the large share of permanent grassland in the UAA of both Ireland and the United Kingdom (see Figure 8.4).

Some regions of Bulgaria and Greece show the opposite trends, presenting high grazing livestock densities and relatively low total livestock densities. Other regions are characterised by high densities of both livestock and grazing livestock (e.g. northern and north-western regions of France, northern Italy).

Figure 8.7: Livestock and grazing livestock densities, NUTS 2 regions, 2005 *(LSU/ha of UAA and LSU/ha of fodder area)*



Source: *Eurostat* (aei_ps_ld)

Irrigation

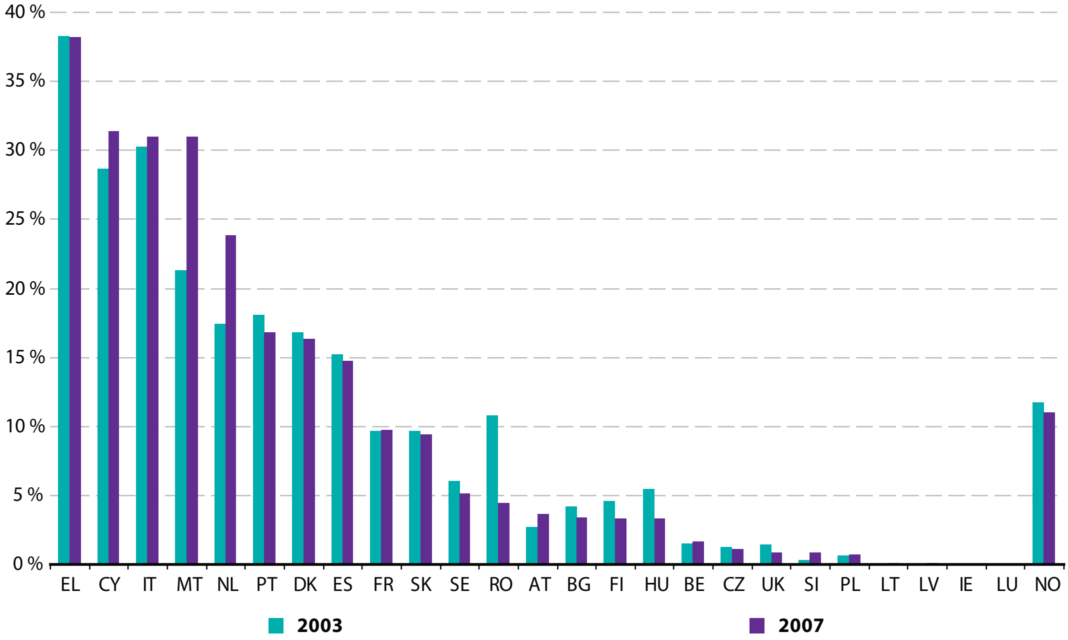
Agriculture is responsible for a large share of water abstraction and use in the European Union (see the chapter on water) and the water use by agriculture has increased over the last few decades. Trends in water abstraction rates depend on different factors: crop selection, irrigation area, irrigation technology, water prices, water restrictions, pumping costs and climate conditions. Farmers may select crops that require more water during the growing season, or that have growth periods more sensitive to soil moisture stress.

Because of these varying factors, irrigated areas change from year to year, and irrigable areas, defined as the total area equipped for irrigation, are instead used to present irrigation trends.

The environmental impact of irrigation is variable but can be very severe, especially in the southern Member States. Across Europe, the main types of environmental impact arising from irrigation are: the combination of over-abstraction of groundwater supplies, salinisation and severe pollution of water by nutrients, pesticides and other farm inputs; soil erosion arising both from intensive irrigation and from the abandonment of formerly hand-irrigated terrace agriculture in the hills; and the desiccation of former wetlands and destruction of former high nature value habitats including arable dryland, low density pastures and sensitive aquatic environments (IEEP, 2000).

Irrigable areas greatly vary among countries mainly because of regional climates (Figure 8.8). Full irrigation is needed in many types of

Figure 8.8 : Irrigable area, 2003 and 2007 *(% of UAA)*



Source: Eurostat (aei_ps_ira, ef_lu_ofirrig, ef_lu_ovcropaa) agricultural production in south European countries (e.g. for growing fruits, vegetables, maize, tomato, olives) and the irrigable area of Greece, Cyprus, Italy and Malta as a percentage of their UAA (respectively, 38.2, 31.4, 31 and 31 % in 2007) is amongst the highest in the European Union. In central and western Europe, irrigation is also used on a supplementary basis to improve crop production in dry summers (e.g. potatoes). This trend is well shown by the relatively high percentage of irrigable area in the Netherlands and Denmark.

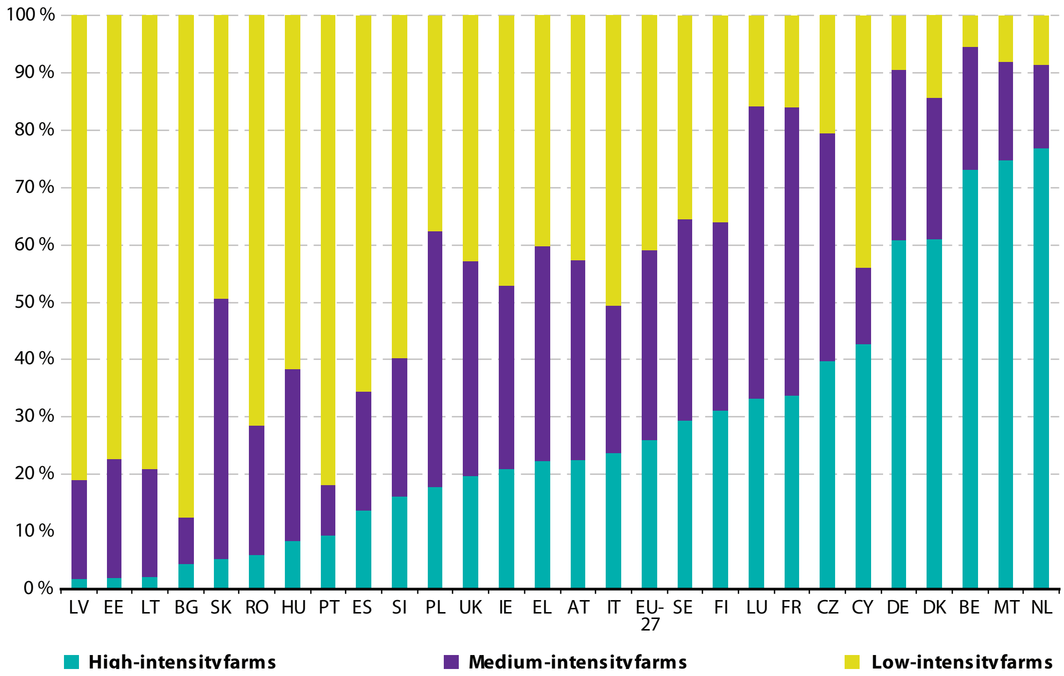
Great increases in percentage of irrigable area between 2003 and 2007 can be pointed out in Malta, the Netherlands and Cyprus, and significant decreases occurred mainly in Romania and to a lesser extent in Hungary.

Extensification/intensification

Intensive farming is an agricultural production system characterised by high inputs of capital or heavy usage of technologies such as pesticides and chemical fertilisers relative to land area, which usually leads to an increase in the level of production per unit of land, livestock unit and agricultural working unit. Intensification has characterised European agriculture for several decades and may result in negative externalities to the environment. Extensive agriculture, on the contrary, involves low inputs of material relative to the area of land farmed.

This indicator measures the share of low-, medium- and high-input farms. Each farm is classified according to the level of input use per hectare, which is calculated on the basis of the spending (in constant euros) on purchased

Figure 8.9 : Share of UAA managed by high-, medium- and low-intensity holdings, 2007 *(%)*



Source: Agriculture and Rural Development DG, EU FADN (Farm Accountancy Data Network).

inputs (i.e. pesticides, fertilisers and animal feed) per hectare of UAA. If it is higher than constant EUR 295 per ha, the farm is qualified as high. When it is below constant EUR 125 per ha, it is classified as low. Otherwise, it is medium.

Figure 8.9 presents the share of UAA managed by high-, medium- and low-intensity holdings in the EU-27 in 2007. On average, in the EU-27, 26 % of the UAA is managed by high-intensity farms while 41 % is managed by low-intensity farms.

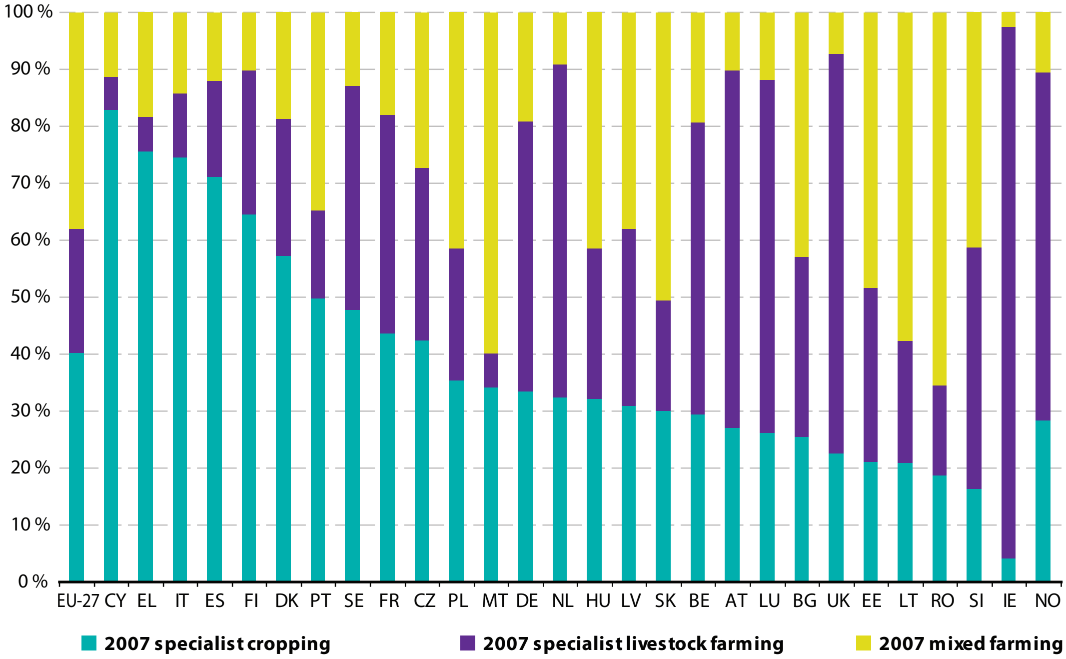
Between 2004 and 2007, the EU-15 showed a very slight but continuous trend towards less intensification: the differences in the share of UAA managed by low-, medium- and high-intensity holdings were respectively + 4, – 3 and – 1 percentage points. The 10 new Member States present an opposite trend as the share of UAA managed by medium- and high-intensity holdings was increasing (respectively + 3 and + 5 percentage points) whereas the share managed by low-intensity holdings was decreasing (– 8 percentage points).

Specialisation

Farm specialisation occurs when a single type of production or service dominates farm income. Examples include a non-specialised livestock farmer ceasing to stock cattle to concentrate on pigs, an arable farmer reducing the number of different crops to specialise in cereals and sugar beet, or a mixed farm ceasing to stock livestock altogether.

Change in land use towards less diverse cropping or livestock patterns that can be associated with specialisation (due to a stronger concentration of the production on a limited number of products) might have negative environmental impacts. These impacts might, for instance, be a

Figure 8.10: Specialist cropping, specialist livestock farming and mixed farming, 2007
(% of total holdings)



Source: Eurostat (aei_ps_sm)

loss of diversity in farmland habitats, associated flora and fauna, and crop varieties and livestock breeds (overall reduction of genetic diversity). It is important to note that not all specialised systems present negative impacts on the environment. For instance, extensive cattle or sheep grazing in mountainous parts of the European Union can be highly specialised but have a positive impact on the conservation of high-value European habitats and associated biodiversity.

Mixed farming, which combines crop and livestock farming, is often seen as less detrimental to the environment. This can, for instance, be illustrated by the generally favourable nitrogen balance in mixed farming systems (manure returns to the area where animal feed has been produced).

In 2007, in the EU-27, 40 % of the agricultural holdings (excluding non-classifiable holdings) were specialised in cropping (i.e. field crops, horticulture or permanent crops) and 22 % in livestock (i.e. grazing livestock or granivores), while 38 % were specialised in mixed farming (i.e. mixed cropping, mixed livestock or mixed crops/livestock) holdings (Figure 8.10). These percentages vary greatly between countries. Some 93 % of Irish holdings are specialists in livestock whereas 83 % of Cypriot holdings are specialists in cropping. The countries with the biggest share of mixed farming holdings are Romania and Malta (65 % and 60 % respectively).

Area under organic farming

Organic farming can be defined as a method of production which places the highest emphasis on environmental protection and animal welfare considerations. Organic farming (117) involves holistic production management systems for crops and livestock, emphasising the use of on-farm management practices in preference to the use of off-farm inputs. This is accomplished by using cultural, biological and mechanical methods in preference to synthetic chemical inputs such as fertilisers, pesticides (fungicides, herbicides and insecticides), additives and medicinal products.

Environmental concerns about sustainability coupled with growing consumer interest in food safety have resulted in many agricultural holdings converting to certified organic production methods. In 2008, just over 4.5 % of the utilised agricultural area (UAA) in the EU-27 was classified as total organic areas (including both fully converted areas and areas under conversion), ranging from 15.9 % in Austria and 10.8 % in Sweden to below 2 % in Ireland, Romania and Bulgaria (Figure 8.11).

The overall percentage of UAA occupied by organic farming has increased from 2007 to 2008 in the EU-27 and in all Member States, except in Italy and France (decrease in percentage points of – 15.3 and – 2.3 %). This increase is greatest for Greece, Slovakia, Bulgaria and Spain (changes of + 12.0, + 16.2, + 22.6 and + 23.3 %, respectively).

Indicators of pressures and risks to the environment

The significant interactions between agriculture and the environment have already been mentioned many times in this chapter. The magnitude of these interactions is partially defined by the farm management practices and agricultural production systems introduced earlier. Agriculture has a significant impact on soil, air, water, biodiversity and landscapes.

This set of indicators aims at tracking the threats posed to the environment by farming. These threats can be linked to land use, input use including nutrients (e.g. fertilisers, manure), pesticides and emissions in water and air. Nine indicators are included in this section, of which two are already operational and are described in more detail. Four of them are well defined but still lacking data (land use change, gross

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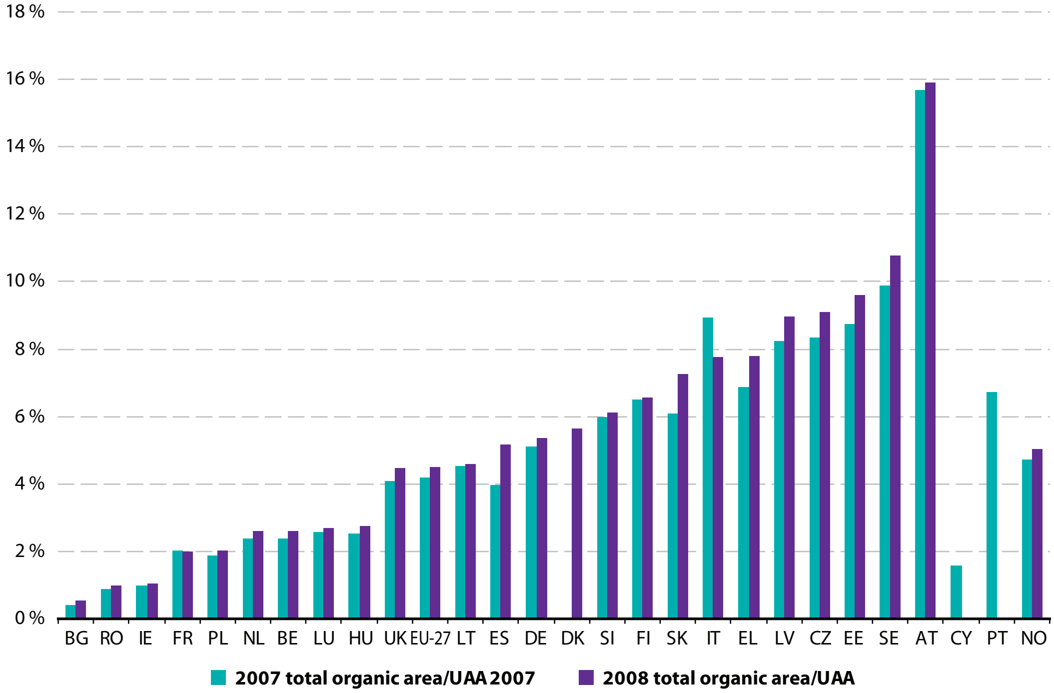
(117) In the EU, farming is only considered to be organic if it complies with Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products.

Figure 8.11: Total organic area (fully converted area and area under conversion), 2007 and 2008
(% of UAA)



NB: EU-27 estimates. No data available for Denmark (2007), Cyprus and Portugal (2008).

Source: Eurostat (food_in_porg1, ev_ov_lusum)

nitrogen balance, risk of pollution by phosphorus and water abstraction). The remaining three still need substantial improvements in order to become operational (risk of land abandonment, pesticide risks and soil erosion). A short introduction to each indicator not presented in this section is given here.

Land use change: conversion of agricultural land to artificial surfaces (i.e. soil sealing) can have several environmental impacts on soil, water and biodiversity resources. The sealing may increase the risks of soil erosion and water pollution. It also disturbs agricultural habitats, impacts on animal migration patterns due to habitat fragmentation and affects the hydrological cycle (increased water run-off and decreased water retention), leading to an increased risk of floods. In addition, it affects the aesthetic value of agricultural landscapes and increases their fragmentation, which can result in more noise and emissions due to increased traffic levels. This indicator measures the share of agricultural area that has been sealed compared to a reference period.

Risk of land abandonment: land abandonment is traditionally defined as the abandonment of exploited agricultural landscapes which are left to their own spontaneous dynamics. This abandonment leads to a loss of landscape diversity and related loss in biodiversity and to an increasing vulnerability to fires and, in some cases, soil erosion. This arises from a regrowth of various shrubs and eventually woodland vegetation on

abandoned agricultural land, which suppresses biodiversity-rich grasslands and leads to an increased fire risk in Mediterranean areas. The reasons for and consequences of land abandonment are very diverse across the EU, ranging from difficult economic conditions to demographic factors.

Gross nitrogen balance: gross nitrogen balance relates to the potential surplus of nitrogen on agricultural land. This is estimated by calculating the balance between nitrogen added to an agricultural system and nitrogen removed from the system per hectare of agricultural land. A persistent surplus indicates potential environmental problems; a persistent deficit indicates potential risk of decline in soil nutrient status.

Risk of pollution by phosphorus: this indicator relates to the potential surplus of phosphorus on agricultural land. This is estimated by calculating the balance between phosphorus added to an agricultural system and phosphorus removed from the system. A persistent surplus indicates potential environmental problems.

Pesticide risk: the term ‘pesticides’ is a generic name that encompasses all substances or products that kill pests. Plant protection products (PPPs), the pesticides used in agriculture, are part of the modern agricultural production system and are used to control occurrence of weeds, insects and diseases prejudicial to crop production, and to minimise labour requirements. They are also used for regulating vegetative crop growth. The risk linked to the use of PPPs is highly dependent on their inherent properties (degradation pathways), on environmental conditions including soil temperature and moisture content and on farm management practices (e.g. application rates). This indicator measures the index of risk of damage linked to PPPs from pesticide toxicity and exposure.

Ammonia emissions: this indicator is described in depth in this section.

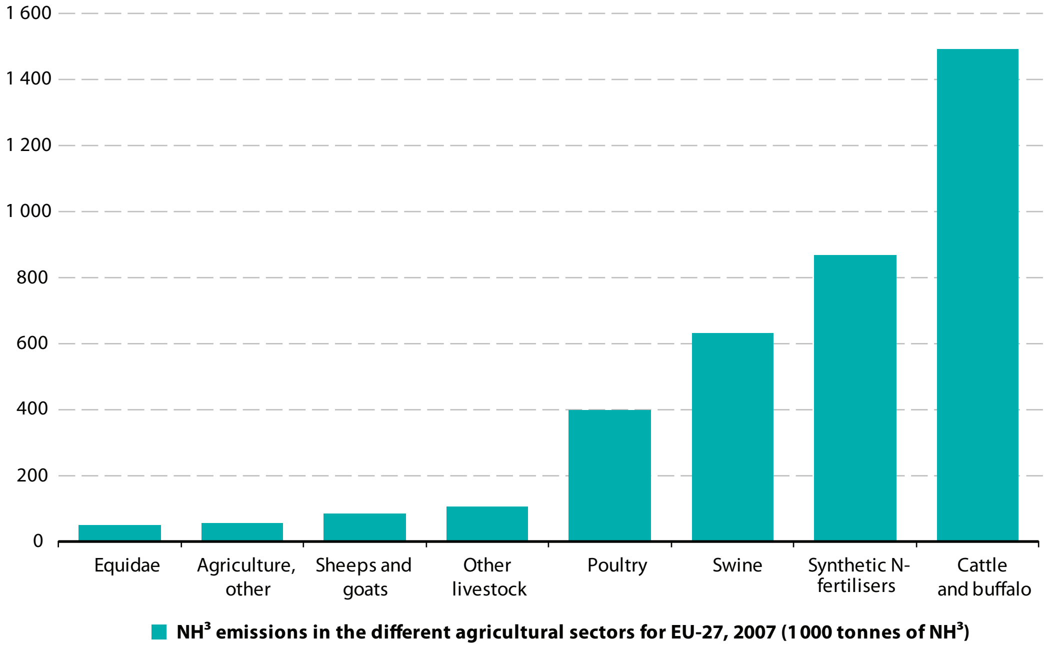
Greenhouse gas emissions: this indicator is described in depth in this section.

Water abstraction: irrigation represents the primary use of water in agriculture. Trends in water abstraction rates depend on different factors: crop selection, irrigation area, irrigation technology, water prices, water restrictions, pumping costs and climate. The environmental impact of increasing water demand can result in declining groundwater levels and the need to build more and larger water reservoirs. In some instances, major water diversion structures are necessary to supply water to irrigation schemes. The diversion or retention of water for irrigation can have serious downstream effects on the environment, especially the drying up of wetland areas. This indicator evaluates the contribution of agriculture to water abstraction by measuring the share of agriculture in water use.

Soil erosion: soil erosion is a natural process that has been accelerated mostly by human activities. Soil erosion may occur when physical agents (mainly water and wind) remove the topsoil by run-off from the land. Erosion by water is a widespread problem throughout Europe whereas wind erosion prevails in some parts of western Europe and central and eastern Europe. By removing the most fertile topsoil, erosion reduces soil productivity and, where soils are shallow, may lead to an irreversible loss of natural farmland. Severe erosion is commonly associated with the development of temporary or permanently eroded channels or gullies that can fragment farmland. Erosion rate is very sensitive to both climate and land use.

The Mediterranean region is particularly prone to erosion because it is subject to long dry periods followed by heavy bursts of erosive rain, falling on steep slopes with fragile soils. This is in contrast to north-western Europe where soil erosion is less prevalent because rain falls on mainly gentle slopes and is evenly distributed throughout the year. Consequently, the area affected by erosion is less extensive than in southern Europe. This indicator calculates the area with a given level of erosion risk.

Figure 8.12: NH_3 emissions from different agricultural sources, EU-27, 2007 *(1 000 tonnes of NH_3)*



Source: EEA (NEC_NFR08_v5_GF)

Ammonia emissions

Ammonia (NH_3) is naturally found in trace quantities in the atmosphere. It is produced by the decay of animal excrement and vegetable matter. When deposited in water and soils, ammonia can potentially cause two major types of environmental damage, acidification and eutrophication, both of which have negative impacts on sensitive vegetation systems and water quality.

In Europe, ammonia emissions mainly occur as a result of volatilisation from livestock excretions (more particularly from cattle, buffalo and swine). A smaller fraction of ammonia emission is due to the volatilisation of ammonia from nitrogenous fertilisers (Figure 8.12). The agricultural sector remains responsible for the vast majority of ammonia emissions within the EU, as agriculture contributes to over 90 % of the total ammonia emissions in most EU countries.

In order to reduce ammonia emissions and to provide protection for the environment, the European Union has set national emission ceilings in Directive 2001/81/EC (118) to be reached by 2010. The purpose of these ceilings is to reduce the areas with critical loads of acid deposition by at least 50 % compared with 1990 (see the chapter on air emissions).

Figure 8.13 presents NH_3 emissions from agriculture in 1990 (reference year) and 2007, as well as emission ceilings as mentioned in Annex I to Directive 2001/81/EC.

Member States show varying trends that are mainly linked to livestock production levels or livestock numbers as well as agricultural practices (e.g. intensive use of nitrogenous fertilisers).

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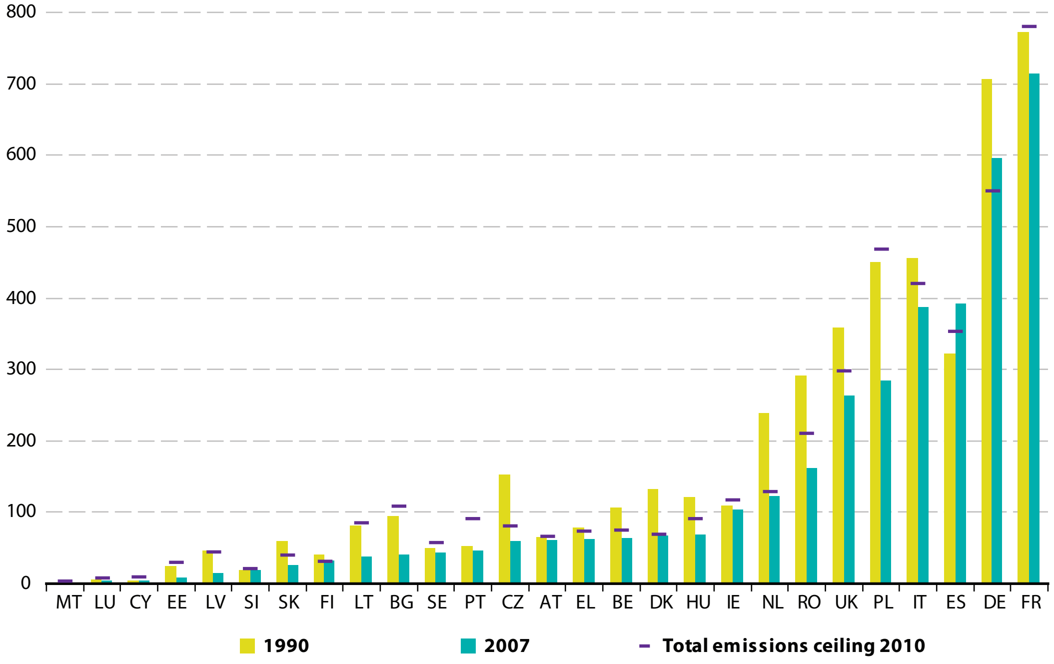
(118) Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants.

Figure 8.13: NH_3 emissions from agriculture, 1990 and 2007, and emission ceilings as mentioned in Annex I to Directive 2001/81/EC *(1 000 tonnes)*



Source: EEA (AP_Gapfill_v6; NEC_NFR08_v5_GF)

Most countries have decreased their ammonia emissions from 1990 to 2007, and most of them (all but Spain and Germany) are below their 2010 emission ceilings. Spain has seen a large increase in emissions, which can be explained by an increase in livestock numbers.

Greenhouse gas emissions

Climate change represents one of the greatest environmental, social and economic threats facing the planet. The European Union is actively working towards a global agreement to control climate change. This process is attributed to a build-up of greenhouse gases (GHG) emitted by human activities, which trap the sun's heat in the atmosphere in the same way as the glass of a greenhouse. Six main greenhouse gases are monitored: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and three fluorinated gases: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

Globally, soil is the biggest terrestrial carbon pool. Soils contain around twice the amount of carbon in the atmosphere and three times the amount to be found in vegetation. The decay of soil organic matter results in the release of greenhouse gases, mainly CO_2, into the atmosphere. Thus, preserving existing carbon stocks in the soil and fighting the depletion of humus (the most stable share of soil organic matter) are of utmost importance for our environment.

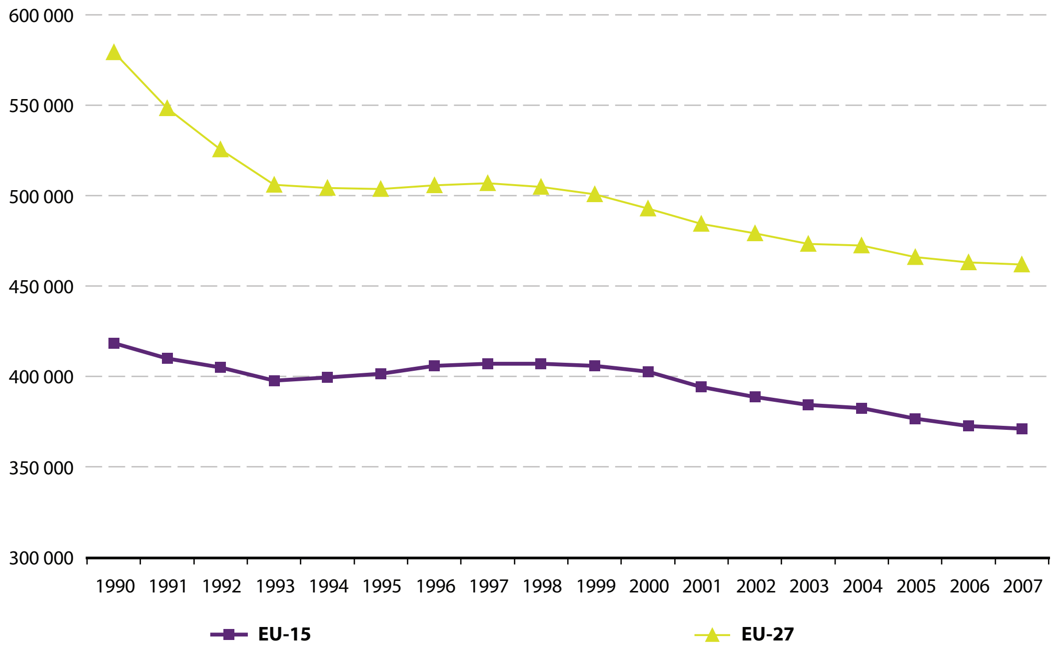
According to UNFCCC emissions reporting, the sources of greenhouse gases from agriculture are: enteric fermentation (fermentation that takes place in the digestive systems of ruminant animals, i.e. cattle, buffalo, sheep); anaerobic decomposition of manure; rice cultivation; agricultural soil management; prescribed burning of savannahs; and field burning of agricultural residues that produce CO_2, but mainly CH_4 and N_2O. Agriculture is therefore a major source of non-CO_2 greenhouse gases, which are many times more powerful (119) than CO_2.

Several farm management practices can potentially reduce GHG emissions. They include, for instance, the decrease in fertiliser use and the application of organic matter to stabilise and increase the soil organic matter content, control of manure management systems to reduce the extent of anaerobic decomposition, improved animal productivity and rumen efficiency or a control of the anaerobic digestion by capturing the methane produced and using it for heating purposes.

The drainage of peatlands and the conversion of grasslands to croplands result in large emissions of greenhouse gases. These emissions, together with an overall depletion of soil organic content in agricultural lands, are a serious threat to soil fertility and a further boost to climate change. To ensure that soils can sustain their functions and provide many vital ecosystem services, the European Commission aims at achieving an effective soil protection policy in Europe through the adoption and implementation of a soil framework directive.

In absolute amounts, the EU-27 agricultural sector produced 462 217 thousand tonnes of CO_2 equivalents of greenhouse gases in 2007, which represented 9 % of the total greenhouse gas emissions of the EU-27. A reduction of 20.2 % can

Figure 8.14: Evolution of the greenhouse gas emissions from agriculture *(1 000 tonnes CO_2 equivalents)*



Source: IPCC, available on the EEA website (UNFCCC_v10 database).

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(119) The level of 'power' of a greenhouse gas is determined according to its effectiveness at absorbing infrared radiation (heat) and trapping it into the atmosphere.

be observed compared to 1990 (Figure 8.14). It should be noted that these numbers only take into account emissions from animal enteric fermentation, manure management, rice cultivation, agricultural soils and burning of agricultural residues. They do not take into account emissions coming from land use and land use changes (see the example of peatlands and conversion of grassland to cropland above), neither do they account for emissions from agricultural machinery or fertiliser production.

The largest decrease in emissions occurred between 1990 and 1993. This decreasing trend can mainly be attributed to reductions in livestock numbers in the new Member States after the strong political and economic changes that occurred in the early 1990s and to changes in manure management.

The state of natural resources in agricultural areas

The indicators of the state of natural resources aim at monitoring the extent of agriculture's impact on the environment, including soil and water quality, biodiversity, habitats and landscape.

Height indicators are grouped in this section but only one of them (the farmland bird index) is already operational. Three indicators are well defined but data is not available: agricultural areas under Natura 2000, water quality (pesticide pollution) and water quality (nitrate pollution). The other four still need substantial improvement in order to become operational (genetic diversity, high nature value farmland, soil quality and landscape state and diversity). A short introduction to each indicator is given here.

Agricultural areas under Natura 2000: traditional agricultural practices have shaped the landscape and habitat types of Europe over centuries, and many of the semi-natural habitat types in Europe are dependent on the continuation of appropriate farm management. The conversion of extensive farming systems into intensive high-input farm management as well as land abandonment are both threatening many semi-natural habitat types and their biodiversity. Conservation areas, designated by Member States, aim at preserving habitats and species that are of Community interest (120) and constitute the so-called Natura 2000 network in the EU (see the chapter on biodiversity and land use for more information).

Extensive agricultural habitat types can be found inside many Natura 2000 sites. Agricultural use can continue inside the sites as long as no damaging activities are exerted on species of Community interest. This indicator measures the share of the utilised agricultural area that is included in the Natura 2000 network.

Across the EU-15, targeted agricultural Natura habitat types (121) represent about 18 % of the terrestrial part of the Natura 2000 network. This means that 15–20 % of the EU-15's Natura 2000 area depends on a continuation of extensive farming practices, such as, for example, haymaking or extensive sheep grazing.

High nature value farmland (HNV): HNV farmland comprises the hot spots of biological diversity in agricultural areas. They are often characterised by extensive farming practices, associated with a high species and habitat diversity or the presence of species of European conservation concern. They are often classified into three types: farmland with a high proportion of semi-natural vegetation; farmland dominated by low-intensity agriculture or a mosaic of semi-natural and cultivated land and small-scale features; and farmland supporting rare species or a high proportion of European or world endangered populations.

The approximate distribution of HNV farmland is described in a joint analysis of the EU Joint Research Centre (JRC) and the European Environment Agency (EEA), although further work on this indicator is required. Most HNV farmland is located in southern and eastern Europe

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(120) See the habitats directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) that complemented the birds directive of 1979 (Council Directive 79/409/EEC on the conservation of wild birds).

(121) The targeted agricultural habitat types are for the purpose of this indicator defined as the habitats in Annex 1 to the habitats directive that depend on a continuation of extensive farming practices.

as well as in central and north-west European mountainous areas. When expressed as area share of farmed land (as derived from Corine Land Cover), the highest percentage shares are found in Austria, Cyprus, Spain, Greece, Portugal and Slovenia (ranging from about 54 % to about 78 %). The average estimated for the EU-27 (excluding Malta) is 32 % in the year 2000 (JRC and EEA, 2008).

Population trends of farmland birds: farmland birds are a barometer of change for the biodiversity of agricultural landscapes in Europe. This indicator is an aggregated index of population trend estimates of a selected group of 36 breeding bird species dependent on agricultural land for nesting or feeding. Assuming a close link between the selected bird species and the farmland habitat, a negative trend indicates that the farmed environment is becoming less favourable to birds.

Even if population trends among farmland birds at country level vary considerably among Member States, farmland birds have suffered a great decline overall. These trends are explicitly discussed in the chapter on biodiversity and land use.

Genetic diversity: this indicator refers to the genetic diversity of livestock breeds and crop varieties in agriculture. This diversity is part of the three levels of biodiversity (see the chapter on biodiversity and land use). The modernisation of agriculture has led to a reduction in the number of species used due to a concentration of agricultural production on particular high-yielding livestock breeds and crop varieties. This trend can lead or has already led to the erosion of the genetic diversity of some species, making them more vulnerable to certain parasites and/or environmental changes. Efforts are being made to invert this trend and grow once-common old crop varieties and livestock breeds in Europe.

Soil quality: this is defined as the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries, to sustain plant and animal productivity, to maintain or enhance water and air quality and to support human health and habitation. Indicators linked to soil quality are, for instance, soil productivity (i.e. the capacity of soil for agricultural biomass production), fertiliser response rate (i.e. input needed to attain optimal productivity), soil environmental quality (i.e. carbon storage, filtering, buffering) and production stability (i.e. the soil's response to annual climatic variability).

Water quality — nitrate pollution: when significant surpluses of nitrates are applied on the field, nitrates can be found in run-off from the land and end up in rivers and groundwater bodies, affecting water quality for human consumption and contributing to river eutrophication. Eutrophication overstimulates the growth of algae, therefore creating conditions that interfere with the health and diversity of indigenous fish, plant and animal populations. The water quality status of European water bodies with regard to nutrients has deteriorated considerably over the last few decades, and agriculture is one of the main sources of nitrate pollution. Key indicators for nutrient losses from agriculture are the use of fertilisers, livestock density and farm management practices that have all been explained earlier in this chapter.

Water quality — pesticide pollution: pesticides are used to control pests, weeds and diseases and therefore contribute to agricultural productivity. However, not all pesticides are fully degraded after agricultural (or other) use, and remains of pesticides are found scattered in the environment, particularly in groundwater. This raises concerns, as any pesticide which is off-target is a pollutant that can be potentially harmful to humans and the environment, depending on the toxicity of the active substance. There is limited information available on pesticide contamination and a lack of reliable and comparable data. Therefore considerable development still needs to be undertaken before defining appropriate indicators to measure pesticide pollution.

Landscape — state and diversity: landscape state is the result of a variety of actions and interactions involving human activities and the environment. Farmers play a crucial role in changing but also maintaining landscapes. This

agri-environmental indicator of landscape state focuses on the role of agriculture in maintaining landscapes and describes their characteristics and variety in Europe. Due to the great European variety of agricultural landscapes that reflect differences in biophysical conditions, farm management practices and cultural heritage, one single indicator cannot capture all the complexity and multiple functions of European landscapes. Thus a range of landscape parameters linked to agricultural land use are being developed as sub-indicators.

Conclusions: European agri-environmental indicators

Society's expectations of agriculture have evolved over the last few decades, and European farming has changed considerably to meet these new expectations. Technological developments have allowed farms to increase yields, but this has had important consequences on the environment. Changes in land use and farming practices, linked to specialisation and intensification, have, for instance, been associated with negative impacts on water, soil, air, biodiversity and habitats.

Statistical information on agriculture therefore no longer only covers production data and farm trends but should also reflect the new challenges faced by agriculture: the reduction of agricultural pressures on the environment, and the delivery of environmental services by farming.

A set of 28 agri-environmental indicators (AEI) has been developed to capture the main positive and negative effects of agriculture on the environment and to reflect regional differences in economic structures and natural conditions. These indicators cover farm management practices, agricultural production systems in the EU, pressures and risks to the environment and the state of natural resources.

Several indicators look into the relative intensification/extensification and specialisation of European agriculture. Information on such processes is, for instance, provided by the share of utilised agricultural area managed by high-intensity farms (26 % in the EU-27 in 2007), the share of specialised holdings (62 % in the EU-27 in 2007) or the use of mineral fertilisers (64 kg/ha and 18 kg/ha of nitrogen and phosphorus respectively for the EU-27 in 2008). However, the evolution over time of these figures must be investigated in greater depth in order to reflect the actual trends. For instance, it appears that the old EU Member States experienced a relative extensification over the 2004–07 period, while farming intensified in the new Member States on the other hand.

A reduction of environmental pressure by the agricultural sector is shown by some indicators. Areas fully converted or under conversion to organic farming are growing and covered more than 4.4 % of the utilised agricultural area of the EU-27 in 2008. Most countries are below their national emissions targets for ammonia from agriculture due to reductions in emissions from 1990 to 2007 and greenhouse gas emissions from agriculture have seen a constant decline from 1990 onwards. Despite improvements in some areas, 26 % of species are threatened by pesticides and fertlisers like nitrates and phosphates.

For some indicators, significant differences were pointed out among Member States or among regions. This is, for instance, the case for the reduction in permanent grassland area, livestock densities or grazing livestock densities as well as irrigable areas. These indicators reflect the high variety of European agricultural systems that depend on abiotic conditions (climate, soil quality etc.).

There are many challenges ahead in terms of improving datasets, spatial referencing and ensuring the timely delivery of indicators to policymakers, and it is important to overcome the limitations that currently restrict the information potential of certain indicators. To this end, efforts are being made towards the conceptual and methodological improvement of these indicators and for the collection of the necessary data or better access to existing data.

Further information

Eurostat main tables and database

Database by themes; Environment and energy, Environment (env); see Agriculture and Environment (env_agri)

Database by themes; Agriculture, forestry and fisheries; see: Agri-environmental indicators (aei)

Tables by themes; Agriculture, forestry and fisheries; see: Agriculture (t_agri)

Tables by themes; Environment and Energy; Environment (t_env); see Area under agri-environmental commitment (tsdpc430).

Tables by themes; Environment and Energy; see Agriculture and environment (t_env_agri)

Eurostat dedicated section

Agri-environmental indicators: http://epp.eurostat.ec.europa.eu/portal/page/portal/agri_environmental_indicators/introduction

Further reading

EEA, 'Source apportionment of nitrogen and phosphorus inputs into the aquatic environment', EEA Report No 7/2005, Office for Official Publications of the European Communities, Luxembourg, 2005, p. 48 ISBN 92-9167-777-9 http://www.eea.europa.eu/publications/eea_report_2005_7

IEEP, Polytechnic University of Madrid and University of Athens, 'A report to the environment directorate of the European Commission: the environmental impacts of irrigation in the European Union', 2000, p. 138 http://ec.europa.eu/environment/agriculture/pdf/irrigation.pdf

JRC/EEA (Paracchini, M. L., Petersen, J.-E., Hoogeveen, Y., Bamps, C., Burfield, I. and van Swaay, C). 'High value nature farmland — An estimate of the distribution patterns on the basis of land cover and biodiversity data', Office for Official Publications of the European Communities, Luxembourg, 2008, p. 87, ISSN 1018-5593. ISBN 978-92-79-09568-9 http://agrienv.jrc.ec.europa.eu/publications/pdfs/HNV_Final_Report.pdf

Martínez-Casasnovas, J. A., Martín-Montero, A. 'Application of Landsat TM images to map long term cropping patterns', University of Lleida, Lleida, Spain, 2004 http://www.macaulay.ac.uk/workshop/remotesensing2004/JAMC_Full_paper.pdf

UNEP, 'Freshwater in Europe — Facts figures and maps', United Nations Environment Programme/DEWA, 2004, p. 92 http://www.grid.unep.ch/product/publication/freshwater_europe.php

See also

Agriculture and Rural Development DG

http://ec.europa.eu/agriculture/envir/index_en.htm

Environment DG

http://ec.europa.eu/environment/agriculture/index.htm

European Environment Agency (EEA), agriculture theme

http://www.eea.europa.eu/themes/agriculture

European Environmental Bureau (EEB)

http://www.eeb.org/index.cfm/activities/biodiversity-nature/agriculture/

FADN public database (Agriculture and Rural Development DG)

http://ec.europa.eu/agriculture/rica/database/database.cfm

IRENA factsheets

http://www.eea.europa.eu/projects/irena/products

Joint Research Centre

http://agrienv.jrc.ec.europa.eu/index.htm

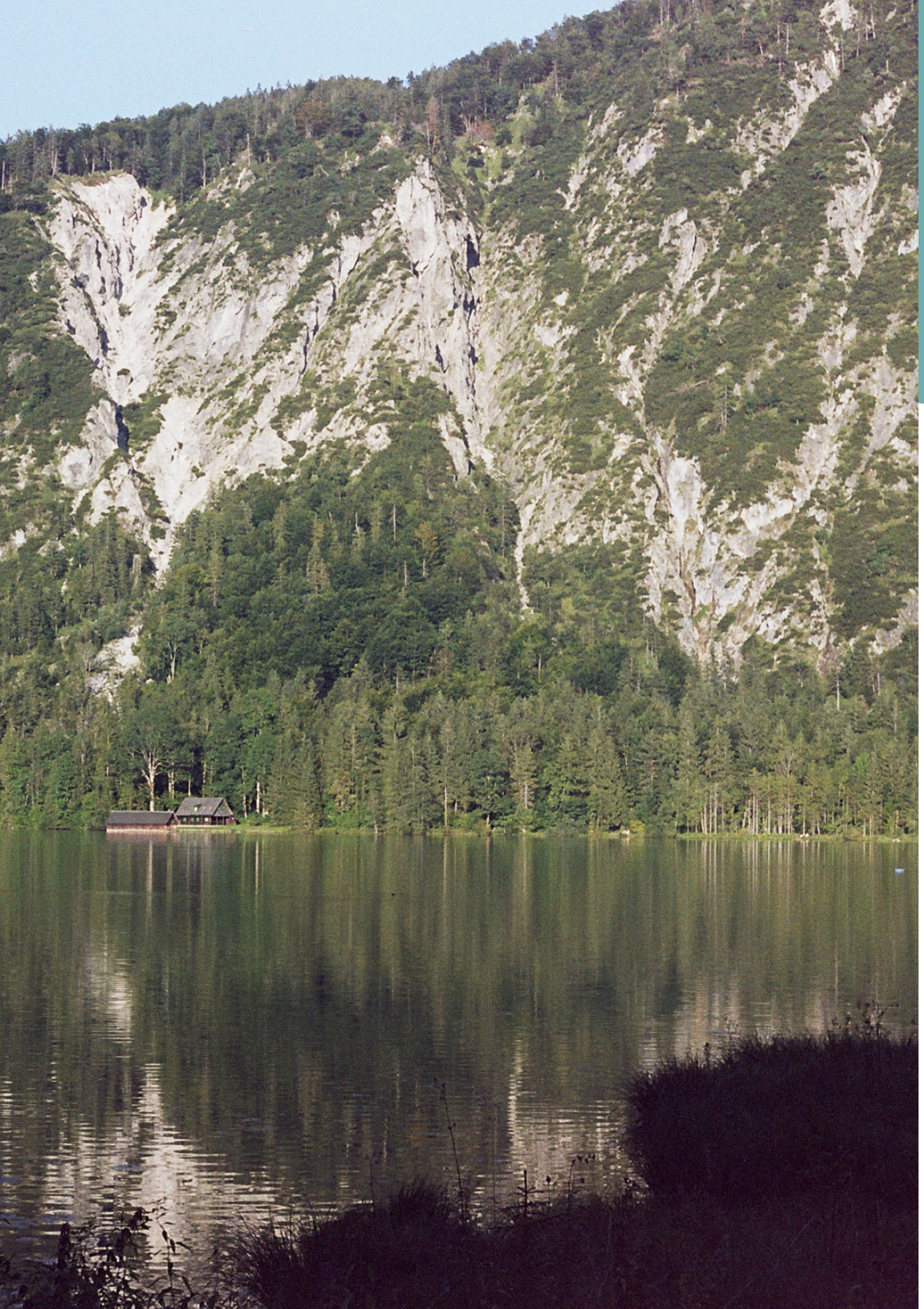
Methodological notes

In order to develop and maintain a system of agri-environmental indicators (AEI) for monitoring the integration of environmental concerns into the common agricultural policy (CAP), a memorandum of understanding has been drawn up between the Agricultural and Rural Development and Environment DGs, the JRC, Eurostat and the EEA to ensure that currently available data are fully used and to pool the different skills and resources of these partners, with the long-term objective of setting up a system for collecting data on the relationship between agriculture and the environment. This will build the basis for an assessment of the impact of agricultural policy decisions on the environment.

Currently, most of the data used to build the 28 agri-environmental indicators described in the communication from the Commission to the Council and the European Parliament — development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy — come from Eurostat (e.g. Farm Structure Surveys, crop statistics), from other EU institutions in the framework of this Memorandum of Understanding (e.g. the Farm Accountancy Data Network, the European Environment Information and Observation Network), from the Member States mainly by means of questionnaires and from independent organisations (e.g. the Pan-European Common Bird Monitoring Scheme).

As the reporting is not always covered by a legal obligation, the responses are usually incomplete, with a rate that varies considerably among countries. Consequently, the resulting data contain many gaps.

Efforts still need to be made for the conceptual and methodological improvement of some of these indicators (as mentioned in the text) and for the collection of the necessary data or better access to existing data, in particular at regional level and on the use of inputs in agriculture.



9

Forestry

Forests and forestry

The global role of forests — despite deforestation

Forests provide a variety of valuable products — such as timber, fuelwood, fibre and non-wood products — and sustain rural communities all over the world. They are home to some 300 million people, and more than 1.6 billion people depend to varying degrees on them for their livelihoods, including for fuelwood, medicinal plants, meat and other food (FAO, 2004). The forestry sector provides jobs for 14 million people, mainly in remote areas (FAO, 2006). Forests also have vital environmental roles, such as combating desertification, purifying water, air and soil, maintaining a large share of biodiversity, storing carbon and regulating the local and regional climate. What is more, forests have sociocultural and landscape value.

Worldwide, forests cover around 30.3 % of the total land area, which represents 0.62 hectares per inhabitant. More than half of the world's forest area is in the Russian Federation, Brazil, Canada, the USA and China combined (FAO, 2005).

Each year about 13 million ha of the world's forests are lost due to felling, but the rate of net forest loss is slowing, thanks to new planting and natural expansion of existing forests. Between 2000 and 2005, the net loss was 7.3 million ha per year — an area the size of the Czech Republic and equivalent to 200 km^2 per day (FAO, 2005).

Forest area is increasing in the European Union

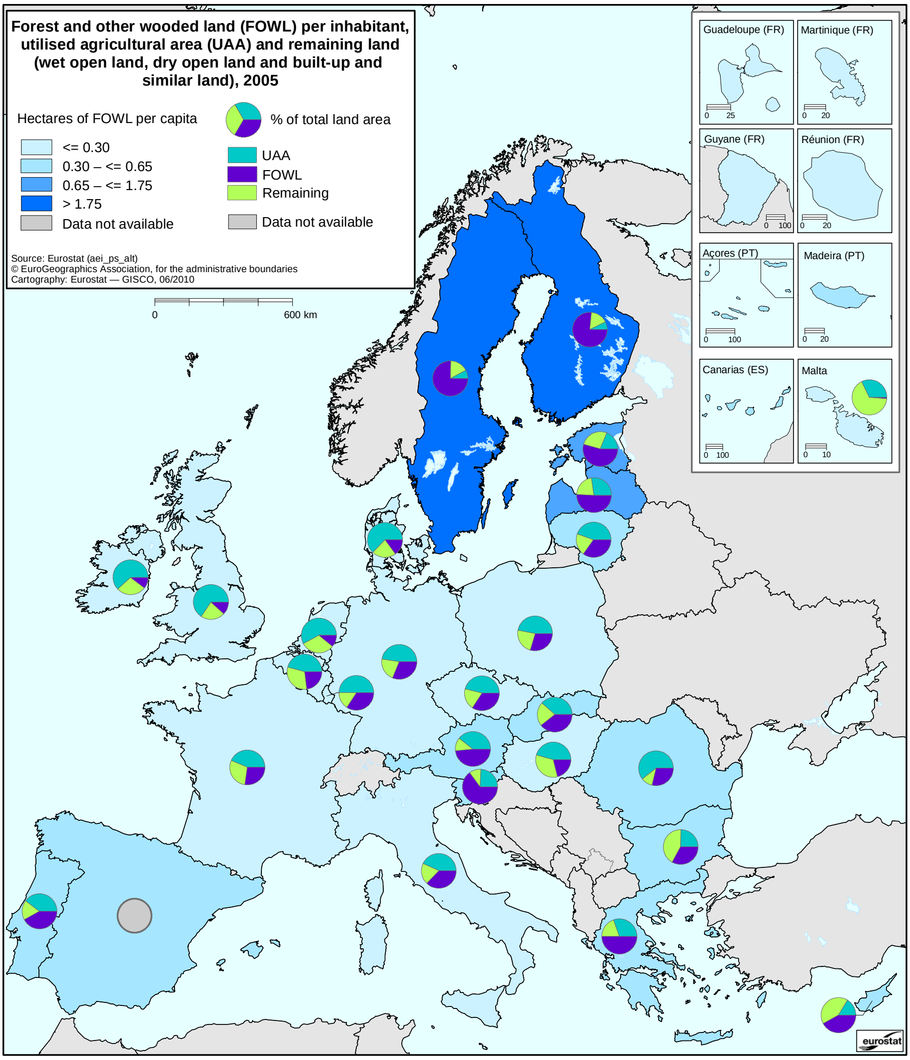
Forests cover 177 million ha in the EU, or 42 % of its terrestrial area (2005 data, FAO/MCPFE). The largest proportion of forests and other wooded land relative to terrestrial area is found in Finland (77 %) and Sweden (75 %), followed by Spain (57 %), Italy (37 %), Germany (32 %) and France (31 %). Together, these six Member States account for more than

Opposite page: Forests provide us with timber and non-wood products while simultaneously purifying our air, water and soil, protecting us from avalanches, regulating our climate and giving us enjoyment and recreation. This is a subalpine forest around the Almsee, Upper Austria. (© M. Wolf-Crowther) two thirds of the total forest area in the EU. The lowest shares of forests and other wooded land relative to terrestrial area are found in Malta (1 %), Ireland (10 %), the Netherlands (11 %) and the United Kingdom (12 %) (Figure 9.1).

As opposed to the global trend, the EU's forest cover has increased over the last decades. Forests covered 174 million ha in 2000 and 177 million in 2005, an increase of 1.6 %.

About 4 % of the world's forests are in the EU, and its population makes up over 7 % of the

Figure 9.1: Forest and other wooded land (FOWL) per inhabitant, utilised agricultural area (UAA) and remaining land (wet open land, dry open land and built-up and similar land), 2005
(ha/capita and % of total land area)



Sources: MCPFE, 2007; FAO FRA 2005, Eurostat (aei_ps_alt) world's inhabitants. Due to its high population density, forest area per inhabitant is only 0.36 ha, half the worldwide average. However, this figure varies between 4.4 ha in Finland or 3.43 ha in Sweden and 0.12 in Denmark or 0.07 in Belgium (Figure 9.1).

Two hundred years ago, forests were intensively used as fuel for industry and heating, as can be observed from paintings of known landscapes, which were often completely devoid of trees. Subsequent generations increasingly used coal products for those purposes, followed by oil. Only recently has there been an increase in wood used for fuel, although rural populations have probably always continued to use wood for heating, depending on availability, and these volumes have gone unrecorded. Nowadays, there are additional pressures on forests besides that of timber supply, such as urban sprawl, expanding transport infrastructure and increasing recreational activities.

Due to increasing pressure on forest ecosystems, active intervention is necessary to preserve the variety of roles forests have to play. This is why most European forests are sustainably managed, i.e. in a way and at a rate that should maintain their productivity, biodiversity, regeneration capacity and vitality and their potential to fulfil relevant environmental, economic and social functions now and in the future (MCPFE, 2007).

Some of the increase in forest area is due to the abandonment of farmland when forests are included in farm property. Summer mountain pastures are also being given up, leading to the expansion of forests. Apart from this, the natural tree line in the mountains is gaining in altitude due to climate change. Some countries have a high level of absentee forest owners because new generations of forest heirs often live in cities and do not manage their inherited properties.

Forests are multifunctional

Forests have many functions. They have **economic functions** by providing all manner of forest products (wood and non-wood products) and services (e.g. by attracting tourists), **environmental functions** (e.g. purifying and protecting water, air and soil, regulating the local climate, storing carbon, harbouring biodiversity) and **social functions** (recreation, cultural and aesthetic values). Their multifunctional nature has long been recognised. In the 15th and 16th centuries, forest policy and management in some Mediterranean countries such as Catalonia and the Republic of Venice were aimed primarily at protecting rural welfare and conserving soil and water, and only secondarily at timber production (Merlo and Croitoru, 2005).

Economic functions

The EU is one of the largest producers, traders and consumers of forest products in the world. A forest product is any material derived from a forest for commercial use. It can be made of wood or be a non-wood product.

Wood products are reported yearly. They can be classified according to their level of transformation — basic, primary or secondary products (Figure 9.2).

Basic products include the trees that are felled and removed from the forest, mostly as roundwood.

Roundwood is either logs or split, roughly squared wood or other forms (e.g. branches, roots or stumps). It can be used as fuel (fuelwood) or as industrial roundwood. Industrial roundwood comprises high-quality logs for sawing or veneer production and the lower-quality pulpwood. The primary products of sawmills and veneer mills are sawnwood, panels (e.g. veneer sheets, plywood), chips and particles and wood residues. The latter are often transformed into pellets, briquettes or reconstituted logs and used as a fuel.

Chips and particles are important products that are further transformed into pulp (for paper production) or into other types of panels (e.g. particle board, oriented strandboard, hardboard, medium density fibreboard, light insulation fibreboard).

Figure 9.2: Overview of wood products

BASIC PRODUCTS (from industrial roundwood)	**PRIMARY PRODUCTS**	**SECONDARY PRODUCTS**
Sawlogs and veneer logs	**Sawnwood** **Veneer sheets** **Plywood** **Wood chips and particles** Particle board Oriented strandboard Hardboard Medium density fibreboard Light insulation fibreboard	**Buildings** **Builder's joinery** **Furniture** **Wooden packaging**
Pulpwood	**Wood pulp** → **Paper**	**Paper and paperboard packaging** **Consumer paper products** **Books, magazines and newspapers**
	Wood residues → **Pellets**	

The primary products can be further transformed into secondary products such as timber-frame buildings, builders' joinery (e.g. I-beams, glue-laminated timber, laminated veneer lumber), furniture, different types of ready-to-use paper products (e.g. writing paper, household and sanitary paper) or packaging materials.

Figure 9.2 presents a simplified illustration of wood products ranging from basic to secondary products.

In the past 10 years, the European Union, in its current composition of 27 Member States, has consistently been the world's second-largest producer of industrial roundwood after the United States. In 2008, production was practically on a par due to the economic downturn in the US, with the EU producing 332.4 million m^3 and the US 336.6 million m^3.

The European Union has been the world's largest producer of sawnwood since 1999, with 105.1 million m^3 produced in 2008. It has also been the largest producer of paper and paperboard since 2000, with 99.6 million tonnes produced in 2008.

Forest-based industries — one of Europe's largest industrial sectors — transform timber into primary and secondary products. They comprise two main branches according to the classification of economic activities: the manufacture of wood and wood products (except furniture); and the manufacture of pulp, paper and paper products, publishing and printing. Furniture and parts of furniture manufactured from wood are also important, but data on this activity are reported together with data on furniture made of other materials and are therefore not easily identified.

The manufacture of wood and wood products employed around 1.4 million people in the EU in 2008, whereas the manufacture of pulp, paper and paper products, publishing and printing employed 2.7 million people (Eurostat database). Publishing is not considered to be a forest-based industry. Data available for 2007 make it possible to estimate that approximately 1 million people were employed in publishing. Therefore, at least

1.7 million people were employed in the manufacture of pulp, paper and paper products and printing in 2007 and 2008. These figures do not take into account the number of people working in the forestry sector per se, i.e. forestry and logging, for which employment is estimated at approximately 490 000 people in 2008 (Eurostat, Labour Force Survey, complemented with forecasts and national figures).

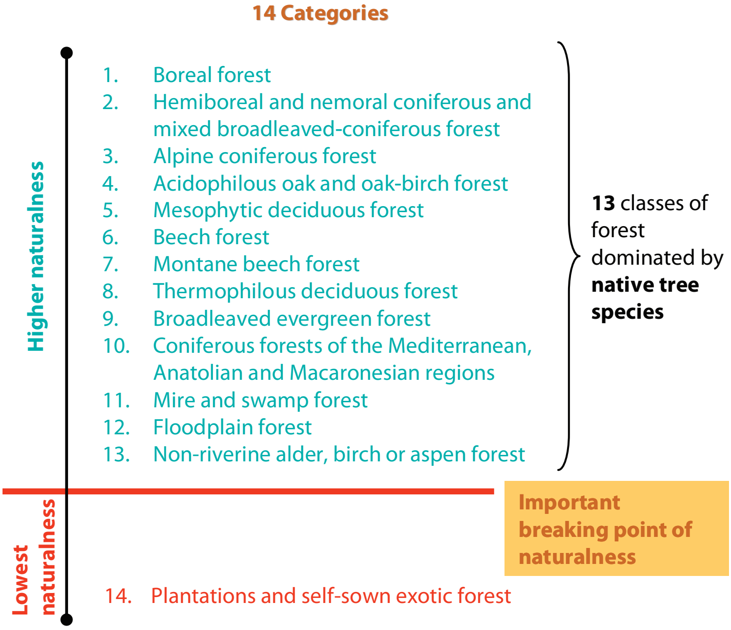
Besides wood, forests supply many **non-wood products**, including food (e.g. truffles, sweet chestnuts, berries, mushrooms, snails and game), fodder (e.g. pig fattening on acorns in the Iberian *dehesas*), cork and medicinal plants. These products are important to people in many rural parts of the European Union due to the additional income they provide. Cork is one of the main non-wood forest products in the EU. Nearly 100 % of the world's cork products come from the EU.

Environmental functions

Of all habitats in the EU, forests are home to the largest number of species, providing many crucial environmental functions, such as the conservation of biodiversity, the protection of water and soil and the mitigation of climate change.

European forest ecosystems are not all equal in their value for **biodiversity conservation**: some are very valuable, while others are quite poor. The differences can be attributed to the different environmental conditions across Europe, different management methods and the varying human pressures exerted on European forests. More than half of the forest species of 'European interest' and over 60 % of forest habitat types identified by the EU's habitats directive (see the chapter on biodiversity and land use) are reported to have 'unfavourable conservation status' (EEA, 2010). The fact that most of the European Union's forests are declared to be managed sustainably (MCPFE, 2007) does not automatically mean that they

Figure 9.3: Natural and exotic forest types



Source: Marchetti, M., 2009.

are always managed to maintain maximum biodiversity. Where the wood-producing function is prioritised, the periods between harvesting of trees (i.e. rotation periods) will be shortened. This can already be observed, for example, in Latvia, where species that prefer open forests have recently increased, while those that need dense, old forests are decreasing and many typical forest birds are becoming rarer (Peterhofs, 2010).

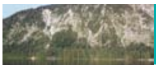
The EU's forests cover many different biogeographical regions and are therefore adapted to all kinds of climate and soil conditions, ranging from boreal to Mediterranean and from alpine to lowland biogeographical zones. These differences result in very different forest ecosystems. Some are well adapted to the extreme winter conditions of the Nordic countries, whereas others thrive on the dry soils and hot summers of the Mediterranean region. The natural forest ecosystems in Europe can be broadly subdivided into 13 types of forest that are directly dependent on biogeographical conditions and types of soil (Figure 9.3). In many parts of the EU, the natural forest types have been replaced by trees planted for commercial purposes outside their optimum ranges or in monoculture, an activity subsumed under the 14th type, plantations. When plantations are of several species, not arranged in rows, and thinning of undergrowth is not radical, it is often uncertain whether forests have been planted; we then speak of semi-natural forests.

Forests in regions that have been intensively managed for roundwood production over hundreds of years present less interest than vast expanses of completely natural forest. About 87.2 % of the European forests are classified as semi-natural and about 8 % as plantations, while the remaining 4.9 %, mainly located in east and north European countries, are classified as undisturbed by man, or natural (MCPFE, 2007). These data include European countries outside the EU, such as Turkey, Norway and Belarus. An earlier study of 26 west, central and east European countries found that scattered relics of virgin forest still existed in remote areas, in mountainous areas and wetlands, especially in the Balkans, Alps and Carpathians. The estimates showed that for the 26 countries involved, slightly fewer than 3 million ha, or about 1.7 % of the total forest area, were in strict forest reserves and other protected areas in the temperate zone of Europe. The countries with the highest proportion of strictly protected areas were Slovakia, Bulgaria, Albania, Slovenia and the Czech Republic. In Austria, a nationwide inventory in the 1990s showed that 3 % of forests were in their natural condition, but they were not always located in protected areas (European Commission, 2000; Parviainen et al., 2000). The study also highlighted the lack of agreement on terms used to define naturalness.

The establishment of the Natura 2000 network (see the chapter on biodiversity and land use) substantially increased the attention given to forest biodiversity at the level of both the EU and its Member States. Almost 30 % of all designated Natura 2000 sites are forests and another 30 % contain some woodland elements (European Commission, 2006).

Aside from their role in biodiversity conservation, most forests have **protective functions** related to regulating water flow, protecting aquifers and preventing erosion, landslides and avalanches. These functions are of tremendous importance in some areas, such as in the mountains. Without forests, erosion, landslides and avalanches would occur, leading to the destruction of settlements and a loss of soil. The recognition of the important role played by forests in water and soil protection played a major role in halting the deforestation of Europe in the late 19th century and also after World War I, when fuelwood was in such short supply that forests often had to be protected from the population.

The role played by forests in **mitigating climate change** is also increasingly recognised. Forests are one of the key factors in the carbon cycle, because they use atmospheric carbon dioxide (CO_2) — a major contributor to global warming — and transform it into biomass. By accumulating large stocks of carbon in the form of woody biomass, deadwood and litter — as well as in their



soils — forests are the largest terrestrial biotic store of carbon and are therefore called carbon sinks. By using wood for many of our long-lived products, they too become a store of carbon.

Forests regulate the local climate and are thought even to play a role in regional weather. It is well known that urban parks and green areas reduce the summer heat by 2–3 °C, as shown, for example, by a recent study conducted in Manchester (Gill, 2009). Forests not only store water but also evaporate huge amounts of it through their leaves. On a regional scale, this can complement the flux of oceanic moisture moving inland, giving rise to winds from the sea towards the land (Makarieva and Gorshkov, 2009). Forests are therefore thought to play a role in atmospheric circulation and the water cycle over land in general.

Social functions

Forests offer many benefits in addition to forest products, such as supplying recreational and cultural services, as well as providing scenic landscapes.

The diversity of forest functions is of concern to policymakers. The EU forest action plan adopted in June 2006 ([122]) recognises the need to maintain and improve the multifunctional role of forests. The plan centres not only on improving the long-term competitiveness of the forestry sector and improving knowledge about forests, but also on protecting the environment and improving the quality of life. Another aim is to coordinate EU initiatives with the forest policies of the Member States. Eighteen key actions are recommended and are to be implemented over five years (2007–11).

European forests are used for a wide variety of recreation activities. The most popular is simply walking, but forest recreation also includes activities such as hunting, orienteering, horseback riding or mountain-biking. Forests have great cultural and spiritual importance, for instance for the traditional collection of mushrooms and berries, hunting and tourism.

Forest protection as a constant concern

Because forests now cover such a wide range of functions, it is important to protect these valuable resources from disturbance and damage.

The main causes of damage to forests are man-made and climate-related. Typical direct human disturbances include **fragmentation**, too many **visitors**, **overgrazing** of the understory by too much game and destruction through **forest fires**. Biotic factors (e.g. **pests** — insects and pathogens), **storms** and naturally induced fires are the main climate-related threats. They are indirectly enhanced by man-made threats such as **air pollution**, which reduce the trees' natural defences, or **global warming**, which is known to influence the severity of natural events or the development, reproduction and survival of pests (Moore and Allard, 2008).

Pests

While they are integral components of forest ecosystems, insects and pathogens have a considerable influence on the health of forests. They can adversely affect tree growth, vigour and survival, the yield and quality of wood and non-wood products, wildlife habitats, recreation and aesthetic and cultural values. Forest insect pests and pathogens may also ruin plantation programmes, kill off tree species and make it necessary to clear-cut large areas of infested trees. Pests can also be imported from different regions by humans, causing disasters (FAO, 2009). One of the many pinewood nematodes (*Bursaphelenchus xylophilus,* a type of worm) from North America was reported for the first time in Europe in 1999, in Portugal. Its larvae feed on the cells of the resin ducts of pine trees, causing 'pine wilt' and ultimately the death of the tree. The larvae also infest different kinds

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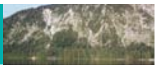
([122]) Communication from the Commission to the Council and the European Parliament of 15 June 2006 on an EU forest action plan (COM(2006) 302 final).



of bark beetles and wood borers, which are the vectors by which the nematode reaches new trees. By 2008, this nematode was reported to have developed in very high numbers in Portugal and had started to spread to Spain. There is no cure for the infestations. Infected trees are cut and either burned or chipped and all lumber from infected areas must be either fumigated or kiln-dried (Mota et al., 1999).

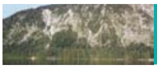
Storms

Storms cause large-scale destruction in both natural and managed forests in the EU. Almost every year, there are incidents in which European forests are damaged, often disastrously, with huge economic losses at the local level. One famous example of such a storm was 'Lothar', which swept across central Europe on 26 December 1999, affecting large areas of France,

Table 9.1: Total area burnt *(ha)*, total number of forest fires, 2005 and 2008

Country	Fire area (2008)	Fire number (2008)	Fire area (2005)	Fire area (2005)/ FOWL (2005)
	ha	number	ha	ha/1 000 ha
BG	5 289	582	1 456	0.40
CY	2 392	114	1 838	4.73
DE	539	818	183	0.02
EE	1 280	71	87	0.04
ES	39 895	11 612	188 697	6.69
FI	824	1 415	495	0.02
FR	6 001	2 781	22 135	1.28
EL	29 152	1 481	6 437	0.99
HU	2 404	502	3 531	1.81
IT	66 329	6 486	47 575	4.31
LT	112	301	51	0.02
LV	364	700	120	0.04
PL	3 028	9 091	7 387	0.80
PT	17 244	13 832	338 262	87.47
RO	373	91	162	0.02
SE	4 280	5 420	1 562	0.05
SI	75	74	280	0.21
SK	118	182	524	0.27
CH	65	46	41	0.03
TR	23 577	2 135	2 821	0.14

Source: Eurostat (for_fire)



southern Germany and Switzerland. Almost every year, winter storms wreak havoc in forests to a greater or lesser extent. More recently, on 24 January 2009, the storm 'Klaus' affected 684 000 ha in south-western France, felling 43 million m^3 of wood or 14 % of the standing wood volume of the affected region and 88 % of maritime pines *Pinus pinaster* (Inventaire Forestier National, 2009). Some 90 % of the trees felled were conifers. They were not yet mature, having been planted following a similar storm some years earlier.

Forest fires

Together with storms, forest fires are the most severe threat to forests in the EU, predominantly in the Mediterranean countries (Portugal, Spain, France, Italy and Greece) (see Table 9.1).

In 2008, Italy suffered the greatest loss of forests due to fire. Around 66 329 ha burned, equivalent to approximately 33 000 soccer fields or half the area of the city of Rome. Spain, Greece and Portugal were also affected, with 39 895, 29 152 and 17 244 ha lost.

Air pollutants

Since the industrial revolution, air pollutants have shown the potential to have minor to severe impacts on forest ecosystems. Ozone can cause visible injury to all green vegetation and hence to tree leaves. The deposition of atmospheric nitrogen can at first have a positive impact on tree growth due to its fertilising effect. However, nitrogen compounds can cause acidification of precipitation and soil. Sulphur can have the same effect.

Damage from such pollutants is often most severe in regions where fog saturated with compounds repeatedly forms at certain altitudes in mountainous areas and remains there for days and weeks, e.g. in parts of the Czech Republic (Braunová, 2004). Sulphur emissions have decreased since 1989, but nitrogen deposition continued to cause damage, and still seems to be a major problem. The damage presented shows that, in spite of significant lowering of air pollution loads, the health of the affected forest stands in polluted regions (which can be far away from the sources of pollution) has not yet stabilised.

Wood supply, carbon storage and climate change

General information on forest area, multiple functions of forests and forest protection across the European Union were provided in the first part of this chapter. In the second part, the focus is on three questions:

- Is there enough wood?
- How much carbon is there in forests and wood products?
- How will forests be affected by climate change?

The role played by forests in providing wood products has been emphasised, as well as the need to sustainably manage wood resources. As demand for wood increases from both wood-processing industries and the energy sector, the question of whether there is enough wood is of great concern to policymakers. Climate change has become one of the most debated environmental issues at international level. The role of forests in mitigating such change is part of the question of how much carbon is contained in forests and wood products. However, climate change may also affect forests, and this is why adaptation of forests is a topic.

Increasing pressure on forests for wood

What is harvested is less than what is grown

In order to understand how much wood is available, it is essential to know how much wood is growing in the European Union's forests and how much is removed.

Growing stock is a measure of the volume of stem wood in a given area of forest or wooded land, usually measured in solid cubic metres (m^3). The total growing stock in the EU is estimated at 23 billion m^3. The six countries with the greatest total growing stock account for almost 63 % of the total. These are Germany (3.4 billion m^3 or 14.6 % of the total), Sweden (3.1 billion m^3 or 13.5 %), France (2.5 billion m^3 or 10.6 %), Finland (2.2 billion m^3 or 9.4 %), Poland (1.9 billion m^3 or 8.2 %) and Italy (1.5 billion m^3 or 6.6 %). With the exception of Poland, these are also the countries with the largest forest area in relation to their terrestrial area (see previous section).

Growing stock per hectare of forest area is a good indicator of how well stocked forests are. The EU average for growing stock is 131.2 m^3 per hectare; it increased by 3.8 % between 2000 and 2005 (Table 9.2).

Both growing stock and growing stock per hectare indicate the amount of wood that is present in the forest, but do not show how much wood is harvested annually and whether this cutting is sustainable. In order to check sustainability over time, forest growth or increment is often compared to the amounts felled. When fellings are expressed as a percentage of the net annual increment, 100 % means that all of the yearly growth produced by the trees is harvested. If the percentage is below 100 %, growing stock will increase, since more grows back than is cut.

Despite considerable annual fellings, the average annual volume of timber harvested in the EU is only slightly over 60 % of the annual forest growth (Table 9.2). Large variations in wood removal can be observed among Member States and fellings as a percentage of the net annual increment range from 16 % in Cyprus to 103 % in Portugal. There are many reasons why fellings can temporarily exceed net annual increment: windthrow from storms and the fight against pest infestations are common reasons. These figures refer to forests available for wood supply (FAWS), where no legal, economic or environmental restrictions have a bearing on the supply of wood.

Increasing demand from both wood-processing industries and the energy sector

Wood is used both for energy purposes (wood directly used as fuelwood, processed wood fuel and production residues) and for wood products (wood used in sawmills, in the panel, pulp and paper industries). The share of different uses in 2007 is presented in Figure 9.4. However, only about one third of the 42 % shown as 'energy use' in this figure comes directly from the forest (i.e. 29 % of wood removed from forests), while two thirds of the 42 % shown as 'energy use' come from production residues from industrial wood processing, including black liquor from paper production (Mantau et al., 2008). It is safe to assume that in most advanced countries there is little scope to increase the energy use of residues from the wood processing industry (UNECE, 2007); they are already being used very efficiently.

The demand from wood-processing industries (for wood and paper products) increased steadily in the years leading up to the 2007 study (UNECE/FAO/University Hamburg, 2007), resulting in an overall rise in demand for wood in the EU. The total quantities of wood used between 2005 and 2007 rose from 779 million m^3 to 801 million m^3, an increase of 22 million m^3 for the EU in a two-year period.

This increase was expected, since the use of wood for paper and wood products has risen steadily along with GDP in most countries over the last decades. In recent years, however, wood energy has become increasingly important for consumers and policymakers as a renewable source of energy, to ensure a secure energy supply and as a source of energy that is considered to have no effect on climate change. The European Union set policy targets for renewable energy (12 % by 2010 and 20 % by 2020, see box on page 284).

Since wood energy is currently the major source of renewable energy, these targets can be expected to have major implications for the forest sector (UNECE/FAO/University Hamburg, 2007). The use of biomass from the forest and from agriculture for bioenergy can be expected

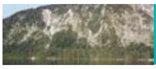


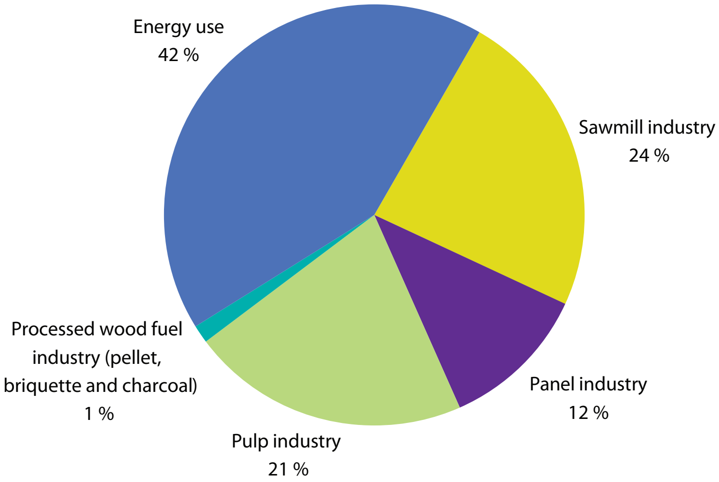
Table 9.2: Growing stock, net annual increment and fellings in all forests and in forests available for wood supply *(m^3/ha and %)*

	Growing stock				NAI in FAWS		Fellings as % of NAI	
	Total (FOWL)		Commercial (FAWS)					
	2000	2005	2000	2005	2000	2005	2000	2005
	m^3/ha	m^3/ha	m^3/ha	m^3/ha	m^3ob/ha	m^3ob/ha		
EU-27	126.4	131.2	145.9	152.6	5.8	6.1	66.6	60.3
BE	205.0	208.5	213.5	217.0	8.0	7.9	66.7	84.6
BG	150.9	160.6	142.2	147.7	6.0	5.5	27.7	40.8
CZ	265.0	277.7	264.9	280.2	7.7	8.1	80.1	83.9
DK	119.5	120.2	149.6	151.2	13.1	13.4	43.3	35.5
DE	305.2	305.2	305.5	305.5	11.1	11.1	40.0	49.8
EE	197.8	194.8	203.0	198.7	5.4	5.3	112.2	52.0
IE	92.0	92.1	97.8	97.4	8.9	8.7	52.2	51.0
EL	26.1	27.1	47.2	47.2	1.1	1.1	58.2	48.3
ES	28.8	31.5	58.9	65.8	2.7	2.7	62.8	66.8
FR	131.3	142.8	144.7	156.2	6.7	6.9	64.7	55.3
IT	131.5	140.0	136.5	145.0	3.8	4.3	33.2	26.4
CY	20.4	20.6	71.5	72.2	1.0	0.9	42.1	16.0
LV	182.2	181.2	190.0	185.6	5.9	5.8	70.1	68.4
LT	178.3	183.6	182.3	186.6	5.1	5.4	70.7	73.2
LU	294.9	294.4	:	:	7.5	7.5	47.1	38.3
HU	170.5	175.2	179.6	179.9	7.2	7.7	62.2	55.6
MT	0.3	0.2	0.0	0.0	—	—	0.0	0.0
NL	169.6	177.4	168.5	175.6	7.7	7.6	58.9	69.6
AT	275.2	291.1	317.2	337.3	9.4	9.3	60.1	64.4
PL	191.6	206.3	189.9	204.9	8.1	8.0	48.1	55.0
PT	89.7	94.6	104.5	115.5	6.4	6.4	82.1	103.0
RO	204.0	202.6	:	:	7.5	7.5	41.3	46.0
SI	262.8	275.1	270.0	282.5	5.8	6.3	39.3	44.0
SK	241.1	256.1	247.2	260.0	6.6	6.8	56.9	74.8
FI	89.0	93.3	93.4	101.8	3.9	4.6	84.6	69.5
SE	99.9	101.6	125.4	127.5	4.3	4.3	81.7	85.5
UK	109.8	119.0	114.9	126.3	8.9	8.7	45.4	47.8
IS	25.5	26.5	64.9	61.6	0.4	0.4	0.6	0.7
LI	242.6	248.6	358.8	367.5	3.4	3.4	64.0	64.0
NO	70.2	74.6	105.1	111.6	1.9	2.0	48.9	46.4
CH	339.5	0.0	368.1	378.9	7.1	7.0	80.2	80.1

FOWL = forest and other wooded land; FAWS = forest available for wood supply; NAI = net annual increment; ob = over bark.
FAWS data from 1990: ES; FAWS data from 2000: DE, RO, PT; NAI data from 2000: DE, ES, AT, PT, LI, NO; NAI data from 1990: GR.

Sources: MCPFE, 2007; FAO, 2005.

Figure 9.4: Wood resource use, EU-27, 2007 *(% of total wood use)*



Source: EUwood, 2009.

to increase sharply in the coming decades and it is interesting to estimate the impacts this could have on wood demand as a whole.

The directive on renewable energy (123) sets mandatory national targets for the overall share of energy from renewable sources and for the share of energy from renewable sources that is used for transport. It lays down rules for statistical reporting by Member States, joint projects with third countries, guarantees of origin, administrative procedures, information and training, and access to the electricity grid for energy from renewable sources. It establishes sustainability criteria for liquid biofuels derived from agricultural crops. For biomass, however, the Member States will develop their own sustainability criteria.

To close the gap between the current share of renewable energy and the targets, Member States are working on biomass action plans. The EU too has developed such a plan (124).

In the light of this rapidly growing demand for wood for different uses, the issue of a sufficient supply of wood is becoming increasingly pressing.

Supply, use and the wood resource balance for 2007

In order to understand the links between wood supply and demand, a study (with data for 2007) was launched by the UNECE/FAO Timber Section and the University of Hamburg (UNECE/FAO/University Hamburg, 2007) using a wood resources balance. The researchers calculated total wood supply (directly from the forest and from indirect sources — mostly residues from industrial wood processing) and compared it with total wood demand for energy purposes and for industrial wood processing.

For the current 27 EU Member States, the results show a higher (by 23 million m³) wood demand (801 million m³) than supply (777 million m³). The differences were much higher in some countries, while in others supply was estimated to be greater than demand (Figure 9.5). These differences may seem strange in conjunction with Table 9.2, which shows that only 60 % of the

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(123) Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources.

(124) Communication from the Commission of 7 December 2005 — Biomass action plan (COM(2005) 628 final), OJ C 49, 28.2.2005.

net annual increment is felled, but those data refer only to forests available for wood supply, whereas the supply estimates took into account likely figures for all wooded land (i.e. hedgerows, orchards, vineyards and parks), as well as post-consumer recovered wood — figures that are not readily available. On the demand side, a study in France estimated high fuelwood consumption by (mainly) rural households and second home owners, which significantly increased the EU total for direct fuelwood consumption. These realistic estimates raised awareness among both forestry and energy researchers that harvested wood volumes, in particular wood for energy generation, seem to be significantly higher than reported by official statistics, meaning that there is probably a large informal market for private households' fuelwood (UNECE/FAO, 2007).

To fill this data gap and help countries show how they are reaching the goals of the directive on renewable energy, Eurostat is funding studies on biomass consumption by households in 13 Member States.

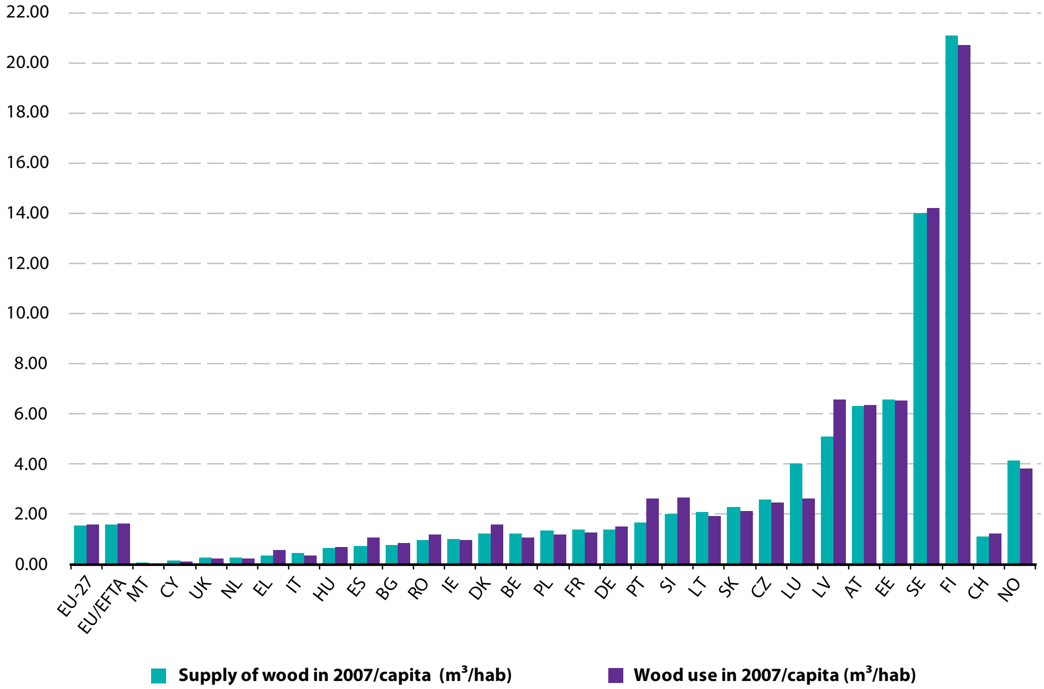
Future wood supply and demand: forecast

As previously shown, energy policies have a high priority for the EU and its Member States and will influence both the forestry sector and forest-based industries.

It is therefore important to analyse the impacts and opportunities for the sector and to estimate what wood supply and demand might be in the coming decades, given this situation.

UNECE/FAO/University Hamburg (2007) produced forecasts of wood demand and supply

Figure 9.5: Wood resource balance, 2007 *(m³/hab)*



Source: EUwood.

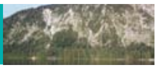


Table 9.3: EU/EFTA future wood supply and demand to fulfil both energy and material needs

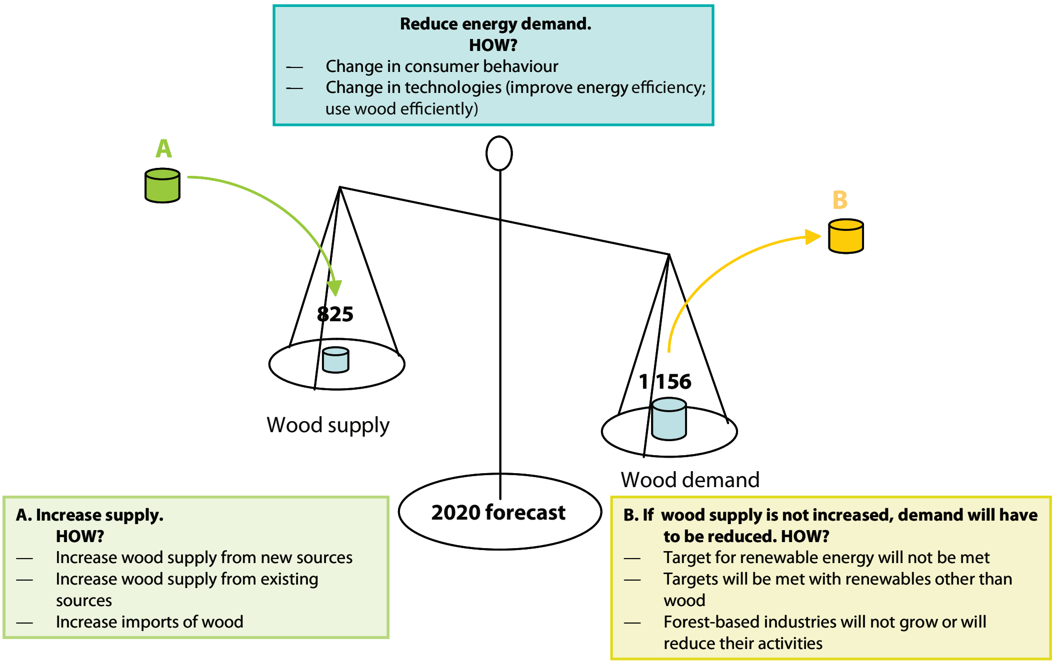
Forecasts EU/EFTA — 2020			**Difference between supply and demand**	
Total wood supply (million m^3)		825		
Total wood demand	Scenario 1 (a)	1 274	Scenario 1 (a)	– 559
	Scenario 2 (75 %) (b)	1 156	Scenario 2 (75 %) (b)	– 448
Total wood demand can be divided into:				
Wood demand from wood-processing industries (sawmills, panel, pulp and paper) (million m^3)		536		
Wood required to achieve national policy objectives for renewable energy (million m^3)	Scenario 1 (a)	738		
	Scenario 2 (75 %) (b)	620		

(a) Scenario 1: Assuming the same share of wood to renewable sources of energy as in 2005.

(b) Scenario 2 (75 %): Assuming that the relative share of wood to other renewable sources decreases by 25 % in 2020 compared to 2005.

Source: UNECE/FAO/University Hamburg, 2007

Figure 9.6: Some options to keep supply and demand in balance both now and in the future *(figures are in million m^3)*

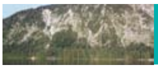


Reduce energy demand.
HOW?
— Change in consumer behaviour
— Change in technologies (improve energy efficiency; use wood efficiently)

A. Increase supply.
HOW?
— Increase wood supply from new sources
— Increase wood supply from existing sources
— Increase imports of wood

B. If wood supply is not increased, demand will have to be reduced. HOW?
— Target for renewable energy will not be met
— Targets will be met with renewables other than wood
— Forest-based industries will not grow or will reduce their activities

Source: Adapted from UNECE/FAO/University Hamburg, 2007.



for 2020 by using the existing European Forest Sector Outlook Study (EFSOS — UNECE, 2005) scenarios for future wood supply and demand, supplemented with national policy targets for renewable energy. National and EU policy targets for renewable energy, bioenergy and energy from wood (when available) were translated into wood volumes by applying a number of straightforward assumptions. The model allowed the researchers to estimate wood demand in 2020 for both energy and wood products.

Table 9.3 shows the differences between supply and demand in 2020. According to the scenarios used to evaluate the quantities of wood required to achieve national policy objectives for renewable energy, demand would be between 448 million m^3 and 559 million m^3 higher than supply in 2020. The difference between supply and demand can be compared to the net annual increment (NAI) of forests in the EU (1 050 million m^3 in 2005). This suggests that a quantity representing 42 to 52 % of the NAI of EU's forests will be missing in the wood balance in 2020.

These numbers must be interpreted very carefully as they represent first assessments and were based on the best available data for 2007. Even if the magnitude of the difference between wood supply and demand can be criticised, the general trend of the numbers remains correct: projected demand is likely to be considerably higher than supply in 2020. The same group of researchers is working on a new forecast with additional data that should become available in 2010. If the new study confirms the gap between future supply and demand, action will be needed if a balance is to be achieved. Figure 9.6 illustrates some of the options.

Quantity of carbon in forests and wood products

European forests act as carbon sinks

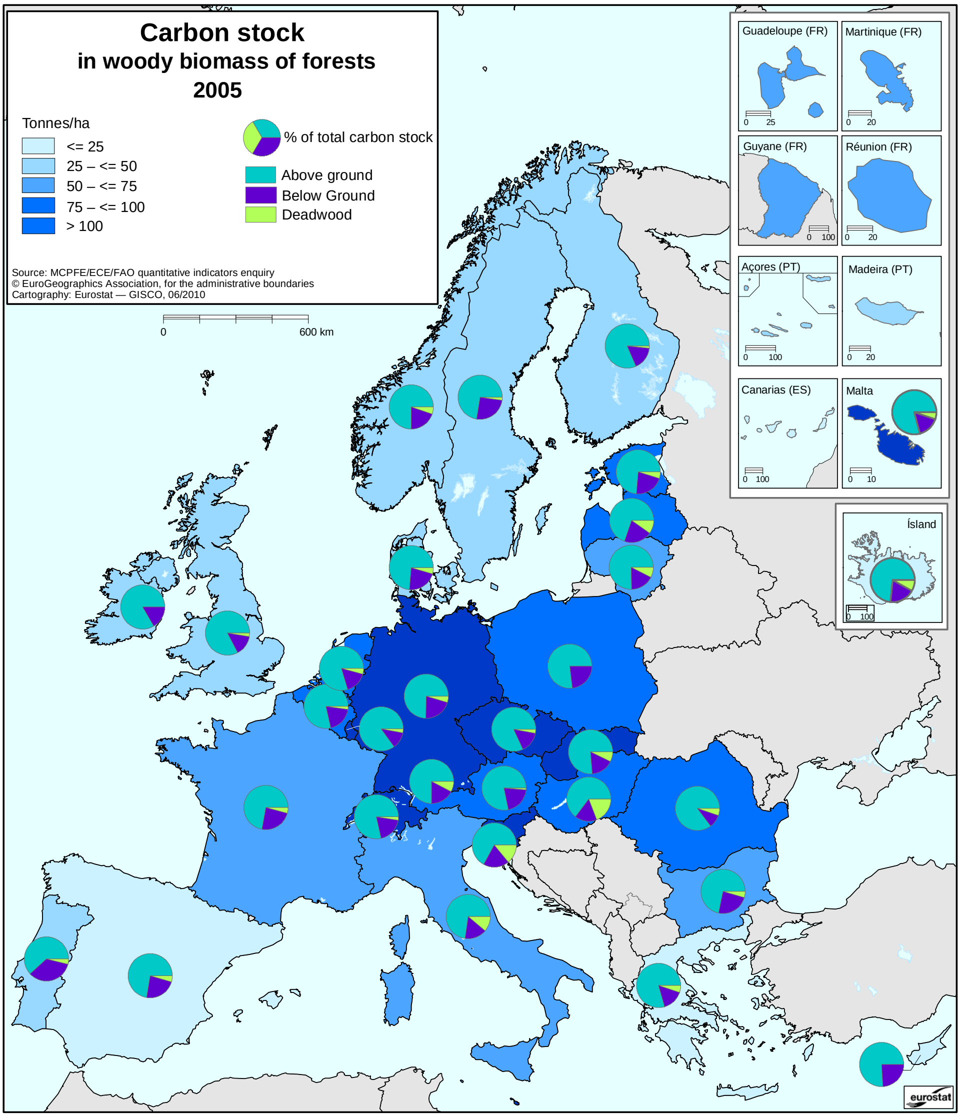
Forests can play a major role in climate change mitigation. Forests are one of the key factors in the carbon cycle, sequestering carbon by taking in carbon dioxide (CO_2) from the atmosphere. By accumulating large stocks of carbon in the form of woody biomass, deadwood, litter and forest soils, forests are the largest terrestrial biotic carbon store and can be a significant sink of carbon (i.e. a carbon reservoir). They can also act as a carbon source: release of carbon from forest ecosystems results from natural processes (decomposition, decay) as well as from deliberate or unintended results of human activities (i.e. wood harvesting, fires, deforestation).

Depending on their characteristics and on local circumstances, forests can therefore play different roles in the carbon cycle, from net emitters to net sinks of carbon. Deforestation, mostly in the tropics, is one of the major sources of carbon entering the atmosphere (equal, according to the FAO, to about 25 % of the man-made emissions of carbon dioxide, i.e. roughly equal to the carbon dioxide produced by the United States).

In sustainably managed forests, the amount of carbon that can be released as a result of harvesting wood is equal to or less than the amount taken from the atmosphere, making forests either 'carbon neutral' or carbon sinks. It is estimated that forests in Europe play a major role in carbon sequestration. The total woody biomass in the 27 EU Member States contained 9.6 billion tonnes of carbon (t C) in 2005. That year, the total CO_2 emissions of all greenhouse gases of the same countries were equivalent to 1.4 billion t C. This means that the amount of carbon emitted every year is nearly one seventh of the carbon stored in the EU's forests. This shows how valuable our forests are for mitigating greenhouse gas emissions by acting as carbon sinks. The net annual increment of the same forests accounted for 191 million t C.

Trees store more carbon when they are in the growing phase than when they are older and grow more slowly. Therefore, a certain amount of cutting and management of forests increases the rate of carbon storage. Figure 9.7 illustrates the amounts of carbon stored in the woody biomass. Member States store varying proportions of carbon in their forests.

Figure 9.7: Carbon stock in woody biomass of forests, 2005 *(tonnes of carbon per hectare and % of total carbon stock)*



Source: MCPFE/ECE/FAO quantitative indicators enquiry.

The role of European forests in climate change mitigation is increasing over time because of consistent increases in forest area, growing stock and increment in Europe over recent decades. The total area of forests in the Member States increased by 2.8 million ha (1.6 %) between 2000 and 2005. Growing stock increased by 4 % in the same period (by approximately 4.8 m^3/ha or 845 million m^3). Carbon stocks increased at the same rate.

Carbon stored in wood products

In addition to issues linked to the role of forest ecosystems in carbon cycles, there are other considerations to be taken into account to understand the complex role played by forests and forestry in carbon emissions or sequestrations.

Harvested wood products (HWPs) are primary and secondary products such as buildings and their structural elements, furniture, plywood, paper and packaging.

Harvested timber is converted into a wide variety of wood products. Carbon remains stored in them during their life cycle. After their use, products are sometimes recycled, but ultimately incinerated or deposited in landfills, where they slowly decay. The carbon stored in the wood fibres, initially captured from the atmosphere, is finally released back into the atmosphere. The duration of carbon storage in wood products depends on the type of product. Some products have long life expectancies, such as wood used in construction, while others exist for less than a year, such as fuelwood or writing paper.

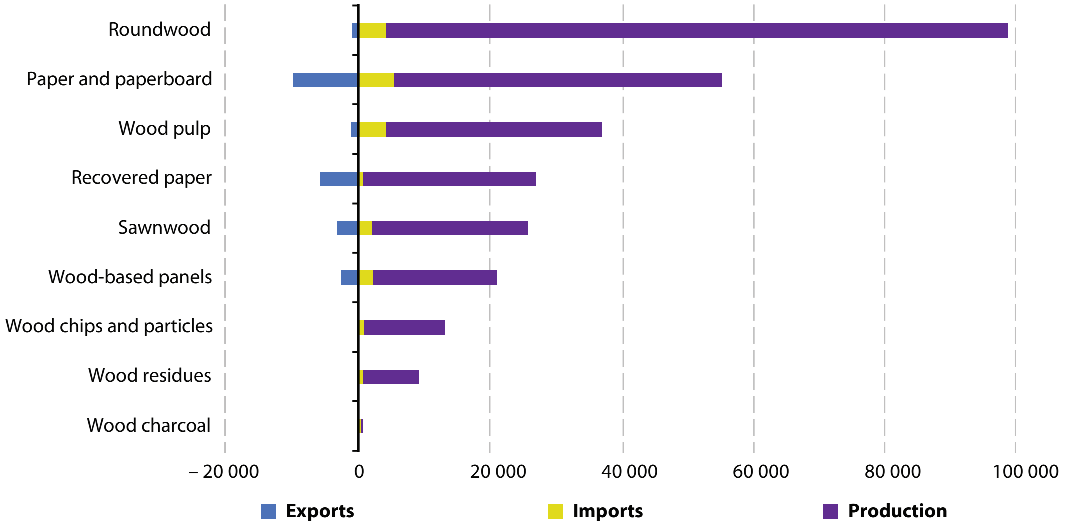
An estimate of the average carbon content of harvested wood products that are in use at any one time requires one to define the average half-lives of many different forest-based products. Because the methods for doing this are currently being worked on, only the amounts of carbon contained in the different primary wood products produced and traded by the EU are presented here.

Supply balance in tonnes of carbon

Supply balances traditionally show the extent to which countries or markets are self-sufficient for certain commodities by looking at production plus imports minus exports (apparent consumption). The data presented here for 2008 show the EU as a single market, with imports from countries outside the EU and exports to countries outside the EU (Figure 9.8).

As previously discussed, the EU is a major producer of wood products, and more particularly of roundwood, paper and paperboard and wood pulp. The EU exports relatively large quantities

Figure 9.8: EU-27 supply balance for wood products, 2008 *(1 000 tonnes of carbon)*



Source: Eurostat Pocketbook, *Energy, transport and environment indicators*, 2009..

of paper and paperboard, recovered paper, sawnwood and wood-based panels, but no woodchips or particles. The EU imports all types of wood products, but to a considerably lesser extent than what it itself produces.

The product data were converted to tonnes of carbon by applying recommended conversion factors for average carbon content. This makes it possible to sum up and compare types of products that are normally expressed in incompatible units.

Most of the carbon contained in primary wood products stays in the EU and only relatively small amounts are traded. These data do not replace an estimate of the amounts of carbon stored in harvested wood products but only show that the EU is nearly self-sufficient in terms of wood markets as expressed in tonnes of carbon.

Effects of climate change on forests

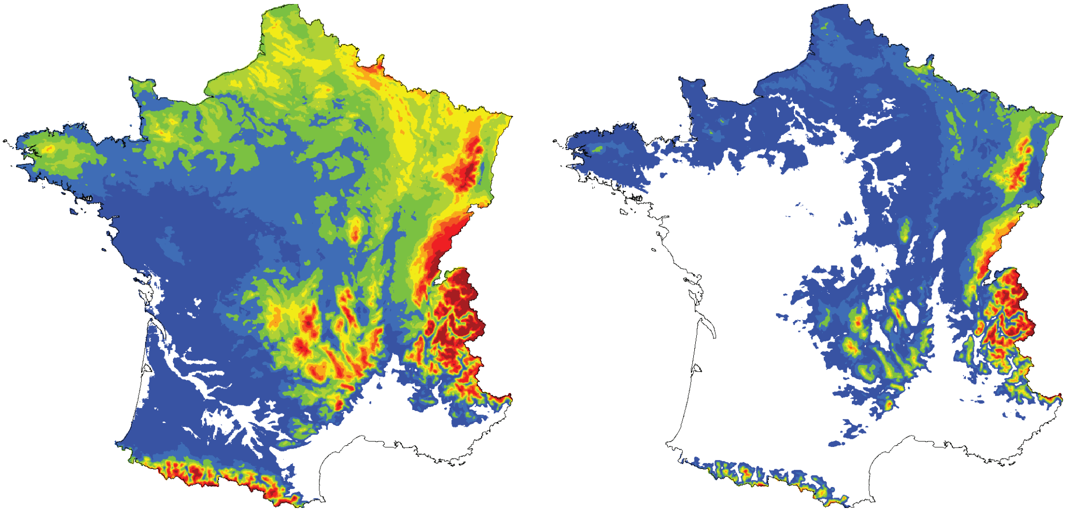
It is thought that the effects of climate change on forests will proceed in steps by a series of crises (Carbofor project). In results presented for France, a model was used to predict likely outcomes for forests under the assumption of summer temperatures that will be + 4 °C higher than the current long-term average and a significant shift in rainfall to the winter months (IPCC B2 scenario). The effects on the carbon budget and on forest tree biodiversity were studied.

The results of the exercise indicate that:

- initially, higher concentrations of CO_2 may lead to increases in wood production until at least 2030, when drought is likely to initiate desertification in the south of the country;
- all forest types would shift northwards; north-eastern France would have a favourable climate for forests while that in the south-west would become unfavourable;
- pathogens such as certain fungi would also move northwards.

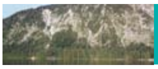
The effects of the predicted changes on the distribution of beech (*Fagus sylvatica*) are shown in Figure 9.9.

Figure 9.9: Climatic conditions in France for beech *(Fagus sylvatica)* in 2010 (left) and modelled for 2100 (right)



The colours show the probability of occurrence of the species: white areas show regions where beech is absent, green a 30–50 % probability of presence and red a high probability (70–100 %) of presence.

Source: Carbofor project.



As reported, the more heat-tolerant species of oak (*Quercus spp.*) are already being substituted for beech in parts of France by foresters in an effort to adapt to the projected changes. However, oak suffers more from drought than beech; this makes it very difficult to decide what to plant, since the decision must take into account the time it will take the trees to reach maturity and harvestable age.

Climate change is also likely to have an effect on soils. Today, sustainable forest management prevents forests from degradation. The protective canopy of the forest ensures that soils rich in carbon are protected from wind and rain. If forests were to die off, this protection would disappear. If carbon in the soil is exposed, it may react with the oxygen in the air, resulting in CO_2 emissions.

Conclusions: forests of the European Union

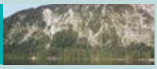
The European Union's forests are multifunctional. Economic viability is not of paramount importance in all countries and regions: forests that protect dwellings and infrastructure from landslides or avalanches, forests that provide employment in rural areas, forests that protect and purify water resources and forests in national parks and other protected areas are examples of multifunctionality.

Currently, more wood grows in forests available for wood supply than is cut. However, a conflict is emerging between wood for wood products and wood for energy and it is not clear yet whether there is enough wood available for both without resorting to imports. Data must be collected on the wood supply from all sources, not only from forests available for wood supply. Demand side data must also improve. Data available from certain countries seem to indicate that we are already using more wood than we were aware of. If this were to be generally true, there would be less room than expected for increasing the use of wood for energy purposes. Biomass energy targets could then only be met by mobilising a greater share of the existing resources and/or extending the forest area (for instance for energy plantations). This will depend on economic circumstances and policy choices, notably about land use priorities.

Because more wood grows than is cut, the European Union's forests are carbon sinks. In part, this is due to the area of forest increasing through abandonment of farmland and summer mountain pastures, but there are also a lot of absentee forest owners who live in cities and do not manage their forests. Trees store more carbon when they are in the growing phase than when they are old and grow more slowly. Therefore, a certain amount of cutting and management of forests increases the rate of carbon storage. However, older trees and deadwood are better for forest biodiversity, so there is a trade-off there, as there is with the goal of using more woody biomass for energy purposes.

Climate change will most certainly entail big changes in the current distribution of tree species and forest types. The ranges of many species will probably shift northwards, with a concurrent increase in the productivity of those forests. Southern areas, however, will be threatened by desertification.

Besides working on improving data on wood supply and consumption, Eurostat is planning to use its data on wood products to estimate how much wood is contained in our buildings and in other long-lived products at any one time. This is an area of carbon storage that interests policy-makers. Eurostat is also working to improve its data on the economic viability of forestry as part of the information on rural development in the EU.



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Tables by themes; Agriculture, forestry and fisheries; see Forestry (t_for)

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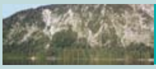

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See also

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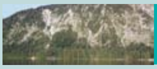


Methodological notes

Eurostat is responsible for the collection of data on production and trade in wood products from the EU Member States and EFTA countries. In this task, Eurostat cooperates with the Food and Agriculture Organisation of the United Nations (FAO), the United Nations Economic Commission for Europe (UNECE) and the International Tropical Timber Organisation (ITTO) as part of a yearly worldwide exercise. The collection of data on wood products is affected by statistical confidentiality of national data sources. Because of this, the number of estimates in the database has increased, which affects the data quality. Eurostat also collects economic data on forestry and logging, as well as on all the manufacturing industries that depend on wood, i.e. the forest-based industries.

Another source of data in this chapter is the FAO's Forest Resources Assessment (FRA) for 2005, a report of the worldwide survey undertaken by the FAO Forestry Department every five years. The data for the year 2000 are definitive in FRA 2005, while the data for 2005 are forecasts. Similar data were collected by the Ministerial Conference on the Protection of Forests in Europe (MCPFE) and published in 'State of Europe's forests 2007', where the data for 2005 are definitive. Forest monitoring in Europe is carried out only once every five years because of the slow growth rate of forests. The FRA forecasts for 2010 will be available in October 2010.

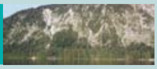
Definitions:

Forests are defined as land with a tree canopy cover of more than 10 % and an area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity *in situ*. Forests do not include land that is predominantly under agricultural or urban use. Forest formations may be either closed — where trees of various storeys and undergrowth cover a high proportion of the ground — or open — with a continuous vegetation cover, of which tree canopy cover exceeds 10 %. Young natural stands and all plantations established for forestry purposes that have yet to reach a canopy cover of 10 % or a tree height of 5 m are included under forests. They are stands that normally form part of a forest — albeit temporarily unstocked because of human intervention or natural causes.

Other wooded land is land of more than 0.5 ha that is not classified as a forest. It has a canopy cover of 5–10 %, comprising trees able to reach a height of 5 m at maturity *in situ*. Alternatively, it has a canopy cover of more than 10 % comprising trees that will not reach a height of 5 m at maturity *in situ* (e.g. dwarf or stunted trees) and shrub or bush cover. It does not include land that is predominantly under agricultural or urban use.

Forest and other wooded land is the total of 'forests' and 'other wooded land'.

Sustainable forest management was defined in 1993 by the Ministerial Conference on the Protection of Forests in Europe as: 'The stewardship and use of forest lands in a way and at a rate that maintains their productivity, biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil now and in the future relevant ecological, economic and social functions at local, national and global levels and that does not cause damage to other ecosystems.'



Growing stock is the volume of all living trees in a given area of forest or wooded land that have more than a certain diameter at breast height. It is usually measured in solid cubic metres (m^3) over bark (i.e. including the bark; FAO glossary).

Net annual increment (NAI) is the average annual volume of gross increase in volume of the growing stock less that of natural losses on all trees with a minimum diameter at breast height of 0 cm. It is measured in cubic metres over bark.

Fellings is the average annual standing volume of all trees, living or dead (measured over bark), which is felled during the reference year, including silvicultural and pre-commercial thinnings left in the forest as well as natural losses (e.g. trees felled by windstorms) which are harvested.

Semi-natural forest: a managed natural forest which, over time, has taken on a number of natural characteristics or planted forests which acquire more natural characteristics over time.

Plantation: planted forests that have been established and are (intensively) managed for commercial production of wood and non-wood forest products, or to provide a specific environmental service.

Natural forest: forests composed of indigenous trees regenerated naturally.

10

Environmental protection expenditure

Defining environmental protection expenditure

Environmental protection expenditure is the money society spends on protecting the environment. Nowadays, the protection of the environment is integrated into all policy fields with the general aim of reaching sustainable development. Clean air, water and soils, healthy ecosystems and rich biodiversity are vital for human life, and thus it is not surprising that our societies devote large amounts of money to curbing pollution and preserving a healthy environment.

Environmental protection expenditure (EPE) is the money spent on activities directly aimed at the prevention, reduction and elimination of pollution resulting from the production or consumption of goods and services (125). These are, for example, waste disposal activities and wastewater treatment activities, as well as activities aimed at noise abatement and air pollution control. Environmental protection expenditure does not directly take into account the expenditure for the sustainable management of natural resources.

All economic sectors, businesses in agriculture, industry and services as well as the public sector and households spend some money on reducing, preventing and eliminating their pressures on the environment.

For instance, both businesses and households pay to safely dispose of waste, production activities spend money to mitigate the polluting effects of production processes and governments pay to provide environmental public goods, such as the basic levels of sanitation required to safeguard health. Governments subsidise environmentally beneficial activities and use public funds to make it easier to borrow money on the financial markets for environmental projects, through measures such as risk sharing, credit enhancement or subsidies to lower the costs of borrowing in communities

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(125) Activities which may be beneficial to the environment, but which primarily satisfy technical needs, or health and safety requirements, are excluded.

that cannot afford the full costs of investments for environmental projects.

The demand for goods and services to prevent or treat environmental damages due to socio-economic activities coming from the growing expenditure in all sectors of the economy encourages the supply of environmental goods and services and stimulates the development of a 'greener' economy.

This chapter provides details on the expenditure carried out by three sectors: public sector, private and public specialised producers and industry. These sectors account for most of the environmental expenditure. The public sector includes mainly central, regional and local public administration. Specialised producers are public or private businesses that provide environmental services, such as waste or wastewater management, as their principal output. Industry includes all activities in mining and quarrying, manufacturing (126) and electricity, gas, and water supply sectors.

Apart from legislative and regulatory tasks, the public sector monitors environmental performance, provides grants and subsidies to encourage environmentally sensitive behaviour and funds research and development activities.

In most European countries, public administrations, such as municipalities, can also provide environmental protection services, such as waste management or wastewater treatment, directly. These services are generally provided by public corporations, whose activities are differentiated from other governmental administrative tasks.

In some countries, however, governments delegate the provision of environmental services to private or (semi-)public corporations whose main activity is directly aimed at protecting the environment. These corporations are called specialised producers and they provide public utility services and typical environmental services, such as waste and wastewater management and soil protection and remediation, as their principal output. The specialised producers are then either public or private corporations.

Industry also plays a role in the protection of the environment. Most industrial activities take internal measures to reduce the environmental impact of their production processes: they invest in cleaner technologies to reduce emissions into air, water and soil and they organise their own waste management services, etc.

The analysis of spending on environmental protection has a strategic interest. For example, it allows the evaluation of the positioning of environmental policies already in place with respect to reference models such as the 'polluter pays' principle. For example, the growth of government-supported environmental expenditure can indicate a situation in which the government, rather than polluters, increasingly intervenes in the environment, and is therefore often indicative of a reality in which this principle is insufficiently applied.

At the same time, a low level of expenditure does not necessarily mean that a country is not effectively protecting its environment. In fact, the indicator tends to emphasise clean-up costs at the expense of cost reductions which could be due to reduced emissions or more effective protection measures.

Environmental expenditure may be broken down in order to analyse its main components. Total EPE is the sum of investments (127) and current expenditure for industry and specialised production sectors, and the sum of investments, current expenditure and subsidies/transfers in the public sector.

Current expenditure includes recurrent spending or, in other words, spending on items that are consumed and only last a limited period of time. These are items that are used up in the process of providing a good or service. Current expenditure would include wages, salaries

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(126) Manufacture excludes the recycling sector: most of these activities are specialised producers in the waste management domain.

(127) Investments are further recorded in two distinct categories: pollution treatment or pollution prevention.

and expenditure on consumables. Investments are tangible fixed assets created to protect the environment from harmful impacts occurring during the production process. Examples of investments from the waste management sector are storage facilities and collecting points, separation plants and shredders and crushers.

Environmental expenditure can also be classified according to which environmental domain (4) is the objective of the expenditure: protection of ambient air and climate (air protection thereafter), wastewater management, waste management, protection and remediation of soil, groundwater and surface water, noise and vibration abatement, protection of biodiversity and landscapes, protection against radiation, research and development and other environmental protection activities.

Air, wastewater and waste are often referred to as the core domains. The other environmental domains are grouped as the non-core domains.

Different sectors' spend for environmental protection

In order to compare expenditure in the different European countries as well as over time, EPE can be expressed in euro per capita and as a percentage of GDP (or gross value added — GVA — when discussing EPE in the industrial sector). When expressed as a share of GDP, EPE is an indicator of the total resources a sector is devoting to protecting the environment.

As Figure 10.1 shows, in 2006, specialised producers spent the most on environmental

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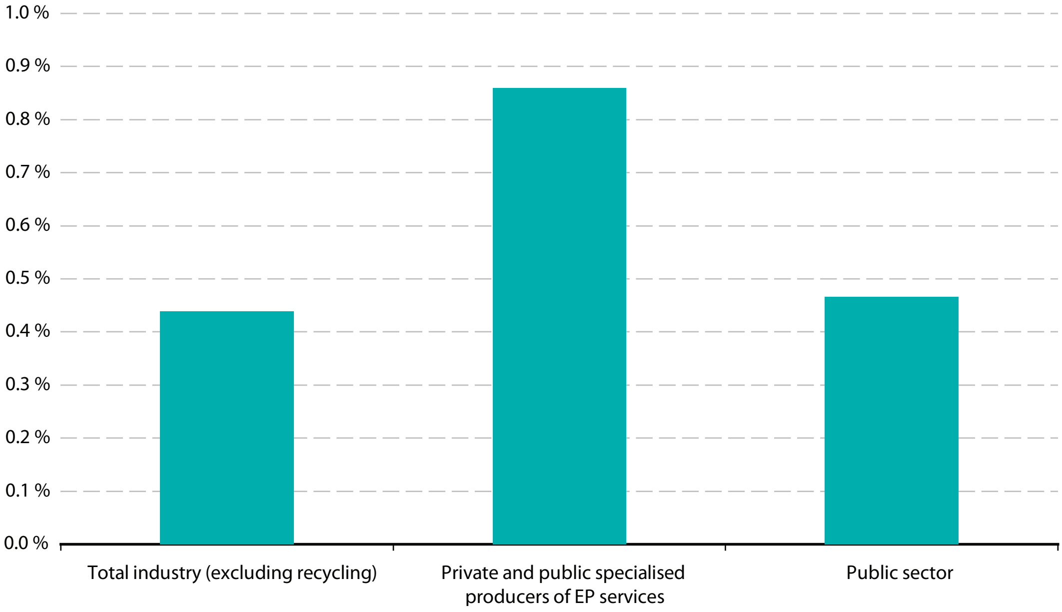
(128) Following the Classification of Environmental Protection Activities (CEPA), Eurostat, European System for the Collection of Economic Data on the Environment — SERIEE (1994).

Figure 10.1: EPE by sectors, EU-25, 2006 *(% of GDP)*



Source: Eurostat (env_ac_exp1), Eurostat (env_ac_exp2) and Eurostat estimates.

protection in the EU-25. Their expenditure accounted for 0.86 % of GDP, which was equal to EUR 214 per capita. Industry and the public sector spent roughly the same (0.44 % and 0.52 % of GDP), which is equal to EUR 109 and EUR 116 per capita respectively.

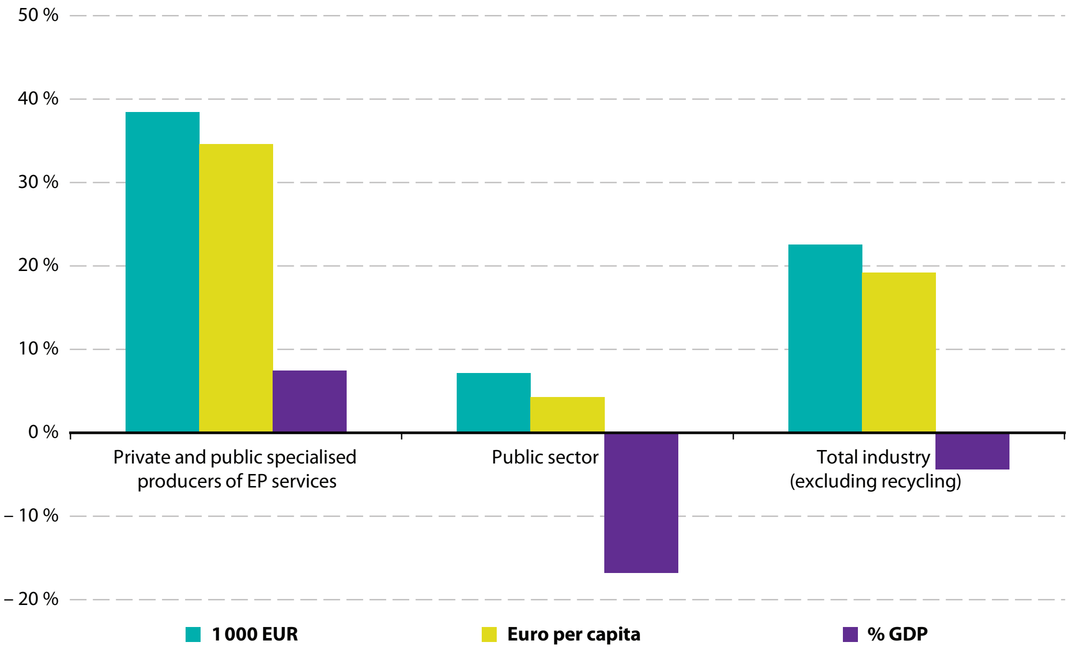
Summing up the expenditure of the three sectors gives a total of 1.82 % of the EU-25's GDP allocated for protecting the environment in 2006.

Between 2000 and 2006, EPE grew in the three sectors in absolute and per capita terms, but decreased as a share of GDP for the public sector and industry. For specialised producers, on the other hand, the EPE grew as a share of GDP (Figure 10.2). These trends have to be interpreted with caution due to the fact that the share of GDP tends to fall if data on EPE are not adjusted for inflation.

Nevertheless, the increase of specialised producers' EPE as a share of GDP and the corresponding decrease for the public sector (– 17 %) and industry (– 5 %) could be due to the privatisation or semi-privatisation of some environmental activities such as wastewater treatment or waste collection in some countries. These environmental activities were mainly carried out by municipalities, and were then turned into private and semi-public corporations so that they now fall into the specialised producers group.

The following sections explain in detail the evolution and the structure of the EPE within the public sector, specialised producers and industry.

Figure 10.2: EPE's change by sector, EU-25, 2000 and 2006 *(%)*



Source: Eurostat (env_ac_exp1), Eurostat (env_ac_exp2) and Eurostat estimates.

Public sector expenditure on environmental protection

EU-25 public sector expenditure

In the EU-25, most of the money spent by the public sector in 2006 went towards providing waste management services, as well as activities related to soil, biodiversity and landscape protection, protection against radiation and research and development. Spending was mostly related to current costs, rather than investments or subsidies/transfers ([129]).

In 2006, 42 % of investments and current expenditure made by the public sector in the EU-25 towards protecting the environment against pollution were devoted to non-core domains, 40 % to waste management activities and 17 % to wastewater management (Figure 10.3). Only a fraction of all general government expenditure went towards air protection activities. These activities are in fact mainly carried by industry, since they mostly have to do with changes in the industrial production processes to reduce and prevent air emissions.

Generally speaking, current expenditure has the biggest share in EPE compared to investments and subsidies/transfers.

Between 2000 and 2006, the repartition of investments and current expenditure for environmental protection between core and non-core domains remained unchanged. The main change in the composition of the public sector's investments and current expenditure for environmental protection occurred inside the core domains and relates to a shift from wastewater management and air protection activities to waste management activities (Figure 10.4).

In 2006, compared with 2000, investments for environmental protection grew by 52 % for the non-core domains, while current expenditure slightly dropped, by 9 %. On the other hand, for the core domains the trend was the opposite: investments dropped by 21 % while current expenditure grew by 17 %. The decrease in investments in the

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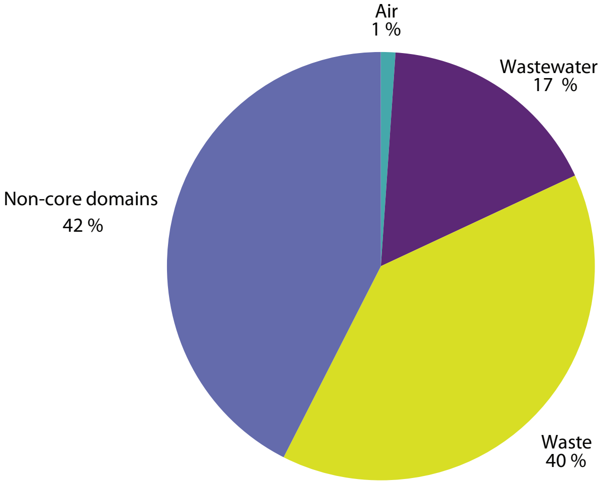
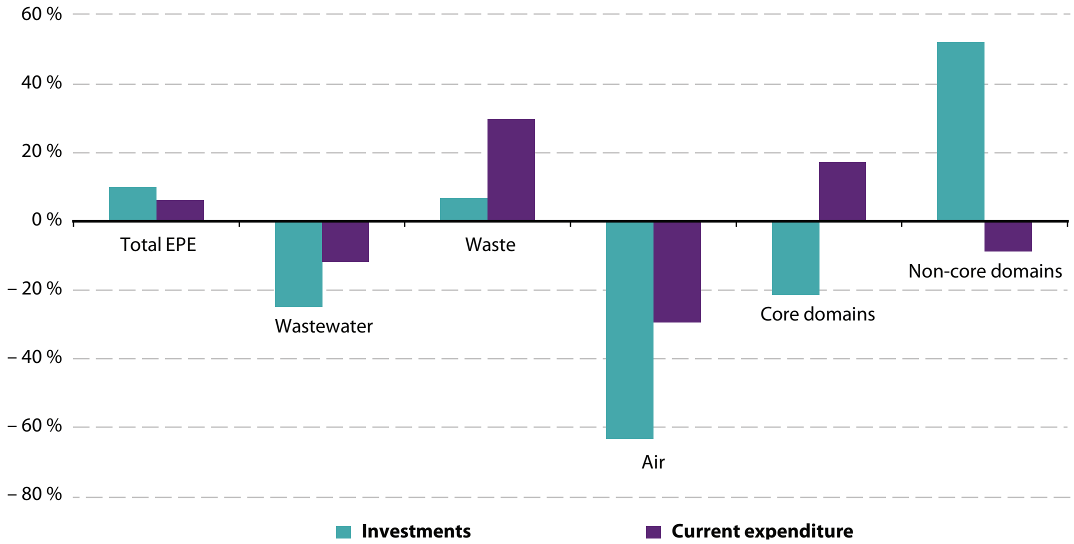
([129]) Subsidies and transfers are not investigated in this publication.

Figure 10.3: Public sector investments and current expenditure by environmental domain, EU-25, 2006 *(% of total public sector investments and current expenditure)*



Source: Eurostat (env_ac_exp1) and Eurostat estimates.

Figure 10.4: Public sector EP investments and current expenditure change by environmental domain, EU-25, 2000 and 2006 *(%)*



Source: Eurostat (env_ac_exp1) and Eurostat estimates.

core domains was due to a reduction of investments in air protection (– 62 %) and wastewater (– 22 %) domains which was not compensated by the increase in waste management investments (+ 6 %).

The increase of current expenditure in the core domains was due to an increase of 30 % in waste management domains which overtook the reductions of current expenditure for air (– 30 %) and wastewater (– 10 %) domains.

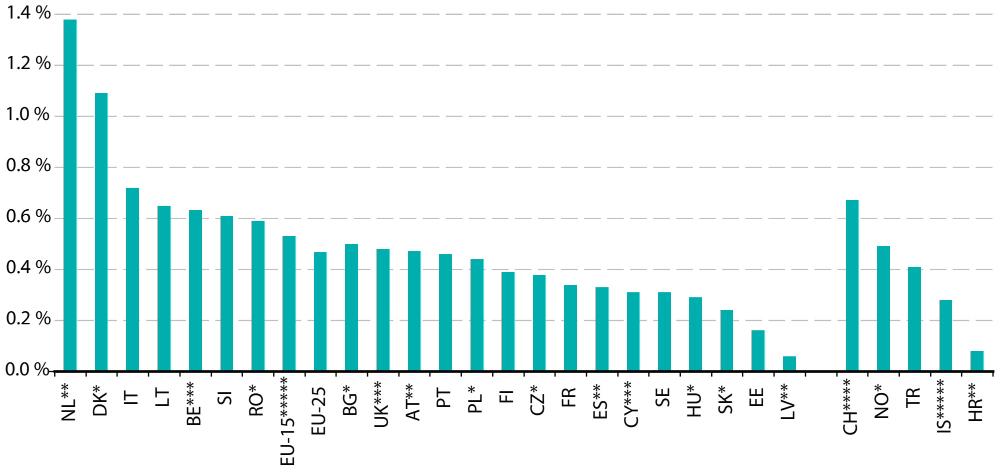
The dynamic of the public sector's investments and current expenditure for environmental protection can be explained by the fact that the public sector has begun to devote resources to the environmental domains which first received greater regulatory attention, such as problems related to waste, wastewater and air pollution. The implementation of these regulations has strongly relied on investments in end-of-pipe equipment, such as wastewater treatment plants and collecting systems, which now require few additional investments and mainly current expenditure to be carried out. Furthermore, with the increasing presence of specialised producers, the public sector has been investing less and less in environmental protection, as these producers increasingly take over the activities in the waste and wastewater management domains.

Public administrations are nowadays shifting their attention and their budget towards other environmental problems such as biodiversity conservation, soil remediation and the reduction of noise. Furthermore, the implementation of the 'polluter pays' principle could be responsible for the reduction of the expenditure in the core domains, since the responsibility for the pollution of air and water and the generation of waste are more easily identified than in the case of biodiversity losses.

Public sector expenditure in 2006

In most European countries, the public sector spent between 0.2 and 0.6 % of GDP in 2006 in

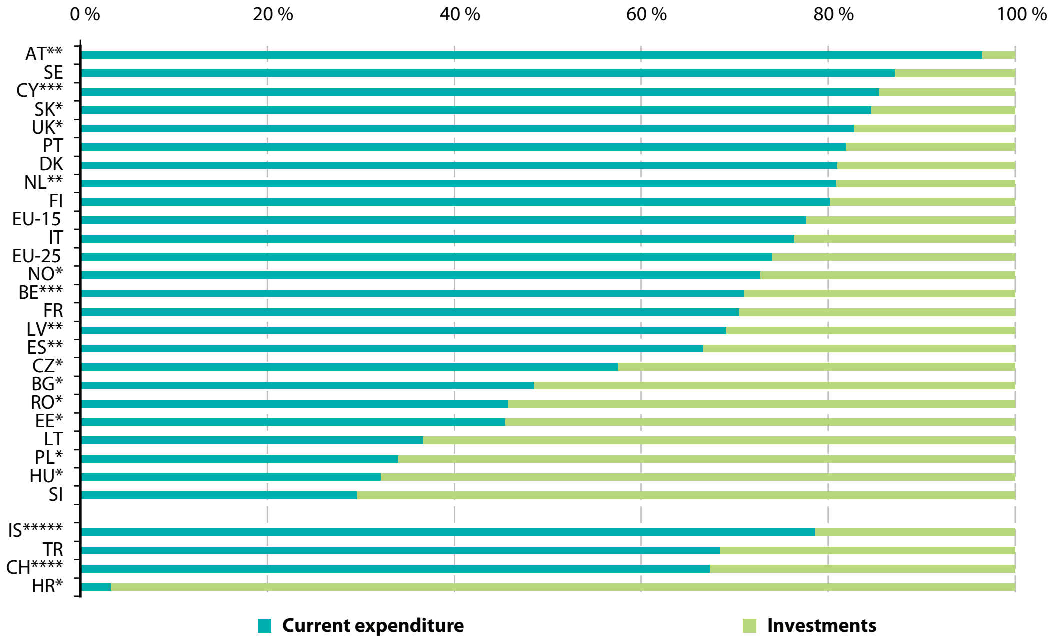
Figure 10.5: Public sector investments and current expenditure for environmental protection, 2006 (% of GDP)



* 2007, ** 2005, *** 2004, **** 2003, ***** 2002

Source: Eurostat (env_ac_exp1)

Figure 10.6: Public sector environmental protection investments and current expenditure, 2006 *(% of total investments and current expenditure)*



* 2007, ** 2005, *** 2004, **** 2003, ***** 2002

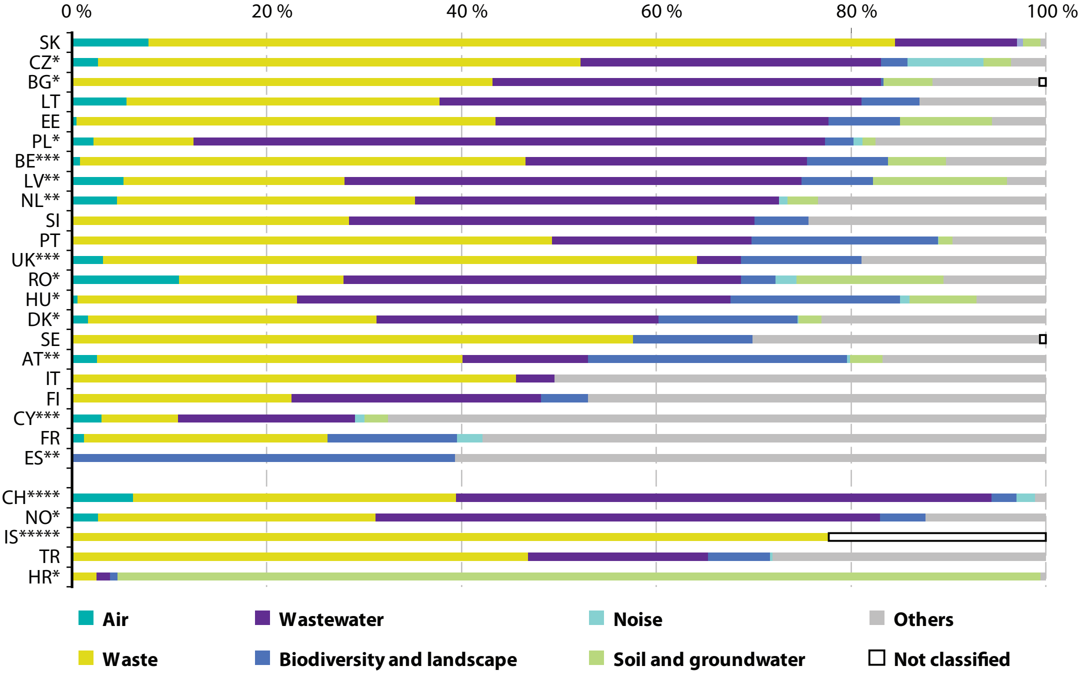
Source: Eurostat (env_ac_exp1)

terms of environmental protection investments and current expenditure. The Netherlands, in 2005, devoted almost 1.4 % of its GDP, while in the same year Latvia allocated only 0.06 % of its GDP (Figure 10.5).

The share of investments in 'total current expenditure + investments' in most of the new Member States is well above the 25 % EU-25 average (Figure 10.6). This is probably due to the high level of expenditure in fixed assets needed to start off activities required by the more stringent EU environmental legislations. For EFTA countries and Turkey, the share of investments in 'total investments + current expenditur' is more or less close to the EU-25 average, while in Croatia it is over 95 %.

Wastewater treatment and waste management are generally the main domains in which the public sector spends. However, according to Figure 10.7, some countries' public sectors spent the most in other domains. This is the case, for example, in Spain, where the public sector principally spent on the protection of biodiversity and other environmental domains. Several countries, like Italy, Cyprus and Spain, classified a relevant part of their general government expenditures as 'other': this includes general environmental administration and management, education, training and information for the environment as well as activities leading to indivisible expenditure and activities not classified elsewhere. Another interesting trend can be seen in Croatia, where more than 95 % of the public sector's investments and current expenditure were devoted to soil and groundwater protection.

Figure 10.7: Public sector investments and current expenditure by environmental domain, 2006, share of total domains



* 2007, ** 2005, *** 2004, **** 2003, ***** 2002

Source: Eurostat (env_ac_exp1)

Specialised producers' expenditure

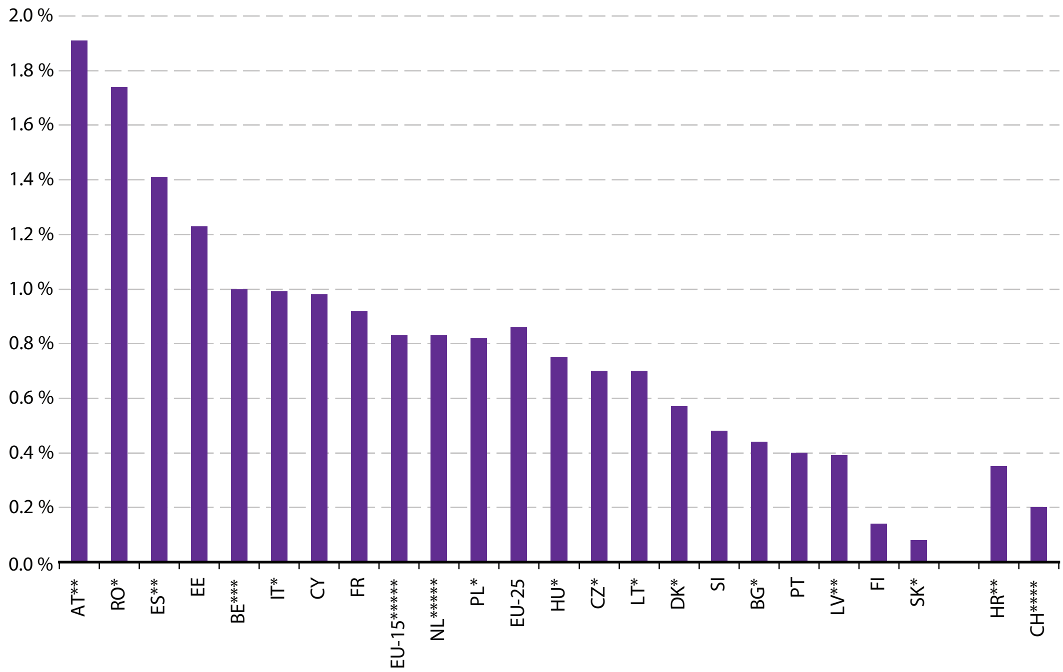
In 2006, the EPE of specialised producers (both public and private) represented around 0.9 % of the EU-25's GDP. The increase in the share of expenditure of this sector in GDP in 2006 compared with 2000 was almost 8 %.

Specialised producers' expenditure in European countries

The expenditure of specialised producers in the European countries in 2006 varies quite a lot (Figure 10.8). Slovakia and Finland are the only countries where specialised producers spent around 0.1 of GDP. Conversely, in Austria and Romania, the expenditure of specialised producers represented more than 1.7 % of GDP.

This varying trend might be due to the fact that in some countries some environmental activities are carried out by specialised producers, whereas in other countries the same activities are still carried out by the public sector. Another reason for the differing levels of expenditure as a share of GDP can be the degree of internalisation of some environmental activities, such as waste and wastewater management by the industry. This is particularly the case for industrial activities which have set in-house waste management services aiming to recycle part of the discarded materials for reintroduction and reuse in the production process.

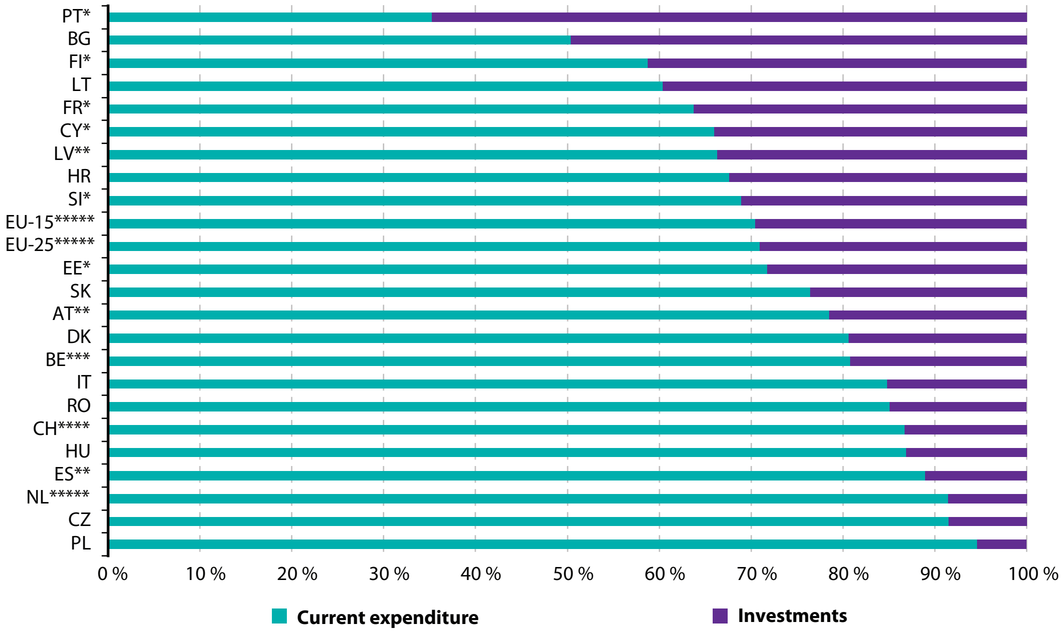
Figure 10.8: Public and private specialised producers' EPE, 2006 *(% of GDP)*



* 2007, ** 2005, *** 2004, **** 2003, ***** 2001

Source: Eurostat, (env_ac_exp1)

Figure 10.9: Public and private specialised producers' EP investments and current expenditure, 2006 *(% of total EPE)*



* 2007, ** 2005, *** 2004, **** 2003, ***** 2001

Source: Eurostat (env_ac_exp1)

The current expenditure of specialised producers is largely predominant, representing 71 % of the specialised producers' EPE in the EU-25 in 2001.

The predominance of current expenditure on investments is observed in most Member States, except in Portugal and Bulgaria, where investments accounted for 65 and 50 % of the total EPE respectively. In the Netherlands, the Czech Republic and Poland, more than 90 % of the expenditure by specialised producers is current expenditure.

Specialised producers' spending domains

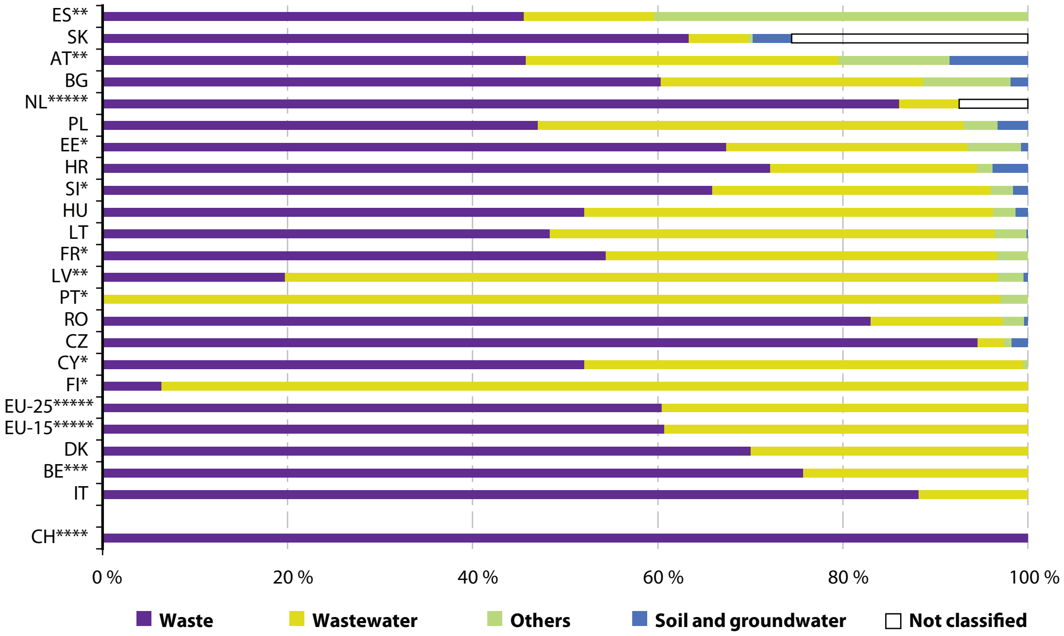
In 21 of the 24 countries for which data are available, expenditure for waste management and wastewater management accounted for 90 % or more of specialised producers' EPE (Figure 10.10). The rest of the EPE was for soil and groundwater protection (for example, for soil decontamination activities) or has been classified in the 'other' domain.

On average, over 60 % of the specialised producers' environmental protection expenditure in EU, EFTA and candidate countries is directed towards waste management.

Wastewater treatment expenditure comes in second place, while in Latvia, Poland and Finland this domain is the principal beneficiary of environmental expenditure of specialised producers.

A particular case is Spain, where around 40 % of the specialised producers' environmental expenditure is devoted to domains other than waste and wastewater.

Figure 10.10: Public and private specialised producers' EPE by environmental domain, 2006 (% of total EPE)



* 2007, ** 2005, *** 2004, **** 2003, ***** 2001

Source: Eurostat (env_ac_exp1)

The purpose of industrial environmental expenditure

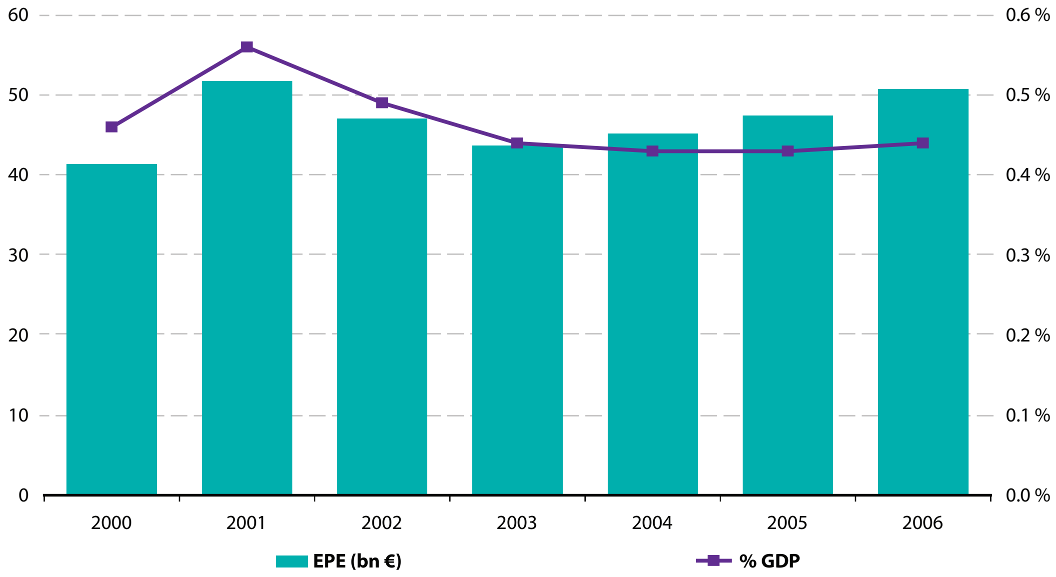
In 2006, the EU-25's industrial environmental protection expenditure reached EUR 50 billion, increasing by 20 % compared with 2000 when it was EUR 41 billion. This growth was not linear. EPE jumped to a maximum of EUR 52 billion in 2001, decreased until 2003 and increased again until 2006 to reach a level not far from that of 2001.

As a share of GDP, however, industrial environmental expenditure showed a downward trend from 2001 to 2004. In 2005 and 2006 it did not move significantly from its 2004 level of 0.43 % of GDP. From 2000 to 2006, the percentage in GVA represented by the industrial EPE of the EU-25 remained stable at around 2.5 %.

For the 2001–06 period, investments for environmental protection in the EU-25 accounted for an average of 22 % of the total industrial EPE (Figure 10.12). In absolute terms, the EU-25's EP investments suffered an important decrease between 2000 and 2004 and slightly increased in 2005 and 2006. When expressed as a share of industrial GVA, EP investments represent 2.8 % of GVA in 2006 (Figure 10.15).

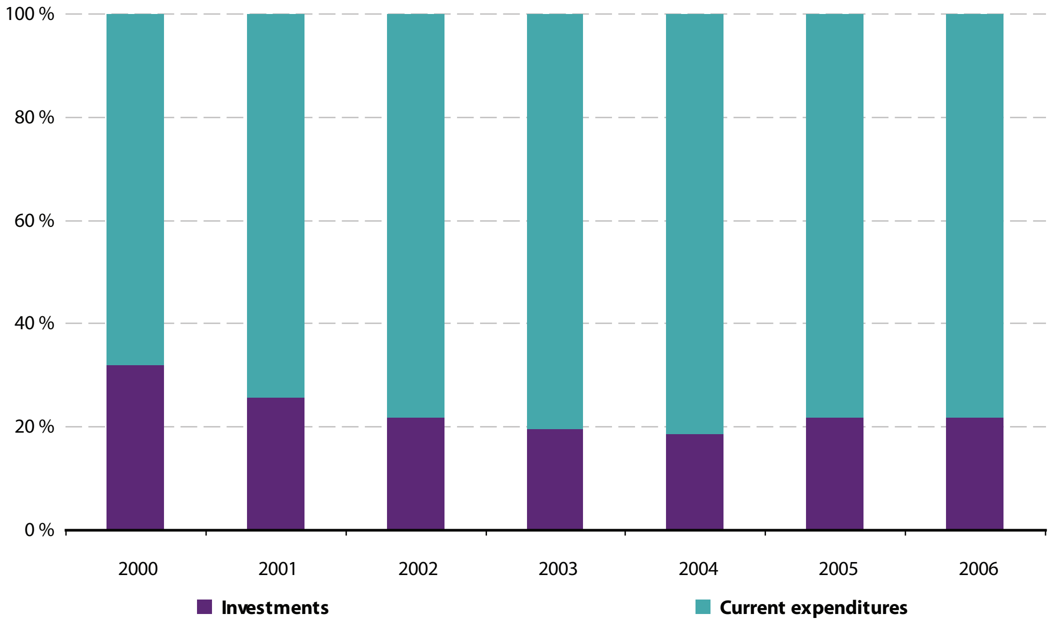
Current expenditure was predominant in the EU-25's industrial EPE during the same period. The share of current expenditure on total EPE constantly increased from 70 % in 2000 to almost 80 % in 2006 (Figure 10.12).

Figure 10.11: Industrial EPE, EU-25 *(billion EUR and % of GDP)*



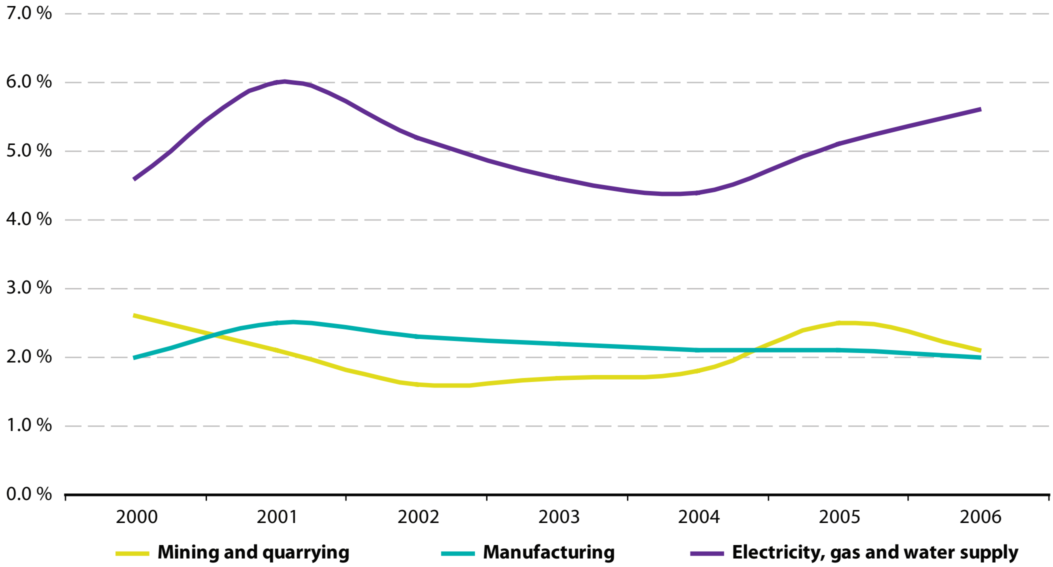
Source: Eurostat (env_ac_exp2)

Figure 10.12: Industrial EP investments and current expenditure, 2000–06 *(% of total EPE)*



Source: Eurostat (env_ac_exp1)

Figure 10.13: EPE by industrial subsector, EU-25 *(% of GVA)*



Source: Eurostat (env_ac_exp1)

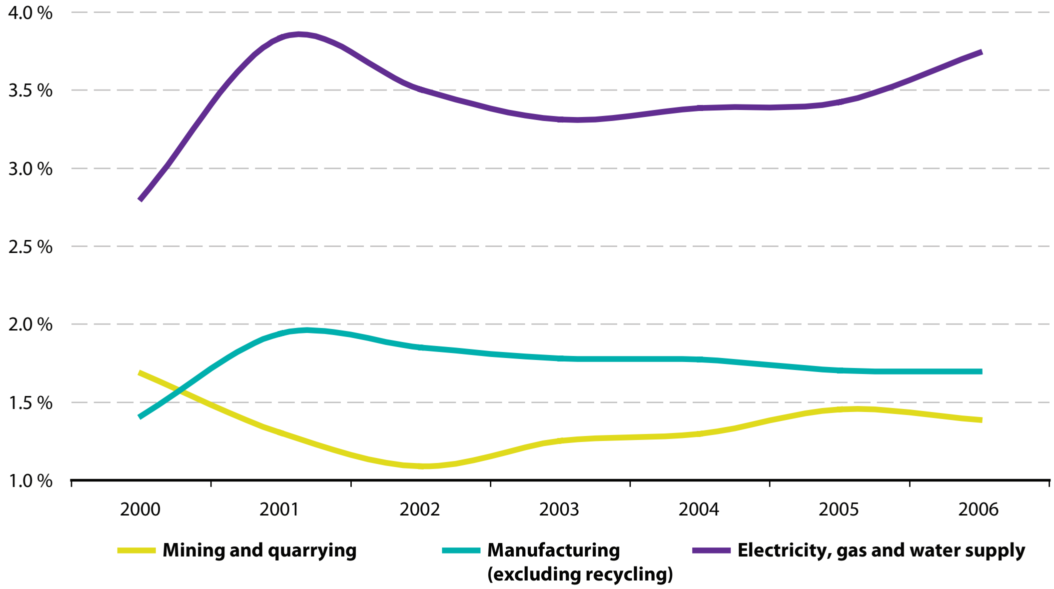
In 2006, the manufacturing sector accounted for 71 % of total industrial EPE in the EU-25, whereas the electricity and water supply sector accounted for 25 % and the mining and quarrying sector for only 4 %.

When considering the environmental industrial protection expenditure in the three mentioned sectors as a share of their GVA, the electricity, gas and water supply sector is the sector that devoted the most to environmental protection (5.6 % of its GVA in 2006). This sector reached a maximum environmental expenditure of 6 % of GVA, (almost EUR 10 billion) in 2001. The manufacturing and mining sectors both spent around 2 % of their GVA on environmental protection; almost three times less than the electricity sector. This situation might be explained by the fact that environmental regulations focused a lot on air emissions and that the production of electricity is the main cause of air pollution in the industrial sector.

The evolution of industrial EPE was not gradual and great changes were often seen over the years in the three sectors. The EPE of the manufacturing sector has been steadily growing at a lower rate than GVA from 2001 to 2006 and this is due to a reduction in both current expenditure and in investments.

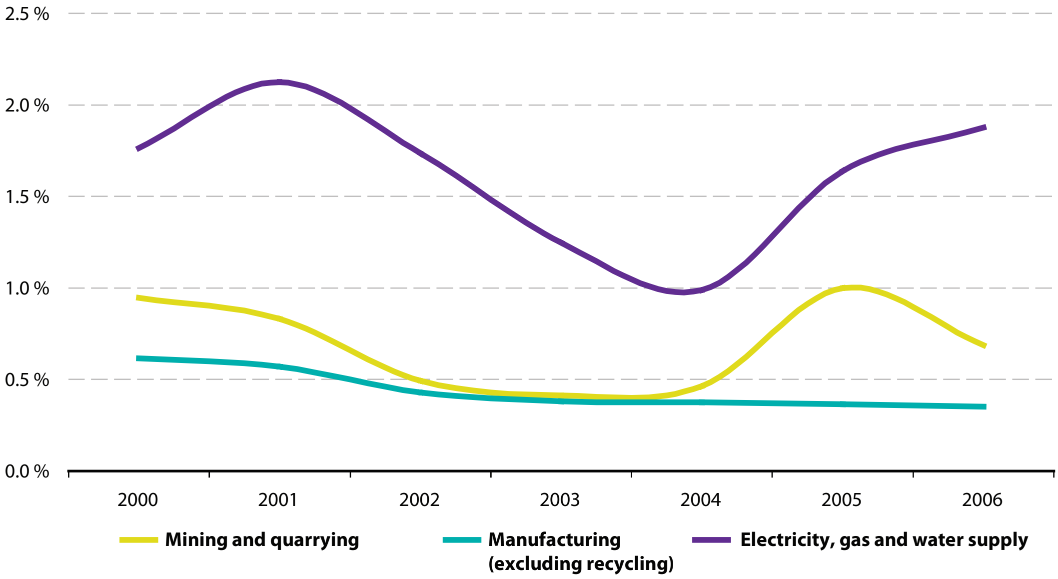
When looking at the current expenditure rather than the total environmental protection expenditure, it emerges that in 2006 the current expenditure for the manufacturing sector in total current expenditure was 76 %, for electricity 21 % and for mining and quarrying 3 %. For the mining and quarrying sector, EPE as a share of GVA decreased from 2000 to 2002 and then increased up to 2005. This growth can be explained mainly by an increase in investments. For the electricity sector, both the decrease of EPE as a share of GVA between 2001 and 2004 and the increase between 2004 and 2006 are mostly due to changes in investments (Figure 10.13).

Figure 10.14: EP current expenditure by industrial subsector, EU-25 *(% of GVA)*



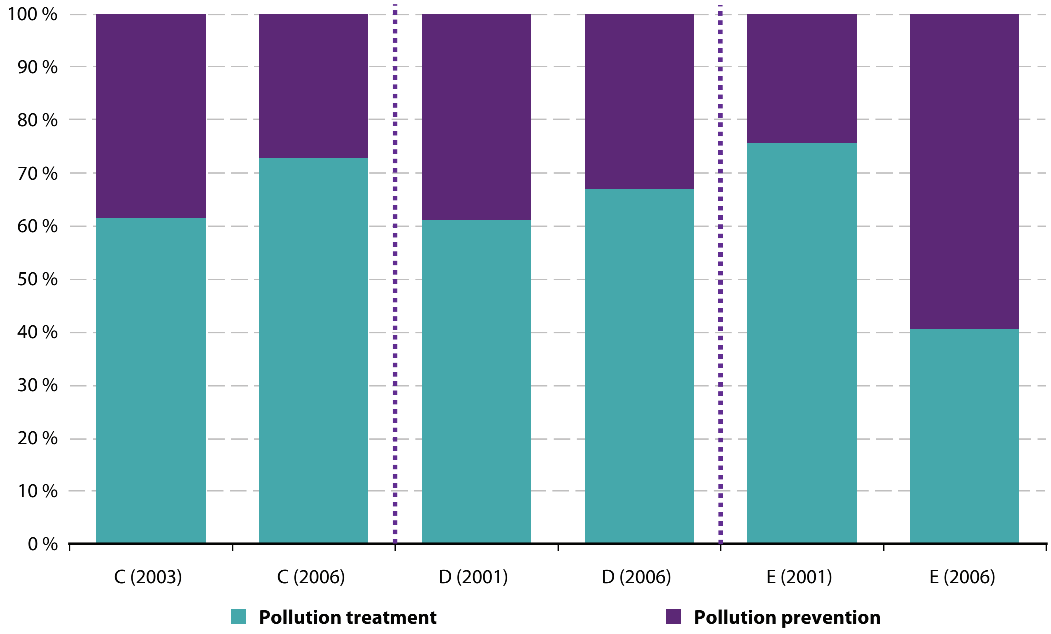
Source: Eurostat (env_ac_exp1)

Figure 10.15: EP investments by industrial subsector, EU-25 *(% of GVA)*



Source: Eurostat (env_ac_exp1)

Figure 10.16: Industrial pollution prevention and pollution treatment investments, EU-25, 2001 and 2006 *(% of EP investments)*



Source: Eurostat (env_ac_exp1)

EP investments can be classified as either pollution treatment (e.g. wastewater plants, filters for particulates) or pollution prevention investments (e.g. new less polluting or more energy-efficient equipment).

In 2001, more than 62 % of the EU-25's EP industrial investments were devoted to pollution treatment measures. This share increased in 2006 both for the mining and quarrying and the manufacturing sectors, but went down for the electricity sector (Figure 10.16).

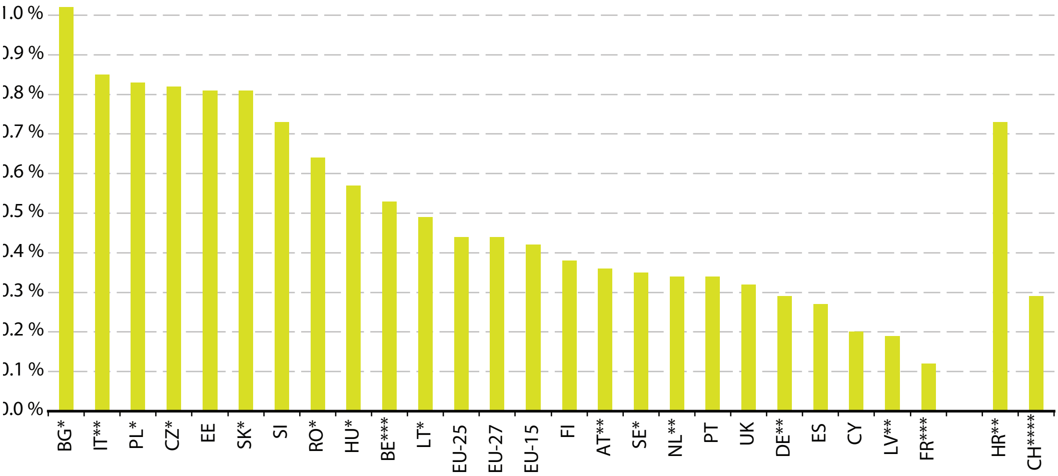
The decreasing share of pollution treatment investments in the electricity sector from 75 % in 2001 to 40 % in 2006 illustrates the shift from end-of-pipe equipment and clean-up services to integrated and clean environmental technologies and products. The demand is indeed shifting to product substitution and industrial process modifications due to both greater emphasis on pollution prevention policies and businesses' strategic environmental planning.

Industrial expenditure variation and distribution

Industrial expenditure in the European countries varied a lot in 2006 as it depends on the industrial structures of each country (Figure 10.17). In any case, in most of the countries, the industrial EPE is between 0.2 and 0.8 % of GDP.

In six countries, industry spent more than 0.8 % of GDP for environmental protection activities: Slovakia, Estonia, the Czech Republic, Poland, Italy and Bulgaria. On the other hand, in three countries industrial EPE was below 0.2 % of GDP: Cyprus, Latvia and France.

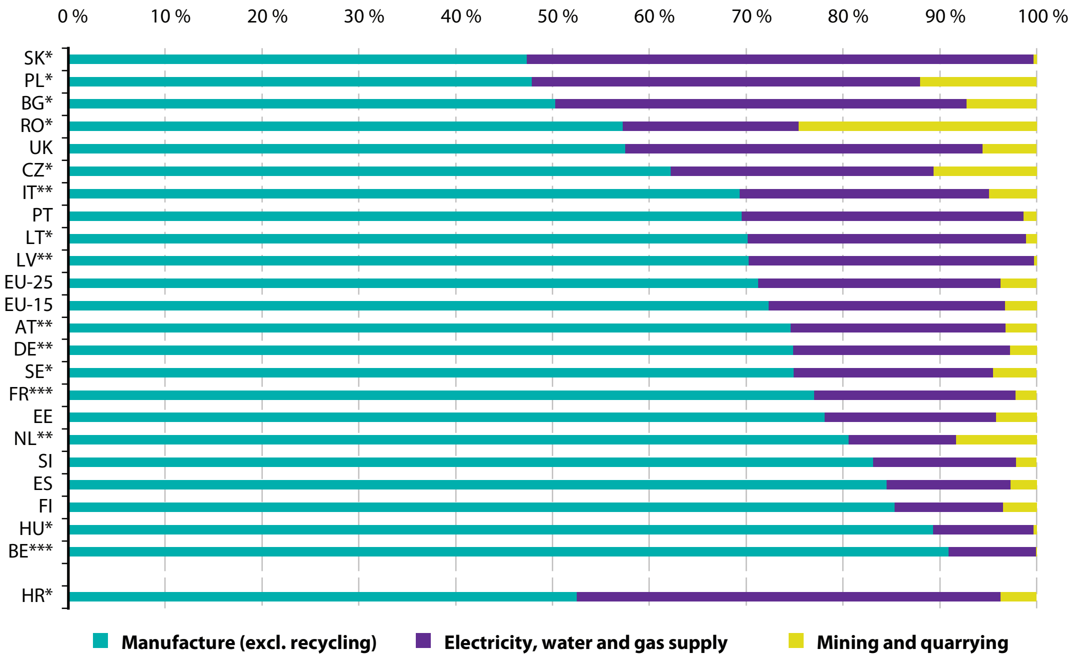
Figure 10.17: Industrial EPE, 2006 *(% of GDP)*



* 2007, ** 2005, *** 2004, **** 2003

Source: Eurostat (env_ac_exp1)

Figure 10.18: EPE by industrial subsector, 2006, *(% of total industry's EPE)*



* 2007, ** 2005, *** 2004

Source: Eurostat (env_ac_exp1)

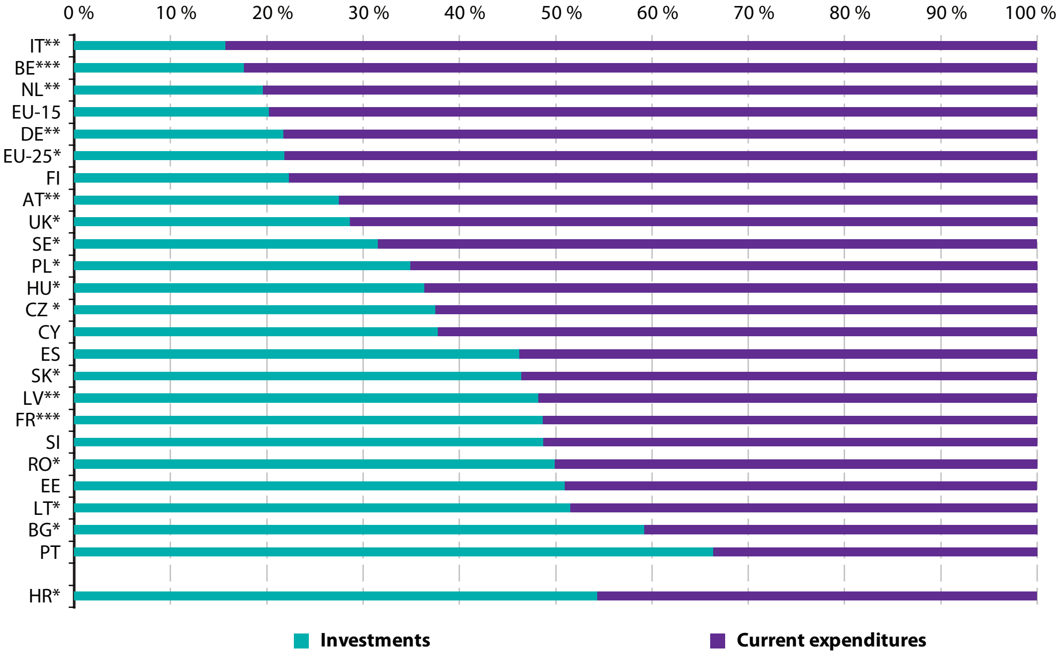
Important differences among countries also emerge when looking at the repartition of the EPE in the three main industrial sectors. The manufacturing sector is the biggest spender in all the countries, with more than 48 % of the total, except in Slovakia, where the biggest spender is the electricity, gas and water supply sector. The manufacturing sector accounted for more than 90 % of industrial EPE in Belgium (Figure 10.18).

Most of the new Member States, except Hungary, Estonia and Romania, had a share of EPE in the electricity, gas and water sector higher than the EU-27 average. This is mainly due to the effort they made to improve their electricity generation sector by reducing emissions. The share of the electricity, gas and water sector was the lowest in Belgium and the Netherlands (only 10 % of total industry EPE).

Romania, Poland and the Czech Republic were the countries with the biggest share of EPE from the mining and quarrying sector. In particular, in Romania the mining and quarrying sector accounted for 24 % of total industrial EPE, compared with the EU-27, for which the contribution of this sector was just 4 %. The countries where the share of the mining and quarrying sector was negligible are Belgium, Latvia and Hungary.

It is worth noting that most of the EU-25 countries were also devoting a larger share of EPE to current expenditure rather than investments. Italy, Belgium and the Netherlands spent more than 80 % of their total EPE on current expenditure. The exception to this trend is Portugal, which spent only 35 % of its industrial EPE on current expenditure (Figure 10.19).

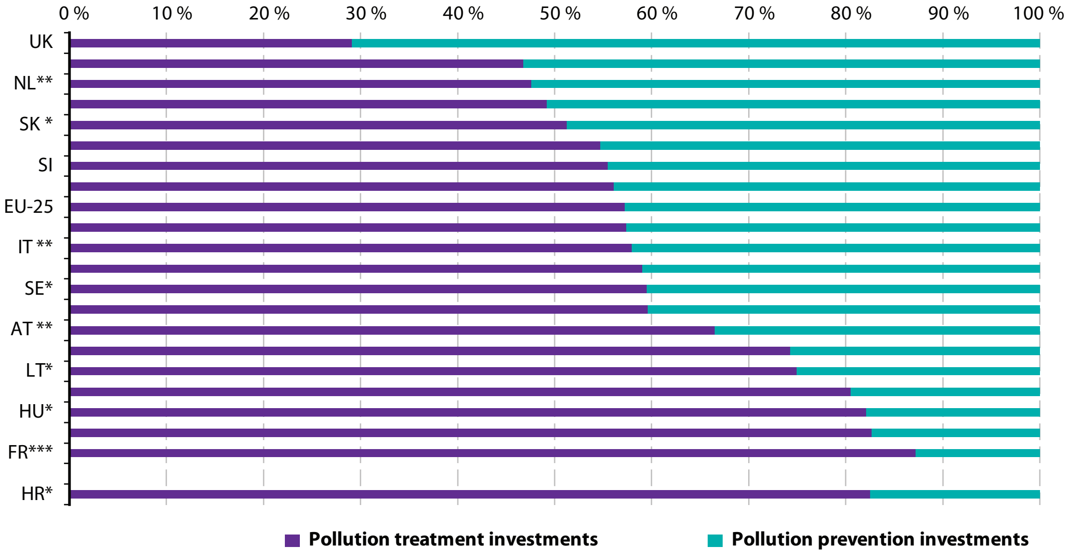
Figure 10.19: Industrial investments and current expenditure for environmental protection, 2006
(% of total EPE)



* 2007, ** 2005, *** 2004

Source: Eurostat (env_ac_exp1)

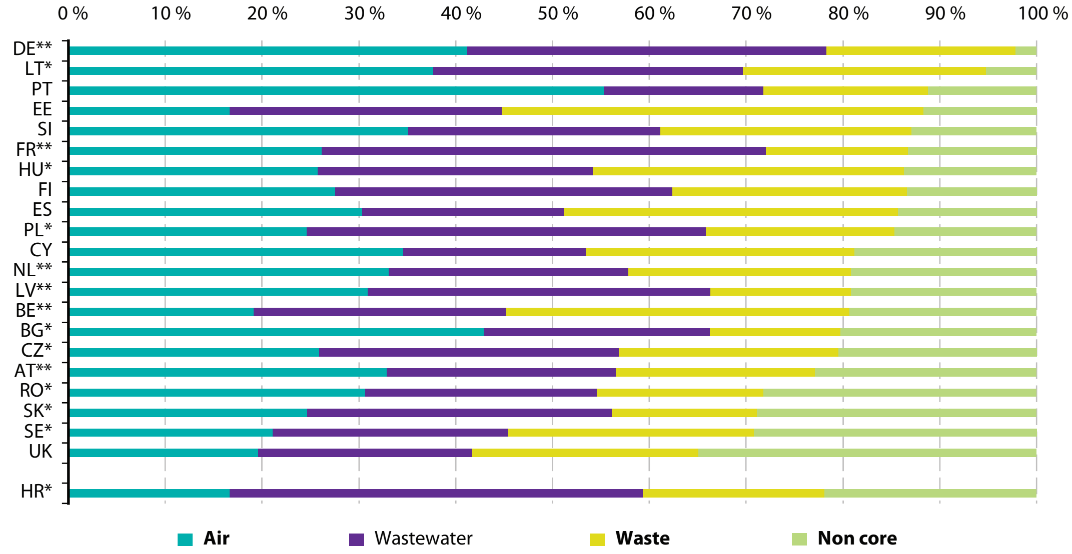
Figure 10.20: Industrial pollution treatment and pollution prevention investments, 2006 *(% of total investments for environmental protection)*



* 2007, ** 2005, *** 2004

Source: Eurostat (env_ac_exp1)

Figure 10.21: Industrial EPE by environmental domain, 2006 *(% of total EPE)*



* 2007, ** 2005, *** 2004

Source: Eurostat (env_ac_exp1)

Some of the new Member countries including Latvia, Estonia, Croatia and Bulgaria were the leading investors concerning tangible fixed assets, with more than 50 % of their total industrial investments.

Pollution treatment investments represented the biggest share of investments for most countries. France and Poland spent the most on investments for pollution treatment, 87 % and 82 % of their environmental investments respectively. Only the United Kingdom devoted more than 70 % of its environmental investments to pollution prevention (Figure 10.20).

Countries that spent considerably more in 2006 on non-core domains were the United Kingdom and Italy (both 35 % of total industrial EPE). Germany and Lithuania, on the other hand, focused their expenditure on core domains: their industries spent less than 5 % of their EPE on non-core domains (Figure 10.21).

In many countries, EPE was equally distributed among core domains. An exception was Portugal, where industry spent much more on air pollution protection (50 % of total industry's EPE) than on waste management and wastewater treatment.

France spent the most on wastewater treatment (45 % of total industry EPE) while Estonia is the country devoting the largest share of industrial EPE to waste management.

Conclusions: Environmental protection expenditure in Europe

Environmental protection expenditure measures are all actions and activities that are aimed at the prevention, reduction and elimination of pollution, as well as any other degradation of the environment. Thus it is an indicator of the commitment of society to protect the environment.

Three sectors — the public sector, private and public specialised producers and industry — account for most of the environmental expenditure. In 2006, the expenditure for protecting the environment in the EU-25 by these three sectors was equal to 1.8 % of GDP.

In the EU-25 in 2006, most of the money spent by the public sector went towards providing waste management services and services in the non-core domains. The EPE of specialised producers was mainly directed towards waste and wastewater management activities. Industrial EPE in most European countries was evenly distributed among environmental domains.

For many years, European statistical services have collected data on air pollution, energy, water consumption, wastewater and solid waste and on their management, in addition to environmental data of an economic nature, as environmental expenditure. The links between all these data enable policymakers to consider the environmental impacts of economic activities (resource consumption, air or water pollution, waste production) and to assess the actions (investments, technologies, expenditure) carried out to limit the causes and risks of pollution.

Eurostat has worked towards systematising the gathering of environmental statistics about the activities of all economic sectors within the EU. These statistics are used to assess the effectiveness of new regulations and policies. The second use of these statistics is for the analysis of the links between the pressures on the environment and the structure of the economy. Harmonised, comparable and comprehensive statistics about environmental expenditure and the sectors funding that expenditure should help to improve policy-makers' decisions.

Further information

Eurostat main tables and database

Environment, see: Environmental accounts (t_env_acc) : Environmental expenditure by the public sector (ten00049); Current environmental expenditure by the public sector (ten00051); Current environmental expenditure by industry (ten00054); Environmental investment by the public sector (ten00050); Environmental investment by industry (ten00053); Environmental protection expenditure by industry (ten00052); Distribution of environmental protection expenditure by the public sector by domain — 2002 (ten00055); Distribution of environmental protection expenditure by industry by domain — 2002 (ten00058); Distribution of environmental investment by industry by domain — 2002 (ten00059)

Environment, see: Environmental accounts (env_acc), Environmental protection expenditure in Europe — detailed data (env_ac_exp1)

Eurostat dedicated section

Statistics explained: environmental protection expenditure

http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Environmental_protection_expenditure

Eurostat publications

European System for the Collection of Economic Information on the Environment (SERIEE), Methods and Nomenclatures, 1994

SERIEE Environmental Protection Expenditure Accounts – Compilation Guide, Methods and Nomenclatures, 2002

Environmental protection expenditure in Europe by General Government and specialised producers 1995–2002, SiF 9/2005, 2005

Environmental protection expenditure by industry in the European Union, SiF 10/2005, 2005

Environmental protection expenditure by industry in the European Union 1997–2004, SiF 93/2008, 2008.

Environmental protection expenditure and revenues in the EU, EFTA and candidate countries 2001–2006, SiF 31/2010, 2010.

Methodological notes

This publication presents data from the statistical office of the European Union (Eurostat) on environmental protection expenditure (EPE) by the public sector, specialised producers (public and private) and the industrial sector in the European countries for the period 1995–2007. The period can vary according to data availability for each country as well as for the EU aggregates.

Since 1996, data on environmental protection in all economic sectors are collected every two years using a joint OECD/Eurostat questionnaire, which is addressed to 37 countries (EU-27, EFTA and candidate countries). The data reporting is voluntary. The EU-25 is the reference aggregate for the rest of the publication. EU aggregates are calculated by summing up the national figures. If no data are available for a certain country and year, estimations are made by Eurostat to 'fill the gap'. These Eurostat estimates are not presented at national level. No other estimation has been made to compensate for variations in coverage or possible underestimation at national level.

Data are published for the European Union as well as for each Member State separately. In addition, data for Turkey, Croatia and the EFTA countries (Iceland, Norway and Switzerland) are provided, when available.

All data presented in this publication are available from the Eurostat dissemination database environment section. The main macroeconomic indicators used for analysis are from national accounts in the economy and finance section, while population figures (on 1 January) are from the demographic section.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Environmentally related taxes

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The importance of environmental taxes as a policy tool

To face environmental problems, extensive and profound changes to existing production and consumption patterns are needed. These changes involve substantial economic costs and can also considerably affect labour and capital markets. The search for instruments capable of producing behavioural changes across all sectors at minimal cost and impact is causing policymakers to pay much closer attention to incentive-based tools, that is, economic tools for the environment (also called market-based instruments).

Economic tools for the environment

Currently, a variety of economic tools are available to the EU in order to reach environmental and sustainable development goals. Fines, charges and taxes, tradable permit systems and deposit-refund systems (130), to name but a few, are used to penalise those who pollute or misuse the environment, to impose the costs of use on the user and to serve as incentives for the adoption of environmentally friendly behaviour.

The EU has increasingly favoured these instruments because they provide a flexible and cost-effective means for reaching environmental policy objectives. The economic rationale for their use comes from their ability to correct market failures (131) in a cost-effective way, unlike regulatory or administrative approaches which tackle environmental problems only as

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(130) The terms charges and fees are often used interchangeably. As opposed to taxes, they are seen as payments for a service, i.e. requited payments. The OECD defines charges and fees as: 'compulsory, requited payments to either general government or to bodies outside general government, such as for instance an environmental fund or a water management board.' A tradable permit is a transferable right to emit a substance which pollutes the environment. A deposit refund system requires consumers to pay a deposit which is subsequently refunded when consumers return the reusable part of the commodity (glass bottles for instance).

(131) Market failure refers to a situation in which markets are either entirely lacking (e.g. environmental assets having the nature of public goods) or do not sufficiently account for the 'true' or social cost of economic activity.

technical issues to be resolved by setting emissions limits, banning specific substances or enforcing the use of specific abatement technologies.

The most commonly used economic tools for the environment are taxes, charges and tradable permit systems. While in economic terms these tools work in similar ways, there are differences between them. Environmental taxes (and, to a lesser extent, charges) have been used increasingly to influence behaviour, since they also generate revenue that can be used for environmental protection, which is not the case with tradable permit schemes (132), for instance.

Environmentally related taxes (for convenience referred to as environmental taxes) can be levied to discourage behaviour that is potentially harmful to the environment. They can provide incentives to lessen the burden on the environment and to preserve it by integrating the cost of adverse environmental impacts into prices. Taxes are a tool for implementing the 'polluter pays' principle since they allow pricing in environmental externalities. Through environmental taxes, consumers and producers are motivated to use natural resources responsively and to limit or avoid environmental pollution.

Environmental taxes

An environmental tax is defined as a tax whose tax base (i.e. the activities as well as the assets subject to the tax) is a physical unit that has a proven, specific, negative impact on the environment (133), such as, for example, the measured or estimated level of emissions of a polluting substance, such as NO_x, CO_2 or SO_2. However, it is often difficult and expensive to measure emissions directly, so many taxes are based on proxies for emissions, for example petrol, diesel or fuel oil (see the methodological notes at the end of the chapter for further information).

ECONOMIC INSTRUMENTS FOR THE ENVIRONMENT AND EU POLICY

Prices should reflect the real economic, social and environmental costs of products and services. This is one of the cornerstones of the EU sustainable development strategy adopted in Gothenburg in 2001, which advocates the use of economic (market-based) tools.

The more intensive use of economic tools for the environment has been promoted in the EU's sixth environment action programme (134) (EAP) and in the renewed EU sustainable development strategy, as well as in the renewed Lisbon strategy for growth and jobs.

The new Europe 2020 (135) initiative, which replaces the Lisbon strategy for the coming decade, is a platform for smart, sustainable and innovative growth which continues to stress the importance of using economic instruments for achieving resource efficiency and climate resilience.

The sixth EAP, approved in 2002, recommends, for example, the use of economic instruments (such as energy taxes and taxes on resources and pollution- and waste-intensive products and processes) to mitigate climate change and promote the sustainable use of resources. It considers the fostering of the application of fiscal measures, such as taxes, charges and fees, a priority. It also proposes the inclusion of a suitable and adequate EU framework for energy taxes, for example, in order to enable the shift to more efficient energy use and towards cleaner energy and transport systems.

In practice, the use of market-based tools at EU level has been increasing, for example with the introduction of instruments such as the EU Emission Trading Scheme ('the EU ETS') (136), the energy taxation directive (137) and, in the field of transport, the eurovignette directive (138).

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(132) Tradable permit systems can generate revenue if the allowances are auctioned by public authorities. Tradable permit systems using auctioned allowances have therefore similar features to a tax (the regulatory and compliance aspects differ).

(133) Eurostat (2001), Environmental taxes – a statistical guide.

(134) Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme of 10 September 2002.

(135) European Commission, COM(2010) 2020, 'Europe 2020: A strategy for smart, sustainable and inclusive growth'.

(136) Originally Directive 2003/87/EC of the European Parliament and of the Council, subsequently amended by Directive 2008/101/EC (to include aviation activities) and most recently Directive 2009/29/EC incorporating new rules for auctioning of the emission permits.

(137) Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity

(138) Directive 2006/38/EC of the European Parliament and of the Council of 17 May 2006 amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures.

This chapter describes the environmental tax revenue in Europe and compares it with the gross domestic product (GDP) and the total revenue from all taxes and social contributions (TSC). In the first case, the comparison helps to provide an understanding of the total tax burden related to activities which 'use up' the environment. In the second case the comparison helps to assess whether there is a potential shift towards a 'green' tax reform, i.e. shifting the tax burden from labour income to the most polluting behaviours.

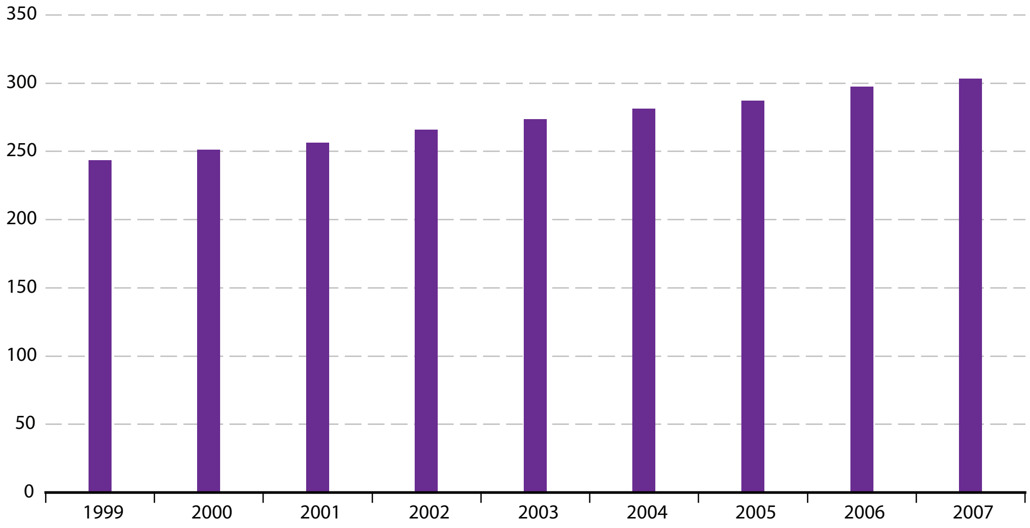
The chapter also provides an analysis of the environmental tax revenue by economic sector (those which are paying the environmental taxes), as well as by type of environmental tax.

The evolution of environmental tax revenues

According to Figures 11.1 and 11.2, environmental tax revenue in the EU-27 increased during the period between 1999 and 2007, but it decreased both as a share of total tax and social contributions (TSC) revenue and in percentage of GDP. In 2007, the revenue from environmental taxes in the EU-27 was around EUR 300 billion and accounted for almost 2.5 % of GDP and 6.2 % of TSC.

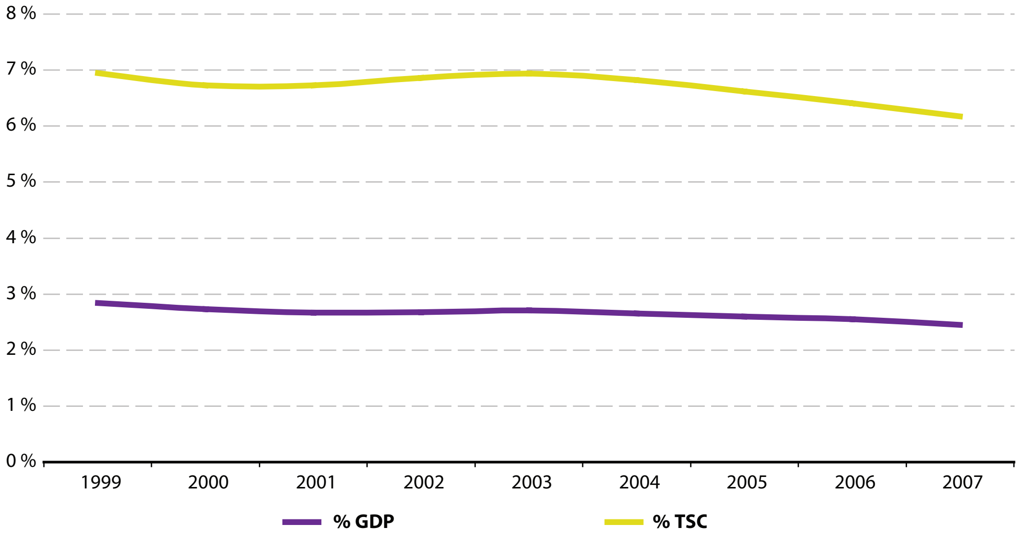
Compared to 1999 (when it accounted for EUR 244 billion, 2.8 % of GDP and 7 % of TSC), in 2007 there was an increase of 24 % in the level of environmental tax revenue in absolute terms, with a corresponding decrease of 14 % and 11 % as shares of GDP and TSC respectively. Increasing revenues from environmental taxes should be interpreted with caution. The increase may be caused by the introduction of new taxes or an increase in tax rates, but also by an increase of the tax base, i.e. higher emissions or increased use of products with a negative impact on the environment. Furthermore, the EU average might hide different environmental tax revenue trends in the Member States.

Figure 11.1 : Total environmental tax revenue, EU-27 *(billion EUR)*



Source: Eurostat (env_ac_tax)

Figure 11.2 : Total environmental tax revenue, EU-27 *(% of GDP and TSC)*



Source: Eurostat (env_ac_tax)

The decrease in environmental tax revenue as a share of GDP can be explained by several factors, such as the erosion of the nominal value of environmental taxation. Environmental taxes are levied per unit of physical consumption and usually fixed in nominal terms. Hence, unlike *ad valorem* taxes, which are levied on the value of the goods, their real value in relation to GDP tends to fall, unless they are adjusted for inflation or otherwise increased at regular intervals.

The level of environmental taxation varies across European countries ([139]). However, in 2007, the environmental taxes in most European countries fell in a band ranging from 2 % to 3 % of GDP and from 4 % to 8 % of TSC (Figure 11.3).

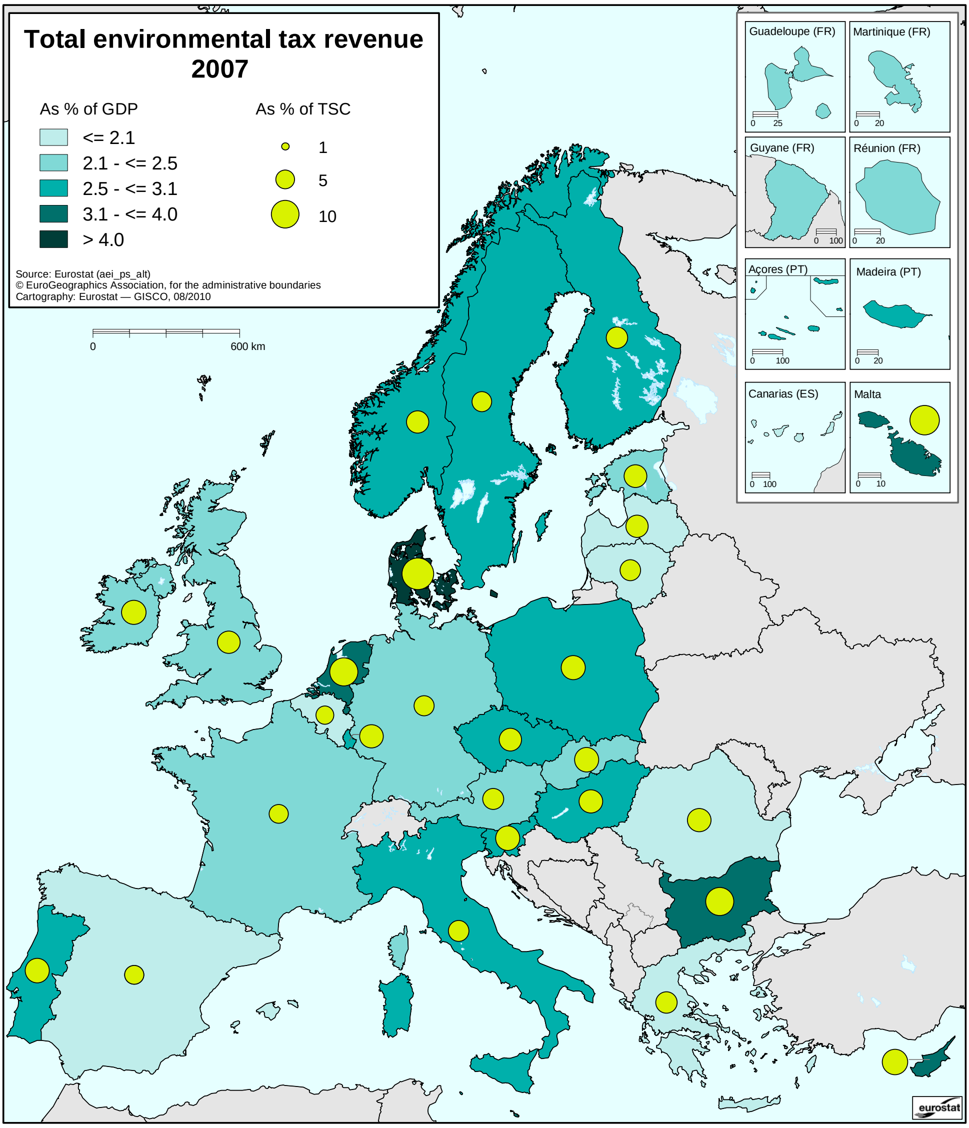
Only two Member States showed levels of environmental tax revenue below 2 % of GDP in 2007: Spain and Lithuania (Figure 11.3). Four countries — the Netherlands, Malta, Bulgaria and Cyprus — had environmental tax revenues between 3 % and 4 % of GDP. Denmark displays by far the highest level of environmental taxation (5.9 % of GDP).

Concerning the share of environmental tax revenue in TSC, five Member States showed levels of environmental tax revenue higher than 8 % of TSC in 2007. Denmark displays again by far the highest share of environmental taxation in total taxes and social contributions revenue (12 % of TSC), followed by Malta with around 11 % of TSC, the Netherlands and Bulgaria, both with 10 % of TSC, and Cyprus (slightly exceeding 8 % of TSC).

Between 1999 and 2007, most of the European countries showed a decline in their environmental tax revenue as a share of both GDP and TSC (Figure 11.4).

([139]) Comparisons across countries should be made with caution. For instance, low revenues from environmental taxes could either be due to low use of environmentally related taxes, or to a broad use of such taxes, where high tax rates have caused significant changes in behavioural patterns among producers and consumers (e.g. reduced emissions). Similarly, high revenues can in some cases be caused by foreign persons purchasing significant amounts of a taxed product in the country in question because the tax rates there are lower than in neighbouring countries (this can be the case for petrol and diesel, for instance). Also, the share of revenue from environmentally related taxes in total tax revenue is influenced by the extent of taxation of non-environmentally related tax bases.

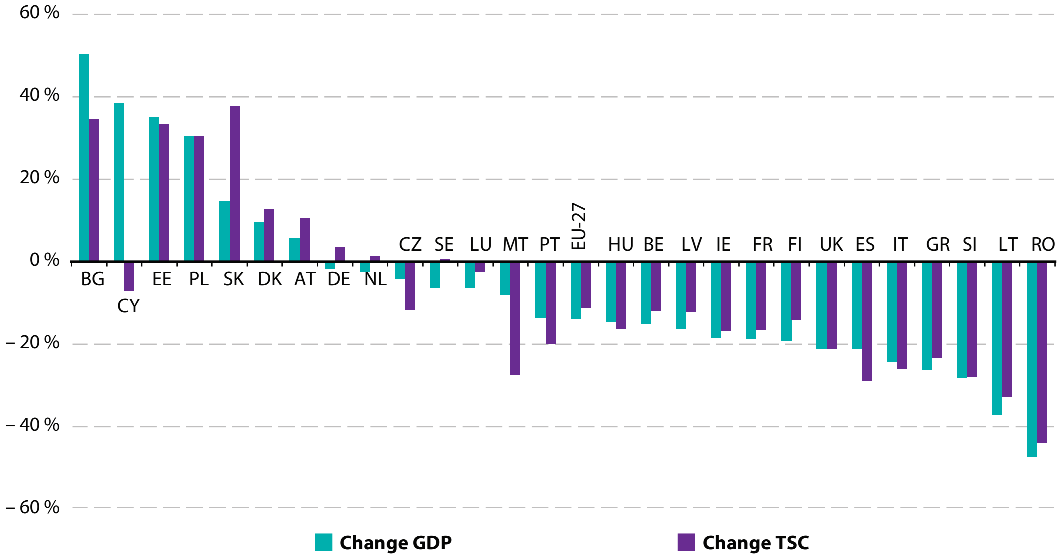
Figure 11.3 : Total environmental tax revenue, 2007 *(% of GDP and TSC)*



Source: Eurostat (env_ac_tax)

The only exceptions were Bulgaria, Estonia, Poland, Slovakia, Denmark and Austria: the average increase for these countries was around 24 % of GDP and 27 % of TSC. In some countries like Germany, the Netherlands and Sweden, the environmental tax revenue as a share of TSC increased between 1999 and 2007, while the environmental tax revenue as a share of GDP decreased. In the case of Cyprus, the trend was the opposite, environmental tax revenue as a share of GDP increased by 38 % corresponding to a 7 % decrease as share of TSC.

Figure 11.4 : Change in total environmental tax revenue as a share of GDP and TSC in European countries, 1999 and 2007 *(% change)*



Source: Eurostat (env_ac_tax)

Types of environmental taxes

There are four distinct subsets of environmental taxes: energy taxes, transport taxes, pollution taxes and resource taxes.

Energy taxes include taxes on energy products used for both transport (e.g. petrol and diesel) and stationary purposes (e.g. fuel oils, natural gas, coal and electricity). CO_2 taxes are included under energy taxes rather than under pollution taxes for practical reasons related to their estimation.

The transport taxes subset mainly includes taxes related to the ownership and use of motor vehicles. These taxes may be 'one-off' taxes related to imports or sales of equipment, or recurrent taxes such as an annual road tax.

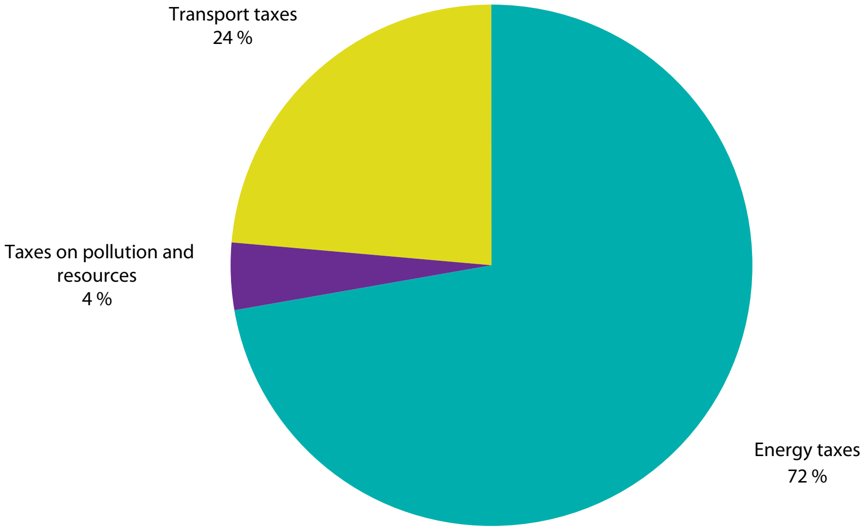
The pollution taxes subset includes taxes on measured or estimated emissions to air (except CO_2 taxes) and water, on the management of waste and on noise.

Finally, the subset on resource taxes covers taxes on extraction of raw materials, with the exception of oil and gas. The latter are excluded as they are economically important to only a few EU countries, making it difficult to have comparable data on resource taxes across countries and over time.

In the EU-27, energy taxes accounted for 72 % of total environmental tax revenue. Transport taxes come in second place, with 24 % of the total environmental tax revenue (Figure 11.5). The remaining 4 % of environmental taxes are made up of the pollution and resource taxes.

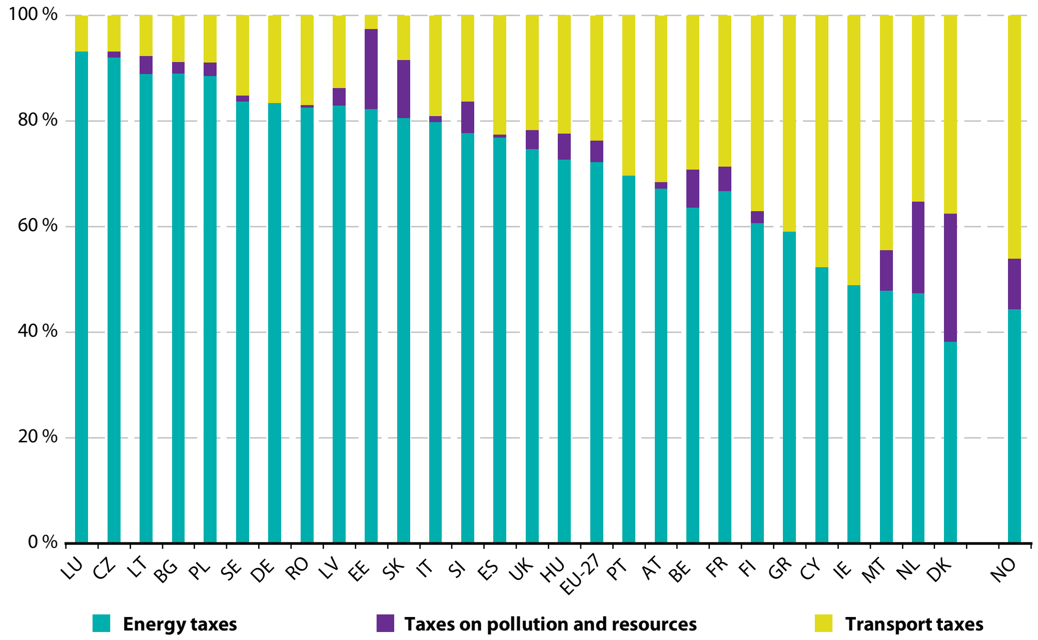
In 2007, energy taxes represented the largest amount of environmental tax for most European

Figure 11.5: Environmental taxes by tax category, EU-27, 2007 *(% of total environmental taxes)*



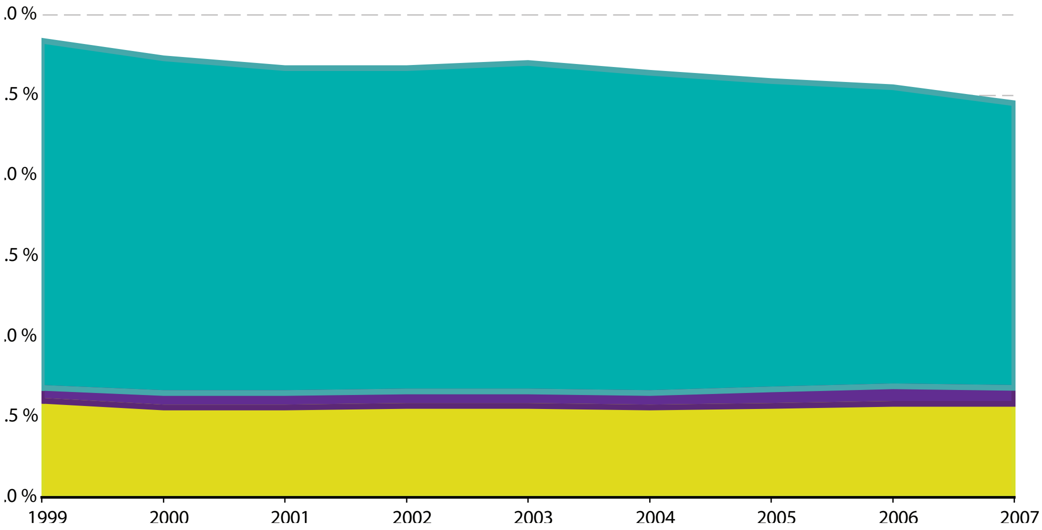
Source: Eurostat (env_ac_tax)

Figure 11.6: Environmental taxes by tax category, 2007 *(% of total environmental taxes)*



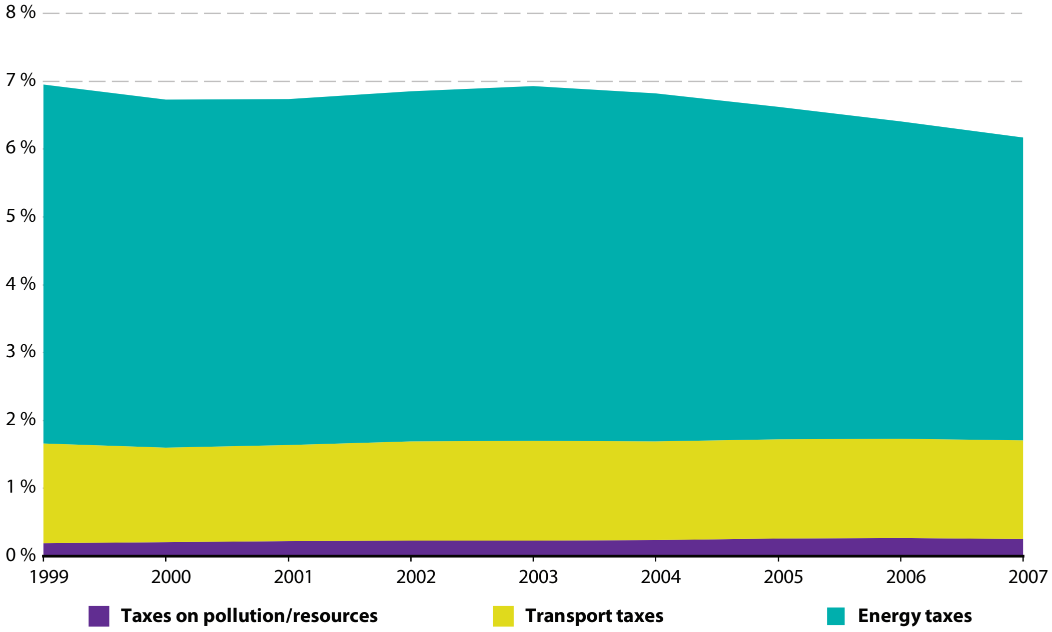
Source: Eurostat (env_ac_tax)

Figure 11.7: Evolution of the environmental tax revenue by tax category, EU-27 *(% of GDP)*



Source: Eurostat (env_ac_tax)

Figure 11.8: Evolution of the environmental tax revenue by tax category, EU-27 *(% of TSC)*



Source: Eurostat (env_ac_tax)

countries (more than 50 % of total environmental tax revenue).

However, transport taxes are significant in some countries, such as Malta, Cyprus, Ireland and Norway, where they account for more than 40 % of the revenue from all environmental taxes (Figure 11.6). Resource and pollution taxes represent a small share of total environmental tax revenue for most of the European countries, but in Estonia, Slovakia, the Netherlands, Denmark and Norway they raised more than 10 % of the total environmental tax revenue.

As Figures 11.7 and 11.8 show, the decrease in environmental tax revenue as a share of GDP and TSC is due to the decline of energy taxes between 1999 and 2007. Transport taxes and taxes on pollution/resources remained relatively constant in the same period, both as percentages of GDP and of TSC.

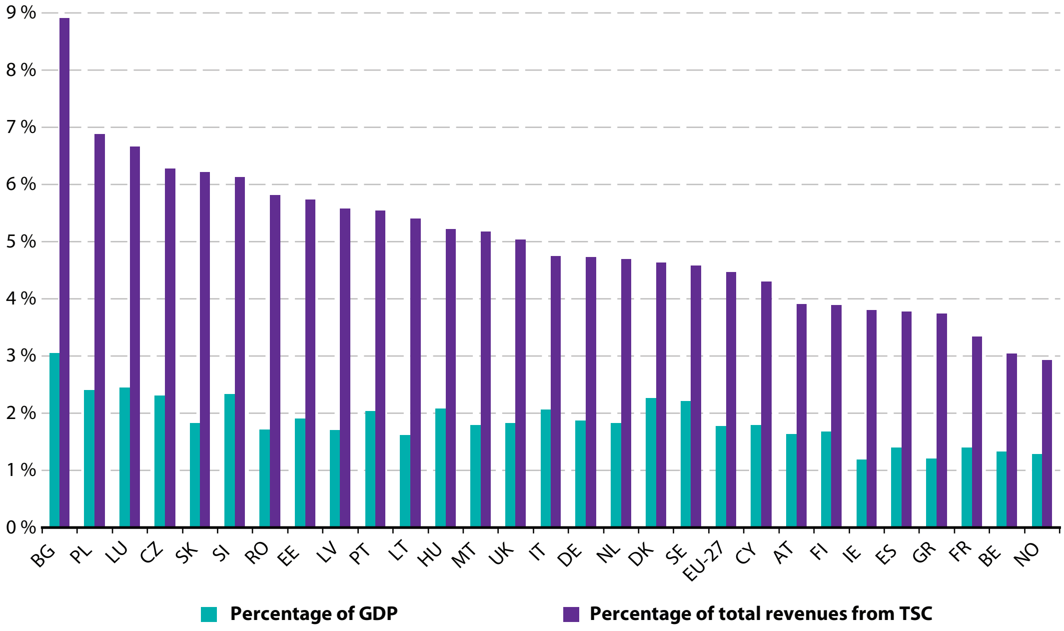
The evolution of energy tax revenues

Bulgaria is the country with the highest revenue from energy taxes in Europe when compared to GDP and TSC: almost 9 % of its TSC comes from taxes levied on energy, which is equal to 3 % of GDP. For the other European countries energy taxes account for between 3 % and 7 % of their TSC, or between 1 % and 2.5 % of their GDP (Figure 11.9).

Differences in energy tax revenue

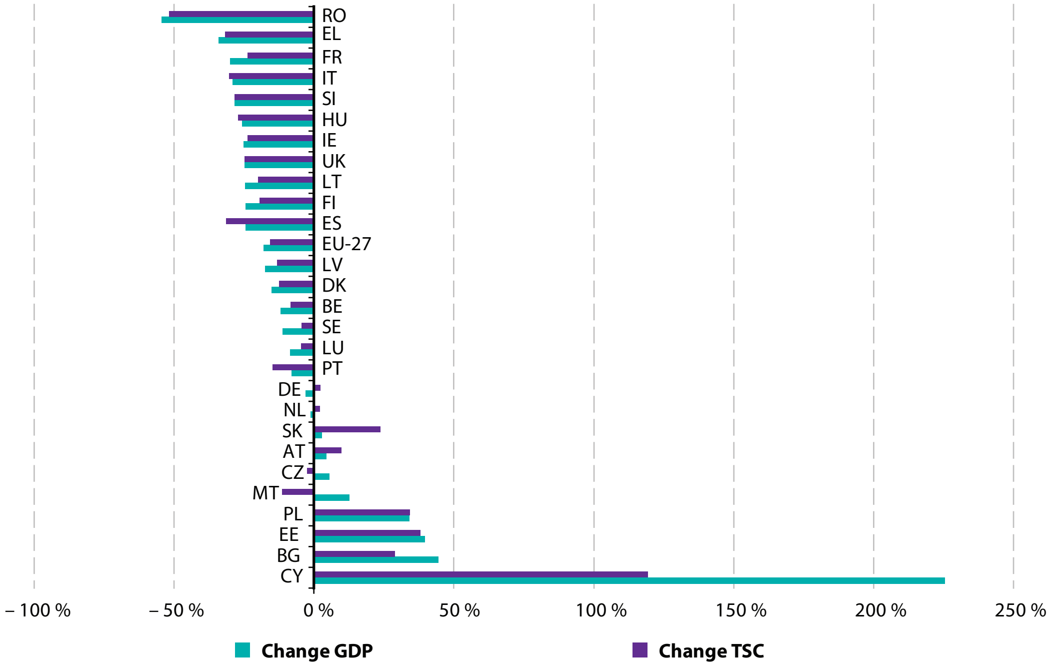
When comparing the share of energy taxes in GDP between 2007 and 1999, the decrease at EU-27 level was of 18 %. At Member State level the situation is quite varied (Figure 11.10). In most of the EU-27 countries the energy tax revenue decreased as a share of GDP, but in the

Figure 11.9: Energy tax revenues, 2007 *(% of GDP and TSC)*



Source: Eurostat (env_ac_tax)

Figure 11.10: Change in energy tax revenue as a share of GDP and TSC, 1999 and 2007 *(% change)*



Source: Eurostat (env_ac_tax)

majority of the new Member States it increased. Romania showed the largest decrease during this period (a drop of more than 50 %). Conversely, in Cyprus, Bulgaria, Estonia, Poland and Malta the increase of the energy taxation in relation to GDP was greater than 30 %.

Factors affecting energy tax revenues

Two factors can explain the reduction of the energy tax revenue to GDP ratio: a decrease in energy intensity and an increased use of non-fiscal tools. The declining trend in energy intensity, which measures the quantity of energy consumed for each unit of GDP, might be one of the explanations for the decrease in revenue from energy taxes as a percentage of GDP from 1999 to 2007 in the EU-27.

Indeed, both the energy consumption of the EU-27 and energy tax revenue increased at a lower rate than the GDP in the 1999–2007 period (Figure 11.11). Consequently, the energy intensity and the tax revenue as a share of GDP of the EU-27 declined throughout the period.

The steady decrease of energy intensity can be attributed to several driving forces: technological advances which make production processes less energy intensive, the growth of the tertiary economic sector (less energy-intensive), increases in energy prices and the effect of energy taxes. All of these factors may have caused a reduction in energy consumption and thus of the tax base.

The strong increases in market prices for petrol from 1998 to 2000, and from 2003 to 2008, for instance, have contributed significantly to a lower use of petrol. As shown by the OECD (140), between 1994 and 2006, petrol use per unit of

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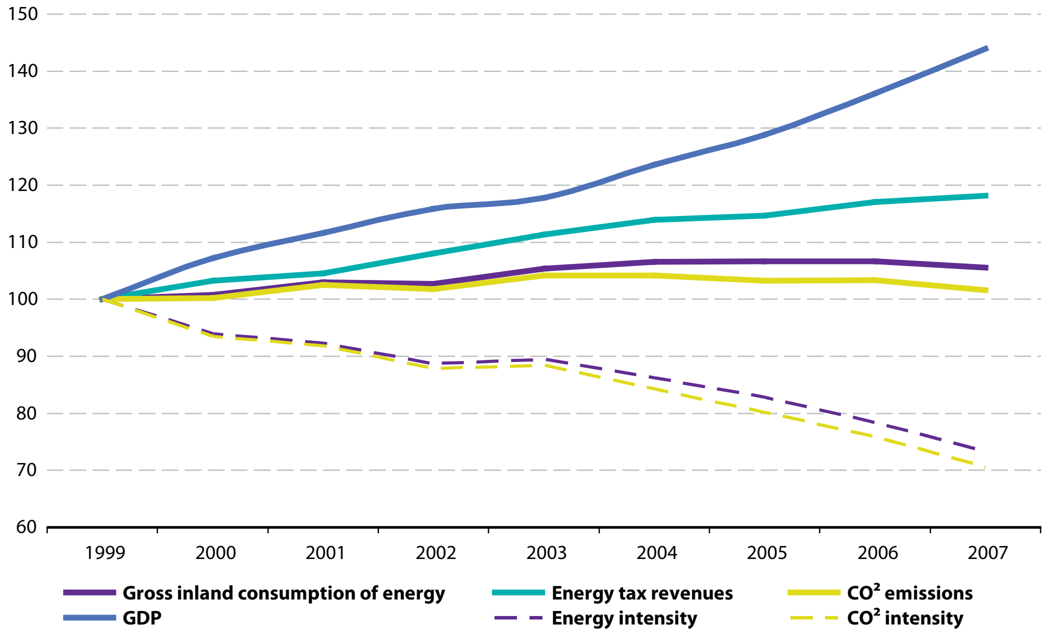
(140) OECD : http://www2.oecd.org/ecoinst/queries/TaxInfo.htm

Figure 11.11: Energy tax revenues, gross inland energy consumption and CO_2 emissions, EU-27 *(index 1999=100)*



Source: Eurostat (env_ac_tax) and EEA.

GDP decreased, while diesel use per GDP unit slightly increased in most European countries. Given that the tax rate for petrol is on average higher than the tax rate for diesel, the shift from petrol to diesel use also contributes to reducing the revenues from fuel taxes in percentage of GDP.

The impact on the energy tax revenues was further increased by a slower increase in the fuel taxes after 2000, especially with regard to petrol (141).

Furthermore, energy taxation is not the only instrument used by EU Member States to reduce energy consumption. An increasing use of non-fiscal tools, such as tradable emission permits (142), is also leading to a reduction in energy consumption, CO_2 emissions and the energy tax revenue.

Energy taxes by economic activity

Besides the distribution of environmental tax revenue by tax category (energy, transport, pollution, resources), environmental tax revenues can be allocated to the different actors which pay them. The breakdown of statistics on environmental taxes follows the residential principle of the national accounts, allowing for a distinction between the taxes paid by residents and non-residents. However, in practice it is difficult to properly differentiate between taxes paid by residents and those paid by non-residents. Malta is the only country capable of identifying environmental taxes on the basis of the residence principle.

In 2007, for most of the EU countries for which data are available, between 40 and 80 % of the energy tax revenues collected by governments were paid by businesses (NACE rev. 1.1 A to O),

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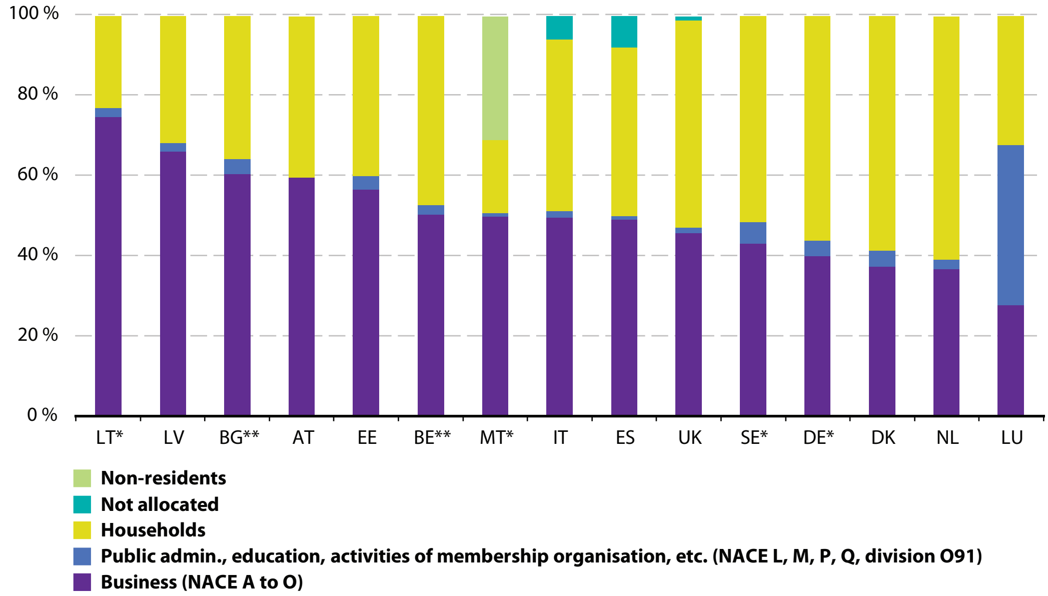
(141) OECD : http://www2.oecd.org/ecoinst/queries/TaxInfo.htm

(142) In the longer term the allowances under the EU ETS are also to be auctioned, generating revenue.

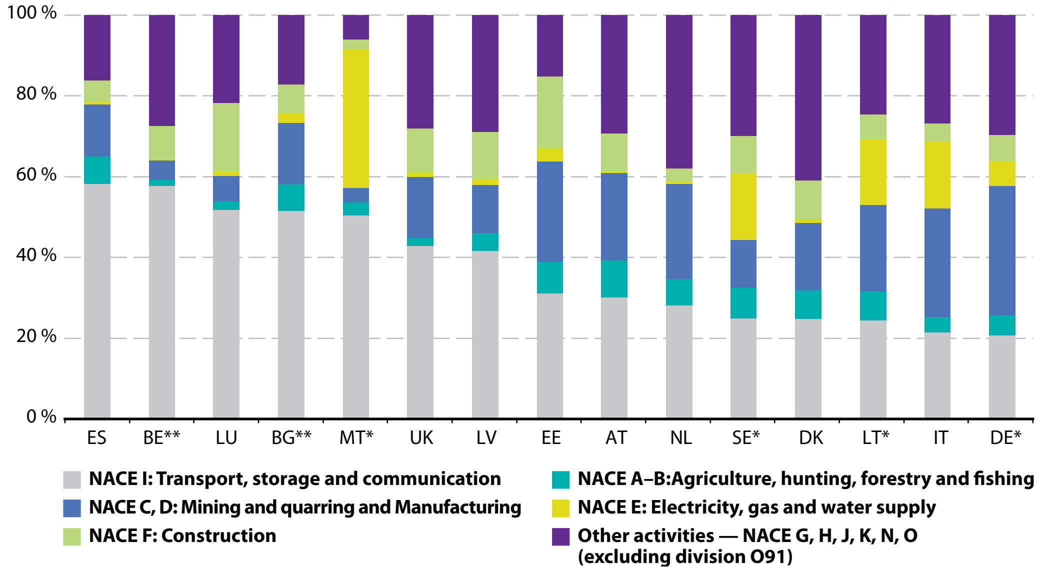
Figure 11.12: Energy taxes by economic activity, 2007 *(% of energy tax revenues)*



* 2006, ** 2005

Source: Eurostat (env_ac_taxind)

Figure 11.13: Energy taxes by business activity, 2007 *(% of total business sector's energy tax paid)*



* 2006, ** 2005

Source: Eurostat (env_ac_taxind)

and between 20 and 55 % by households. In Luxembourg, public administration, education and similar activities are responsible for one third of energy tax revenue, while in Malta 30 % of total tax revenue is attributed to non-residents. In countries such as Italy, Spain and the UK, it is not possible to allocate the entire revenue of environmental taxes to the sectors having paid for them (Figure 11.12).

In nine out of 15 countries for which data are available, the main part of the energy tax revenue generated by the business sector (around 40 % on average) comes from the transport sector. In Sweden, Lithuania, Italy and Germany the industrial sector (NACE rev. 1.1 divisions C, D and E) pays the majority of energy taxes (around 40 % on average), while in Denmark it is the service sector (excluding transport) (Figure 11.13).

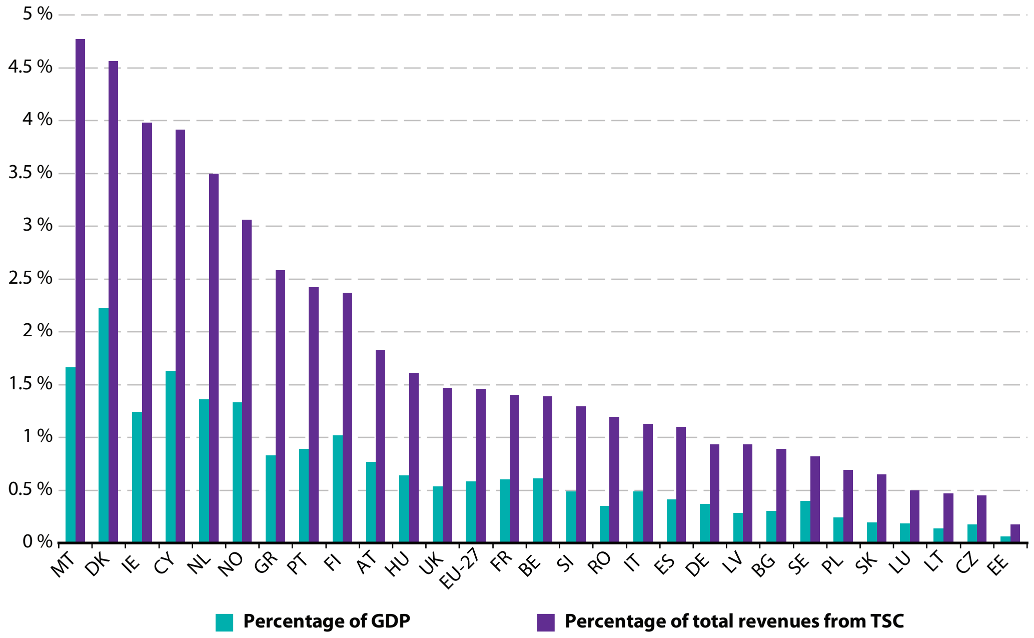
Transport tax revenues

As previously mentioned, transport tax revenue showed a growth in absolute terms but remained constant in relation to GDP and TSC from 1999 to 2007 in the EU-27 (Figures 11.7 and 11.8).

Transport tax revenues in European countries

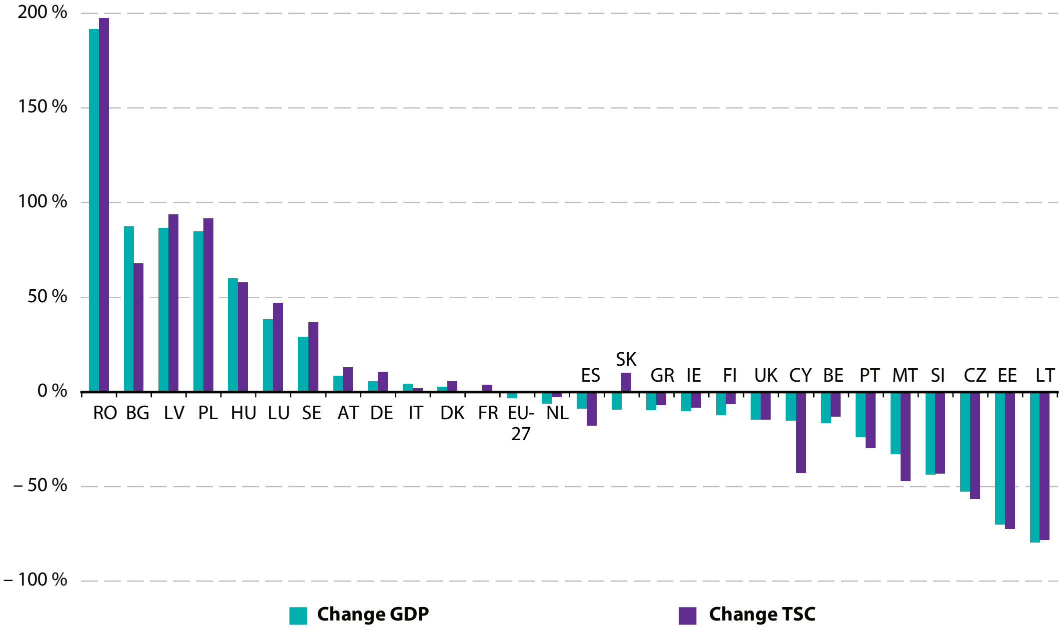
In 2007, the EU-27's revenue from transport taxes accounted for almost 0.6 % of its GDP (Figure 11.14). At Member State level, Denmark has the largest transport tax revenue with respect to GDP (more than 2 %). In Malta, Cyprus, the Netherlands, Norway, Ireland and Finland, transport tax revenues represent more than 1 % of GDP, while in the rest of the countries the revenue associated with transport taxes was lower than 1 % of GDP (Figure 11.14).

Figure 11.14: Transport tax revenues, 2007 *(% of GDP and TSC)*



Source: Eurostat (env_ac_tax)

Figure 11.15: Change in transport tax revenue as a share of GDP and TSC, 1999 and 2007
(% change)



Source: Eurostat (env_ac_tax)

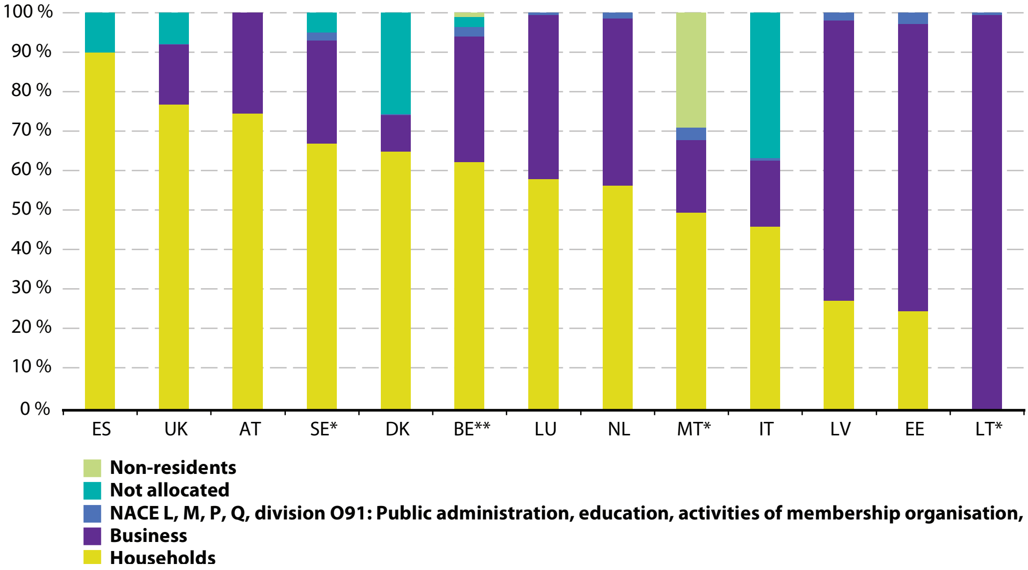
As a share of TSC, transport tax revenue represented between 0.5 % and 4 % of TSC for most European countries in 2007. In only three countries (Lithuania, the Czech Republic and Estonia) did transport taxes represent less than 0.5 % of TSC (Figure 11.15). These three countries are also the countries which experienced the largest decrease in transport tax revenues between 1999 and 2007, both as share of GDP and TSC (Figure 11.15). Conversely, Romania, Bulgaria, Latvia and Poland present the highest increase over the same period.

Transport taxes by economic activity

In most of the EU countries, transport tax revenue in 2007 was generated mainly by the household sector. In nine out of 13 countries for which data are available, the household sector contributed more than 50 % of transport tax revenue. Only in Latvia, Estonia and Lithuania were transport taxes mainly paid by the business sector (Figure 11.17).

Within business activities, most of the transport tax revenue comes from services (NACE rev. 1.1 G, H, J, K, N and O excluding O90). Transport activities account for most of the transport tax revenue (50 % on average) in four countries: Latvia, Luxembourg, Lithuania and Estonia. Industry and construction account for a large share of transport tax revenue from business activities in Italy and Sweden (around 40 %).

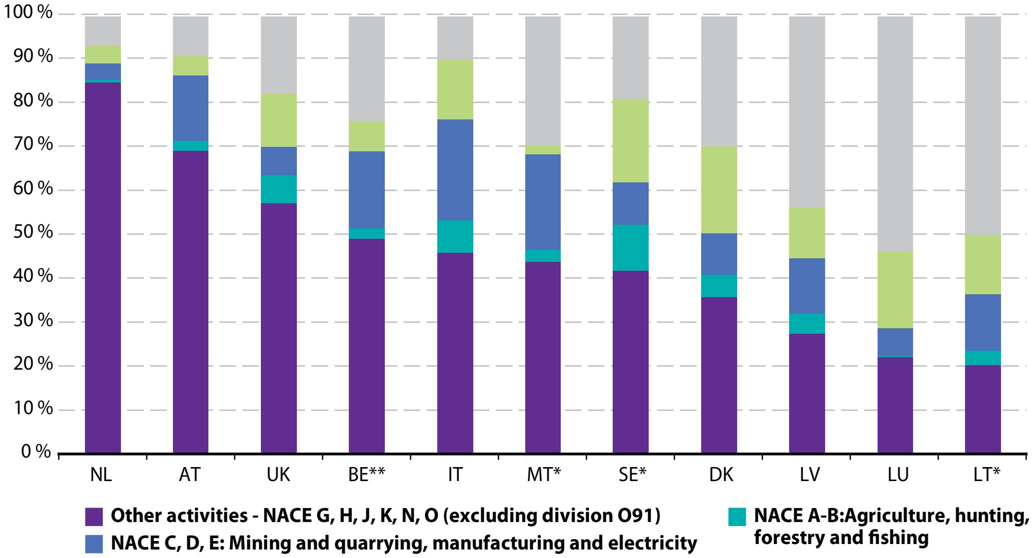
Figure 11.16: Transport tax revenue by economic activity, 2007 *(% of total transport tax revenue)*



*2006, ** 2005

Source: Eurostat (env_ac_taxind)

Figure 11.17: Transport tax revenue by business activity, 2007 *(% of total business sector's transport tax paid)*



*2006, ** 2005

Source: Eurostat (env_ac_tax)

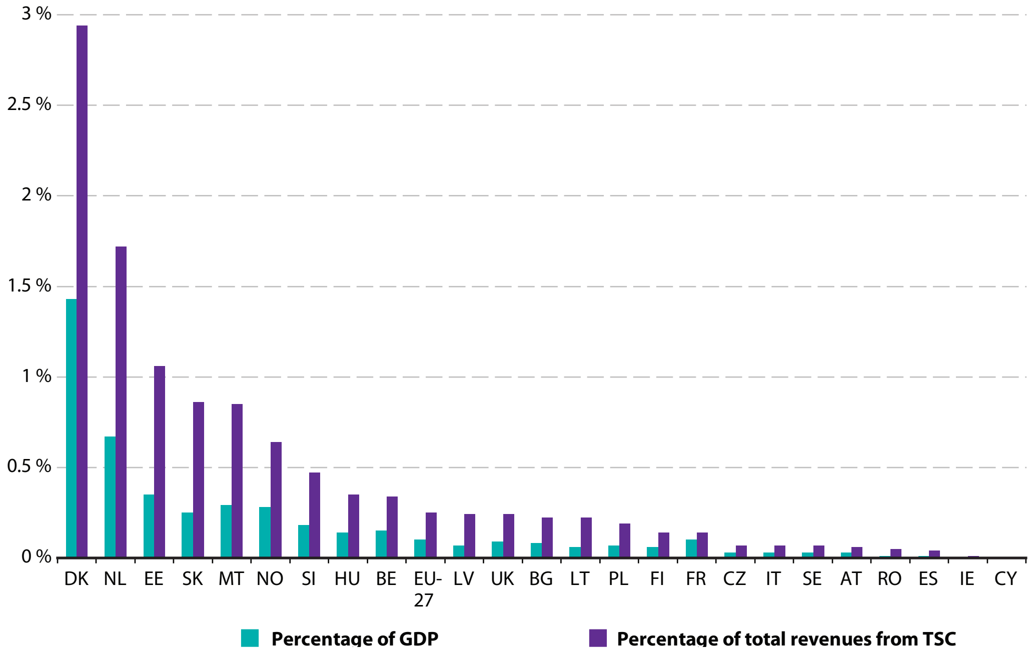
Pollution and resource tax revenues

In 2007, the EU-27's revenue from pollution and resource taxes accounted for only 0.1 % of GDP and 0.2 % of TSC (Figure 11.19). Pollution and resource tax revenues showed a growth in absolute terms but they stayed constant in relation to GDP and TSC between 1999 and 2007 (Figures 11.7 and 11.8).

Denmark again has the largest revenue from pollution and resource taxes with respect to GDP and TSC (1.4 % of GDP and 2.9 % of TSC), followed by the Netherlands with 0.6 % of GDP and 1.7 % of TSC. For the remaining countries, less than 0.3 % of GDP and 1.1 % of TSC were attributed to pollution and resource taxes.

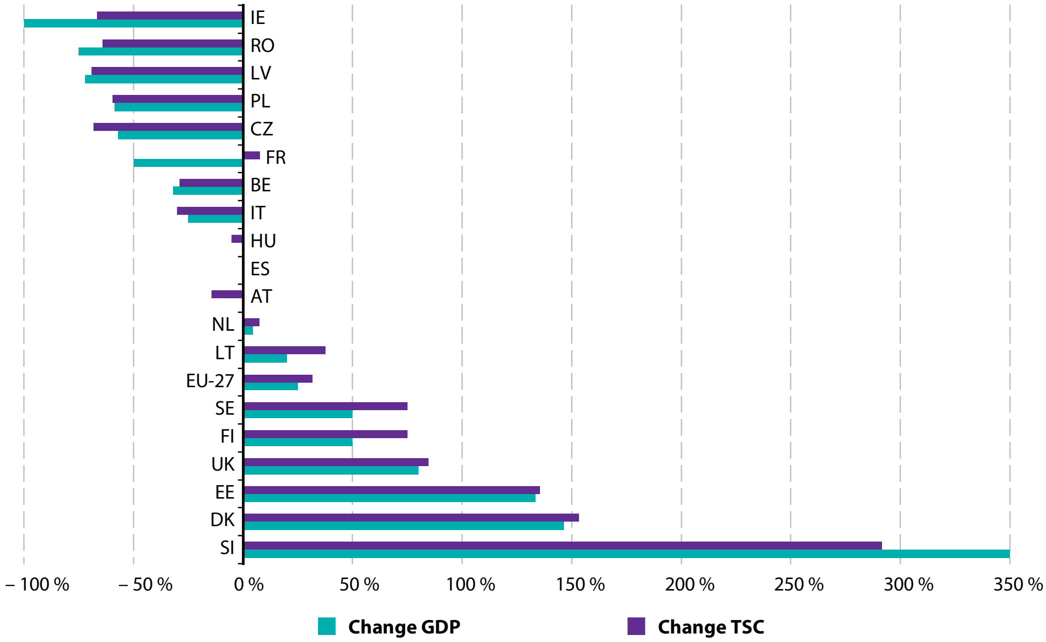
Concerning the evolution of pollution and resources tax revenues as a percentage of GDP and TSC, Romania, Ireland, Latvia, Poland and the Czech Republic have seen a decrease in their revenues in 2007 compared with 1999. Conversely, Denmark more than doubled its revenue from this type of tax during the same period. The substantial increase in pollution and resource tax revenues in Slovenia can be explained by the fact that almost no pollution/resource tax was levied in 1999.

Figure 11.18: Pollution and resource tax revenues, 2007 *(% of GDP and TSC)*



Source: Eurostat (env_ac_tax)

Figure 11.19: Change in pollution and resource tax revenue as a share of GDP and TSC, 1999 and 2007 *(% change)*



Source: Eurostat (env_ac_tax)

Conclusions: Environmental taxes in the European Union

Environmental taxes have long been a cost-effective instrument to influence consumers to buy less-environmentally damaging products and to change their behaviour in general. They also provide incentives for innovation to further improve products and processes. EU policies recommend the use of economic instruments in order to cope with environmental goals and the sustainable development strategy.

In 2007, energy taxes accounted for 72 % of total environmental taxes and transport taxes for 24 %, with pollution and resource taxes making up the remaining percentage in the EU-27 Member States.

The share of environmental taxes in GDP and TSC has remained relatively stable or slightly decreased from 1999 to 2007 but environmental taxes form an increasingly significant share of households' and businesses' tax expenditures. This is especially the case in new Member States.

The reduction of tax revenue may be the consequence of stringent environmental protection. Revenues also change as a result of changes in the economy towards more or less environmentally friendly production and consumption patterns. On the other hand, there has been a green tax reform in some European countries which has led to an increase in the weight being put on environmental taxes with respect to other forms of taxation (such as labour taxation).

Data on environmental taxes with a breakdown by industry are disseminated by Eurostat. They are found in the Eurostat dissemination database and are published in *Statistics in Focus* and larger publications.

Environmental tax revenue data are also regularly published, in an aggregate form, by Eurostat and the Directorate-General for Taxation and Customs Union in the publication 'Structures of the taxation systems in the European Union'.

Some experience has been gained by European countries in collecting and reporting environmental taxes to Eurostat. Currently, concepts, definitions and new developments concerning environmental taxes are being discussed at international level. Based on this, the current collection system and the statistical methodological guide on environmental taxes will be improved over the coming years.

Further information

Eurostat main tables and database

Environment, see: Total environmental tax revenues as a share of total revenues from taxes and social contributions (ten00064) Total environmental tax revenues as a share of GDP (ten00065)

Environment, see: Environmental accounts (env_acc), Monetary flow accounts (env_acm), Environmental tax revenue (env_ac_tax) and Environmental taxes by industry (NACE A31) (env_ac_taxind)

Eurostat dedicated section (http://epp.eurostat.ec.europa.eu/portal/environmental_accounts/introduction)

Eurostat publications

Statistics in Focus No 1/2007, Environmental taxes in the European economy 1995–2003, 2007.

Energy, transport and environmental indicators, Pocketbook, 2009.

Panorama of transport, Statistical Books, 2009.

Further reading

European Commission, *Taxation trends in the European Union: Data for EU Member States and Norway*, Office for Official Publications of the European Communities, Luxembourg, 2009.

European Topic Centre on Sustainable Consumption and Production, *Effectiveness of environmental taxes and charges for managing sand, gravel and rock extraction in selected EU countries*, European Topic Centre on Sustainable Consumption and Production, Copenhagen, 2008.

European Environmental Agency, *Environmental taxes: Implementation and environmental effectiveness*, Office for Official Publications of the European Communities, Luxembourg, 1996.

European Environmental Agency, *Environmental taxes: Recent developments in tools for integration*, Office for Official Publications of the European Communities, Luxembourg, 2000.

European Environmental Agency, *Market-based instruments for environmental policy in Europe*, Office for Official Publications of the European Communities, Luxembourg, 2005.

See also

The OECD and the European Environment Agency (EEA) have, in cooperation with the European Commission, developed a database on the use of market-based instruments for environmental policy and natural resource management (environmentally related taxes, fees and charges, environmentally motivated subsidies, tradable permits systems, deposit refund systems) in member countries, which includes all Member States of the EU as well as non-EU members of the EEA (in particular the accession countries). It also covers voluntary approaches. The database is available on the OECD website through a number of pre-defined queries at http://www2.oecd.org/ecoinst/queries/index.htm

Methodological notes

The European strategy on environmental accounts, approved in 2003 and revised in 2008, regards the collection of data and the implementation of estimates of environmental tax by activity branch as a priority

The Directorate-General for Taxation and Customs Union collects environmental tax revenue statistics as a total for the four categories of environmental taxes: energy, transport, pollution and resources, with annual updates based on tax data reported to Eurostat through the national accounts transmission programme. Eurostat is responsible for final data validation and dissemination.

In addition to environmental tax revenue, Eurostat collects data on environmental taxes in a breakdown by economic activity (by sector paying the taxes). The main tool for this data collection is a questionnaire which is sent to the EU and EFTA countries every year. The time series for which data are collected start in 1995 and follow a T-2 reporting pattern, where T is the year when the data is collected. The questionnaire consists of a cross-classification of the main environmental tax categories (total environmental taxes, energy taxes, transport taxes, pollution taxes and resources taxes) with a breakdown following NACE 2-digit level plus households, non-residents and not allocated.

The Eurostat publication '*Environmental taxes — A statistical guide, European Communities, 2001*', constitutes the methodological reference base for filling out the questionnaire. Taxes are compulsory and unrequited payments to the general government, where the benefits provided to the taxpayer are not directly linked to the payments. To be considered as an environmental tax, Eurostat and OECD Member States have chosen to single out the tax bases that seem to have a particular environmental relevance, and to consider all taxes levied on these tax bases as environmentally related regardless of the explicit motives behind their introduction. This means that the purpose of the tax can be something other than environmental protection, while still being classified as an environmental tax (for example, the annual vehicle tax). The tax base is the product, activity or substance that the tax rate is based on, i.e. a physical unit (or a proxy of it) of something that has a proven and specific negative impact on the environment. The main categories of environmentally relevant tax base are the following:

Measured or estimated emissions to air	
Measured or estimated NO_x emissions	Other measured or estimated emissions to air
SO_2 content of fossil fuels	
Ozone-depleting substances (e.g. CFC or halon)	
Measured or estimated effluents to water	
Measured or estimated effluents of oxydable matters (BOD, COD)	Other measured or estimated effluents to water
	Effluent collection and treatment, fixed annual taxes

Certain non-point sources of water pollution		
Pesticides (based on e.g. chemical content, price or volume)	Artificial fertilisers (based on e.g. phosphorus or nitrogen content or price)	
	Manure	
Waste management		
Waste management in general (e.g. collection or treatment taxes)	Waste management, individual products (e.g. packaging, beverage containers)	
Noise (e.g. aircraft take-offs and landings)		
Energy products		
Energy products used for transport purposes	Natural gas	Electricity consumption
Unleaded petrol	Coal	Electricity production
Leaded petrol	Coke	District heat consumption
Diesel	Biofuels	Heavy fuel oil
Other energy products for transport purposes (e.g. LPG or natural gas)	Light fuel oil	District heat production
Energy products used for stationary purposes	Other fuels for stationary use	
Transport		
Motor vehicles, one-off import or sales taxes	Registration or use of motor vehicles, recurrent (e.g. yearly) taxes	
Resources		
Water abstraction	Other resources (e.g. forests)	
Extraction of raw materials (except oil and gas)		

Value added type taxes (VAT) are excluded from the definition of environmental taxes. This is mainly because of the special characteristics of this type of tax. VAT is a tax levied on all products (with few exceptions), and it is deductible for many producers, but not for households. It does not, therefore, influence relative prices in the same way that other taxes on environmentally related tax bases do.

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