Natural Resources and the Environment 2005. Norway

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Preface

Statistics Norway compiles statistics on important natural resources and environmental issues, and develops methods and models for analysing trends in the extraction and use of natural resources and changes in the state of the environment, focusing particularly on relationships between these factors and other socio-economic developments. The annual publication *Natural Resources and the Environment* gives an overview of this work.

An important objective is to ensure that this publication presents the environmental situation so that it can be readily understood while at the same time including considerable detail. *Natural Resources and the Environment 2005* starts with an updated presentation of indicators that illustrate aspects of the government's priority areas for environmental policy. The proposal for a national set of indicators for sustainable development is presented in a separate section. This is followed by detailed descriptions of various topics, which include both statistics and analyses. Finally, the appendix provides more detailed statistics in the form of tables.

Statistics Norway would like to thank the people and institutions who have supplied data for *Natural Resources and the Environment 2005*.

The publication was produced by the Division for Environmental Statistics, Department of Economic Statistics, with contributions from the Unit for Energy and Environmental Economics and the Unit for Petroleum and Environmental Economics, Research Department, and the Division for Primary Industry Statistics, Department of Industry Statistics. The 2005 edition was edited by Frode Brunvoll, Henning Høie and Svein Erik Stave. Alison Coulthard and Veronica Harrington have translated the Norwegian version into English.

Natural Resources and the Environment 2005 is also available at http://www.ssb.no/english/subjects/01/sa_nrm/ . More detailed information on the topics covered may be found at http://www.ssb.no/english/subjects/ and in StatBank Norway at http://www.ssb.no/english.

Statistics Norway,
Oslo/Kongsvinger 2 May 2006

Øystein Olsen

Contents

List of figures

1. Status and important trends

List of tables

List of boxes

4. Forest and uncultivated land

5. Fisheries, sealing, whaling and fish farming

6. Air pollution and climate change

7. Waste

8. Water resources and water pollution

9. Land use

1. Status and important trends

The state of the environment, which depends on a complex variety of biological and physical processes that interact with human behaviour and the pressures this exerts, is of crucial importance to people's welfare. The management and use of the environment and natural resources occupies an important place in the public debate and frequently makes the headlines in the media. Strategies for sustainable development at both national and international level are being given high priority. This illustrates the importance of natural resource and environmental issues, and the need to consider them in conjunction with economic and social developments.

An important task in the field of environmental statistics is thus to compile statistics that describe the state of the environment and environmental trends in a way that clearly illustrates the most important linkages between them.

1.1. Introduction

Sections 1.2 and 1.3 of this chapter present some indicators or key figures (see box 1.1) that can be used to describe the state of the environment, environmental pressures and resource use in Norway. In section 1.4, we describe some features of economic developments in Norway and discuss how these affect the environment. Environmental protection expenditure and investments in manufacturing industries are also discussed. In spring 2005, a commission appointed by the Government put forward a proposal for a set of indicators for sustainable development in Norway (Official Norwegian Report 2005:5). The indicators are presented in section 1.6.

The book continues with statistics and analyses related to Norway's natural resources and resource policy issues in Chapters 2-5. Chapters 6-9 focus on important environmental issues and problems. Finally, the appendix provides more detailed statistics on various aspects of the environment and natural resources in the form of tables.

The statistics presented in this publication are mainly from Statistics Norway (an overview will be found on our website: http://www.ssb.no/english/subjects/01/miljo_en/), but in some cases we have also used figures from other institutions to give a more complete picture. Much of the information in Chapter 1 has been taken from the white papers on the government's environmental policy and the state of the environment in Norway and the Norwegian Pollution Control Authority's website *State of the Environment Norway* (http://www.environment.no/).

Box 1.1. Environmental indicators

Information on the environment includes a variety of topics, and it can be difficult to interpret overall trends. Indicators or key figures have therefore been developed that give simplified descriptions of phenomena and problems. Because they are simplified, they may illustrate some aspects of a phenomenon clearly, whereas others are not well described, and the indicators are not independent of each other. Often, several indicators are therefore used to describe a phenomenon.

Environmental policy focuses mainly on environmental problems that are caused by human activity. For environmental indicators to be adequate and function as effective tools, they must be linked to socio-economic factors. One generally-recognised way of structuring environmental indicators is the PSR model (Pressure-State-Response), which was developed by the OECD (e.g. OECD 1994, 1998, 2001a and 2004). This has been further developed as the DPSIR framework, which includes the driving forces behind environmental pressures and the impacts of environmental change. This is used for example by the European Environment Agency (EEA). Environmental problems are analysed by looking at:

- *Driving forces* These include population growth, economic activity, etc., which lead to
- *environmental Pressures* such as emissions to air and water and extraction of natural resources. These in turn result in changes in
- the *State of the environment*, for example changes in water quality or air quality, which cause
- *environmental Impacts* such as fish mortality, adverse effects on human health, reduction in crop yields or species extinction. At some point, society can react by making a
- *Response* to environmental problems, e.g. a CO_2 tax, protection of areas, treatment of emissions. The response in turn results in changes in economic driving forces, environmental pressures and various aspects of the state of the environment.

The figures compiled by Statistics Norway mainly provide a basis for indicators related to driving forces and environmental pressures. It is important that such indicators also show which types of activities exert pressures on the environment. Indicators are also important in the context of linking environmental statistics to economic models, analyses and projections. Indicators for responses are being developed.

In addition to the four OECD reports mentioned above, important international reports on environmental indicators and reports on environmental indicators for important sectors include the following: the European Environment Agency's *Environmental signals* (EEA 2002a), *EEA Signals 2004* (EEA 2004), *TERM 2002 - Paving the way for EU enlargement - Indicators of transport and environment integration* (EEA 2002b), *Environmental pressure indicators for the EU (Eurostat 2001) and Environmental indicators for agriculture* (OECD 2001b).

A set of indicators for transport was presented in the report S*amferdsel og miljø - Utvalgte indikatorer for samferdselssektoren* (Transport and environment - Selected indicators for the transport and communication sector) (Brunvoll et al. 2005).

A general overview is provided by *Overview of sustainable development indicators used by national and international agencies* (Hass et al. 2002).

Box 1.2. Priority areas of Norwegian environmental policy

In Report No. 58 (1996-97) to the Storting on an environmental policy for sustainable development, eight priority areas of environmental policy were established. A ninth priority area was introduced in Report No. 21 (2004-2005) to the Storting:

1. Conservation and sustainable use of biological diversity
2. Outdoor recreation
3. The cultural heritage
4. Eutrophication and oil pollution
5. Hazardous substances
6. Waste and waste recovery
7. Climate change, air pollution and noise
8. International environmental cooperation, environmental assistance, and environmental protection in the polar regions
9. Regional planning and land-use policy

These priority areas provide the basic structure for the result monitoring system used by the environmental authorities. This system was developed to provide a structure for the background data for the white papers on the Government's environmental policy and the state of the environment in Norway, based on reporting from various sectors and data from environmental statistics and environmental monitoring. Strategic objectives and national targets have been set for each of the priority areas. The results are to be monitored by means of indicators for each of the priority areas.

Natural Resources and the Environment 2005 describes environmental pressures in several of the priority areas of environmental policy and presents several of the indicators that have been selected.

More information: Report No. 21 (2004-2005) to the Storting: *The Government's environmental policy and the state of the environment in Norway.*

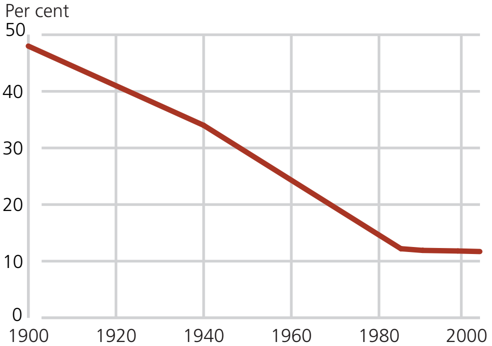
1.2. The state of the environment in Norway

This description of the state of the environment in Norway is structured according to the priority areas of environmental policy defined by the environmental authorities (see box 1.2). Some of the priority areas are described in more detail than others because more statistical material is available, making it possible to describe the current status using suitable indicators. In other areas, the environmental statistics do not provide an adequate basis for describing the current status or trends.

Priority area 1: Conservation and sustainable use of biological diversity

Over the past 20 years, the most important threats to biological diversity have been changing. In the 1970s and 1980s, pollution such as acid rain was considered to be the most serious threat to biological diversity in Norway. Today, physical alterations and changes in land use appear to be causing the greatest negative pressure on biodiversity. A series of apparently insignificant developments may have cumulative effects that make it difficult for species and populations to survive and seriously impair the productivity of ecosystems. One important way of responding to these problems is to protect areas in some way. As of 1 January 2005, 39 266 km^2 or 12.1 per cent of the total area of Norway was protected. This is an increase of 15 per cent from the year before, and is due to the establishment of three new national parks and a number of new nature reserves and protected landscapes.

Figure 1.1. Wilderness-like areas[1] as a percentage of Norway's total land area[2]. 1900-2003



[1] Wilderness-like areas are defined as lying at least 5 km from the nearest major infrastructure development, defined as public roads and railways (except tunnels): forest roads: farm tracks, access roads and roads to summer farms exceeding 50 m in length: ancient tracks improved for use by tractors and off-road vehicles: tracks approved for motor vehicles when the ground is not snow-covered (Finnmark): power lines carrying 33 kV or more: reservoirs (entire extent of water at highest regulated water level), regulated rivers and streams: power plants, penstocks, canals, levees, embankments and flood protection works.
[2] Excluding Svalbard and Jan Mayen.
Source: Directorate for Nature Management.

Wilderness-like areas

- The size of wilderness-like areas is an indicator of pressure on biological diversity. In wilderness-like areas, pressure from human activity is low, and there is little disturbance of the original biological diversity.
- The extent of such areas in Norway fell dramatically from 1900 to 1985. Since 1985, the loss of wilderness-like habitat has continued, but at a much slower pace.
- In 2003, wilderness-like areas made up 11.7 per cent of the total area of Norway.

For more information, see Chapter 9: Land use.

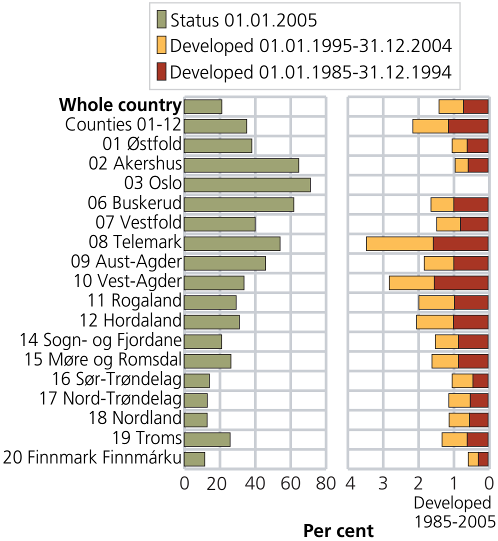
National targets – biological diversity

1. A representative selection of Norwegian habitats shall be protected for future generations.
2. Major disturbance such as infrastructure development shall be avoided in endangered habitats, and in vulnerable habitats important ecological functions shall be maintained.
3. The cultural landscape shall be managed in such a way that biological diversity, the historical and aesthetic value of the landscape and its accessibility are maintained.
4. Harvesting and other use of living resources shall not cause species or populations to become extinct or endangered.
5. The introduction of alien species through human activity shall not damage or limit ecosystem functions.
6. Populations of endangered species and species for which Norway has a special responsibility shall be maintained or restored to viable levels.
7. The needs of future generations shall be taken into account when managing soil resources that are suitable for cereal production.

Priority area 2: Outdoor recreation

Norway's strategic objective for this priority area of environmental policy is that "*everyone shall have the opportunity to take part in outdoor recreation as a healthy and environmentally sound leisure activity that provides a sense of well-being both near their homes and in the countryside*". Coastal areas offer very valuable opportunities for outdoor recreation. At the same time, there is great pressure to allow development of these areas, which means that public access for recreation purposes is becoming more and more restricted.

Figure 1.2. Proportion of the coastline less than 100 m from the nearest building in 2005. Changes from 1985 to 2005



Source: Land use statistics, Statistics Norway.

Access to the coast

- More than 23 per cent of the coastline is less than 100 m from the nearest building. In the counties around the inner Oslofjord, more than two thirds of the coastline is less than 100 m from the nearest building.
- Since 1965, the Planning and Building Act has restricted developments along the shoreline, and tighter restrictions have been introduced since. Despite this, buildings were constructed or altered along 1.5 per cent, or 1 250 km, of the shoreline from 1985 to 2005.
- The greatest changes have taken place in the southern parts of the country, where the largest proportion of the coastline was already developed (for detailed figures, see Appendix, table I4).

For more information, see Chapter 9: Land use

National targets – outdoor recreation

1. The tradition of outdoor recreation based on the right of access to uncultivated land shall be kept up by all sections of the population.
2. Children and young people shall be given the opportunity to develop skills in outdoor recreation activities.
3. Areas of value for outdoor recreation shall be safeguarded so that environmentally-friendly access and passage and harvesting of natural resources is promoted and the natural resource base is maintained.
4. Near housing, schools and day care centres, there shall be adequate opportunities for safe access and play and other activities in a varied and continuous green structure, and ready access to surrounding areas of countryside.

***Priority area 3*: The cultural heritage**

Our cultural heritage is a source of knowledge about people's lives and activities throughout history. It can improve our understanding of the links between history and the present day, the natural environment and different cultures. We can use our heritage to rediscover lost knowledge and skills and to find answers to new questions that arise in connection with sustainable development.

A recent white paper on the cultural heritage (Report No. 16 (2004-2005) to the Storting) highlights the fact that a number of cultural monuments and sites are in a critical condition. A survey carried out by the Directorate for Cultural Heritage shows that there is a growing backlog of essential repairs to and maintenance of protected monuments and sites. The white paper describes cultural environments and landscapes as an important knowledge bank. They can be interpreted to learn how people began to use their surroundings, and how they altered them and influenced their development. The cultural heritage can also provide information that can be used in sustainable resource management. It can provide insight into how environmental problems arose and how they can be resolved. Sustainable development of our society can only be achieved if the decisions we make are based on a long-term perspective. Cultural monuments, sites and environments are non-renewable resources. Once damaged or removed, they are lost for ever.

No suitable indicators for monitoring progress towards the national targets for this priority area have been developed as yet.

More information: there is some relevant material on cultural environments in Chapter 3: Agriculture (section 3.3) and background material in Chapter 9: Land use.

National targets – cultural heritage

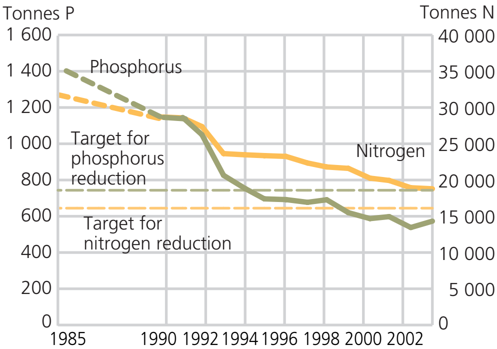
1. Annual losses of cultural monuments, sites and environments as a result of demolition, damage and decay shall be minimised, and by 2020 shall not exceed 0.5 per cent of the total.
2. Cultural monuments, sites and environments protected under the Cultural Heritage Act shall be safeguarded and a standard requiring only normal maintenance shall be achieved by 2020.
3. The selection of permanently protected cultural monuments, sites and environments shall include a wider range in terms of geography, social class, ethnicity, industrial and commercial use and historical periods, and by 2020 a representative selection of these monuments, sites and environments shall be protected under the Cultural Heritage Act.

Priority area 4: Eutrophication and oil pollution

Eutrophication is caused by excessive discharges of nutrients to water, and results in a deterioration of water quality. The most important nutrients involved are phosphorus and nitrogen, and the main sources are industry, agriculture, fish farming and private households. Both marine areas and fresh water bodies are affected. Norway's coastal waters from the border with Sweden to Lindesnes at the southernmost tip of Norway are adversely affected by eutrophication, and this stretch of coastline is a sensitive area as defined by the EU waste water directive.

Discharges of oil and chemicals from shipping, petroleum activities and onshore activities can damage organisms and ecosystems in the open sea, on the sea floor, in the littoral zone and on land. Pollution of coastal areas also reduces their value as recreation areas and for other purposes. The authorities have adequate data on discharges of oil from petroleum activities, but the figures for discharges from onshore sources and shipping are incomplete, particularly as regards illegal discharges.

Figure 1.3. Trends in anthropogenic discharges of phosphorus (P) and nitrogen (N) to the North Sea. 1985-2003



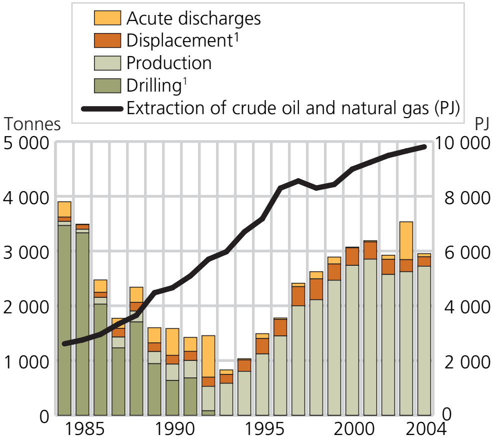
Source: Norwegian Institute for Water Research (2004).

Eutrophication of fjords and marine waters

- In the North Sea region (from the border with Sweden to Lindesnes), where extensive measures have been put into effect to reduce discharges, calculations show that inputs of nitrogen and phosphorus to the North Sea have been reduced by 42 and 62 per cent respectively from 1985 to 2003.
- The reduction in phosphorus discharges is mainly a result of more efficient treatment of waste water from industry and private households, but measures in the agricultural sector have also had some effect. It has proved more difficult to reduce nitrogen discharges, but nitrogen removal has been given priority in the last few years in areas where Norwegian discharges of nitrogen have a significant effect on eutrophication status.

For more information, see Chapter 8: Water resources and water pollution.

Figure 1.4. Discharges of oil from petroleum activities. Tonnes. Extraction of crude oil and natural gas. PJ. 1984-2004



[1] Oil-contaminated ballast water in storage cells on production platforms, displaced when the cells are filled with produced oil.
Source: Norwegian Pollution Control Authority and Energy Statistics, Statistics Norway.

Oil pollution

- Oil production results in both uncontrolled (acute) discharges and legal, licensed (operational) discharges.
- Operational discharges are the largest category. They have risen considerably since 1992, but have been relatively stable in the last few years. The largest source of oil discharges from the oil and gas industry today is produced water, i.e. water associated with the reservoirs that is produced along with the oil or gas. It contains residues of oil and other chemicals.
- Acute discharges from oil production and other activities have varied widely in the period 1984-2004. The level was high in 2003 as a result of a large spill on the Draugen field, but relatively low in 2004.

National targets – eutrophication and oil pollution

1. Inputs of the nutrients phosphorus and nitrogen to parts of the North Sea that are adversely affected by eutrophication shall be reduced by about 50 per cent by 2005, using 1985 as the base year.
2. Operational discharges of oil shall not result in unacceptable injury to health or environmental damage. The risk of environmental damage and other adverse effects of acute pollution shall be acceptable.

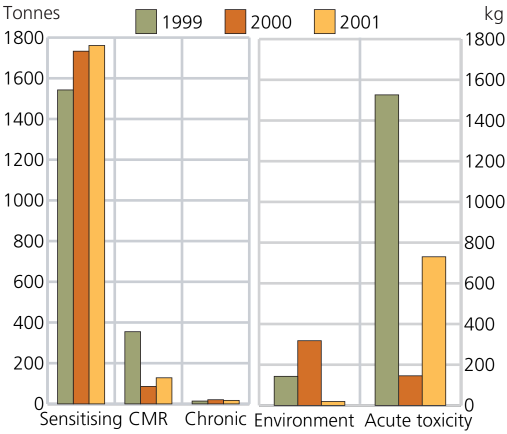
Priority area 5: **Hazardous substances**

Our use of hazardous chemicals and emissions of these substances are responsible for one of the most serious environmental threats facing the world. A number of chemicals break down very slowly in the environment and can therefore accumulate in food chains. They are a serious threat to biological diversity, food supplies and the health of our and future generations. There have been substantial reductions in emissions of many of the most dangerous substances, but new problems are constantly being revealed. There is a general rise in the use of chemicals, and chemicals are being used in new types of products.

In 2002, Statistics Norway developed a methodology for a set of indicators that can show trends in the use of products containing hazardous substances. This uses data from the Product Register, which runs the central register of chemicals in Norway. The Product Register holds information on all products that are required to carry warning labelling (quantities manufactured, imported and exported, and their composition). Statistics Norway uses the different groups or danger categories into which products are divided on the basis of their intrinsic properties.

The method provides a basis for establishing complete statistics on chemicals including all products containing hazardous chemicals. So far, results have been obtained for hazardous products used for non-occupational purposes (by private households), in the construction industry (NACE 45), in other service activities (NACE 93) and for publishing and printing and boat-building.

Figure 1.5. Consumption of hazardous chemicals in households, by danger categories[1,2]. 1999-2001



[1] Some products are classified in several danger categories, but are only included in one category in the statistics.
[2] CMR = Carcinogenic, mutagenic or toxic for reproduction.
Source: Finstad 2003.

- Consumption of substances containing carcinogenic, mutagenic and reprotoxic substances dropped by more than 60 per cent from 1999 to 2001. The main reason for this is a cut in consumption by the textile industry after the introduction of a tax on perchloroethylene in cleaning products.
- On the other hand, the consumption of products containing sensitising substances rose by 200 tonnes or 14 per cent from 1999 to 2001. This was mainly because of a rise in consumption of paints and varnishes and of ordinary cleaning products that are classified as sensitising.
- Consumption of products that can have chronic effects or are classified as acutely toxic or as dangerous for the environment is low, and there are few products in these groups.
- The indicator illustrated in figure 1.5 has not been updated since the publication of *Natural Resources and the Environment 2004*. Statistics Norway is continuing the development of statistics on chemicals.

For more information, see Chapter 6: Air pollution and climate change.

National targets – hazardous substances

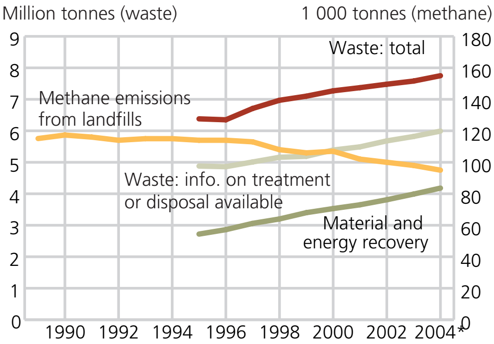
1. Emissions of certain of the most environmentally hazardous substances shall be eliminated or substantially reduced by 2000, 2005 or 2010.
2. Emissions and use of substances that pose a serious threat to health or the environment shall be continuously reduced with a view to eliminating them within one generation (by the year 2020).
3. The risk that emissions and use of chemicals will cause injury to health or environmental damage shall be reduced substantially.
4. The dispersal of the most environmentally hazardous substances from contaminated soil shall be stopped or substantially reduced. Steps to reduce the dispersal of other hazardous substances will be taken on the basis of case-by-case risk assessments.
5. Contamination of sediments with substances that are hazardous to health or the environment shall not give rise to serious pollution problems.

***Priority area 6*: Waste and waste recovery**

Waste treatment can generate emissions of pollutants. Landfilling of waste generates emissions of methane, which is a greenhouse gas. Landfills, particularly the older ones, also contain various kinds of hazardous substances and other substances that can pollute air and water. Waste incineration eliminates methane emissions and other problems associated with landfilling, but generates emissions of various pollutants to air and produces dust and ash that must be treated as hazardous waste. However, new incineration technology has made it possible to reduce such emissions considerably.

Waste contains both energy and materials that can be recovered and replace other energy sources or natural resources.

Figure 1.6. Methane emissions from landfills, total quantity of waste generated[1,2] total quantity for which there is information on method of treatment or disposal, and waste delivered for recovery[3]



[1] Waste quantities have been back-calculated since last year, and the figures therefore differ somewhat from those in Natural Resources and the Environment 2004. Preliminary figures for 2003 and 2004.
[2] Hazardous waste is not included.
[3] Waste quantities split by method of treatment or disposal for the years 2003 and 2004 are preliminary figures based on earlier projections.
Source: Waste statistics, Statistics Norway and emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Waste generated, waste recovery and methane emissions

- The quantity of waste, excluding hazardous waste, generated in Norway rose by about 22 per cent from 1995 to 2004.
- The quantity of waste delivered for material recovery (including composting) and energy recovery rose by 54 per cent in the same period. In 2004, the recovery rate for all waste for which information on disposal or treatment was available was 70 per cent. Norway's goal is to reach an overall recovery rate of 75 per cent by 2010.
- Methane emissions from landfills, which are considered to be one of the most serious environmental problems associated with waste management, have been decreasing since 1990, and emissions in 2004 were about 19 per cent lower than in 1990.

For more information see Chapter 6: Air pollution and climate change and Chapter 7: Waste.

National targets – waste and waste recovery

1. The growth in the quantity of waste generated shall be considerably lower than the rate of economic growth.
2. The proportion of waste recovered is to be raised to about 75 per cent of the total quantity in 2010 and subsequently to 80 per cent. This is based on the principle that the quantity of waste recovered should be increased to a level that is appropriate in economic and environmental terms.
3. Practically all hazardous waste is to be dealt with in an appropriate way, so that it is either recovered or sufficient treatment capacity is provided within Norway.

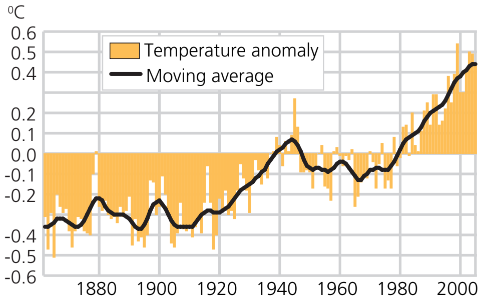
Priority area 7: Climate change, air pollution and noise

Climate change

Concentrations of greenhouse gases in the atmosphere are rising as a result of human activity. The most important reason for this is emissions of carbon dioxide (CO_2) from combustion of fossil fuels, which have already resulted in the highest CO_2 concentrations in the atmosphere for 400 000 years (Norwegian Pollution Control Authority 2005a). As concentrations of greenhouse gases rise, the atmosphere retains more of the thermal radiation from the earth, which will cause the global mean temperature to rise and result in climate change. This phenomenon is called the anthropogenic greenhouse effect.

If greenhouse gas emissions continue to rise, there will be a growing risk of extensive and damaging effects of climate change. To solve the problem will require a reorganisation of world energy use, which is the most important source of greenhouse gas emissions. The countries of the world are trying to organise emission reductions within the framework of the Kyoto Protocol (see Chapter 6, box 6.5).

Figure 1.7. Global mean temperature[1] 1861-2004

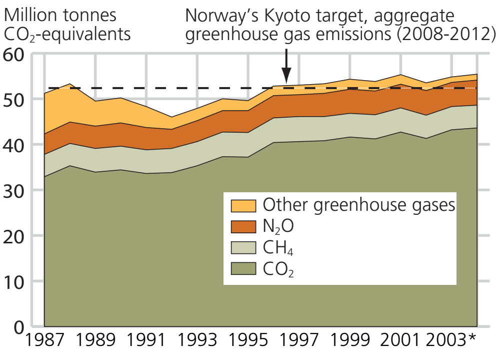


[1] Deviation from the normal value for the period 1961-1990.
Source: Climate Research Unit, University of East Anglia and Hadley Centre, UK Meteorological Office.

Global mean temperature

- The global mean temperature rose by about 0.6 °C during the last century. Some of this rise may be explained by natural variations, but the UN Intergovernmental Panel on Climate Change (IPCC) has concluded that there has been a discernible human influence on the global climate. 1998 was the warmest year registered since records began in 1861, while 2003 and 2002 were the next warmest.
- 2004 was another warm year, the fourth warmest since 1861.
- The annual mean temperature in Norway in 2004 was 1.4 °C above average, making it the sixth warmest year since the Norwegian Meteorological Institute started measurements in 1867.

Figure 1.8. Greenhouse gas emissions in Norway. Historical figures and Kyoto target. 1987-2004



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Greenhouse gas emissions in Norway

- Norwegian greenhouse gas emissions rose by more than 11 per cent from 1990 to 2004. According to the Kyoto Protocol, Norwegian emissions may only rise by 1 per cent between 1990 and the period 2008-2012 when the Kyoto mechanisms (see box 6.5) are taken into account.
- From 2003 to 2004, Norway's greenhouse gas emissions rose by 1 per cent. This was almost entirely due to a 1 per cent rise in CO_2 emissions.
- CO_2 accounts for about 80 per cent of Norway's greenhouse gas emissions.

For more information, see Chapter 6.1.

Depletion of the ozone layer

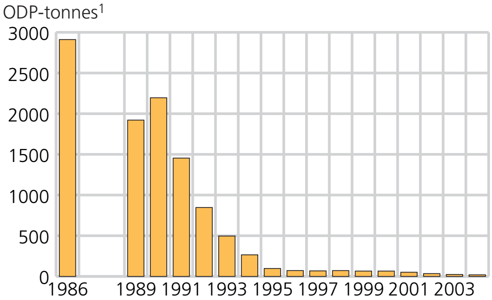
Emissions of gases containing chlorine and bromine, such as CFCs, HCFCs and halons, deplete the atmospheric ozone layer, which protects the earth against harmful UV radiation from the sun. Excessive UV radiation may harm people, plants and animals and marine ecosystems. The greatest rise in UV radiation as a result of depletion of the ozone layer is expected to occur in polar marine ecosystems.

The largest decreases in ozone concentrations are currently being observed over Antarctica, particularly in September and October each year. In this "ozone hole", up to 60 per cent of the total ozone is lost. After a couple of months new ozone is produced and the ozone layer regenerates until the next cycle starts. This phenomenon was first registered in the early 1980s (Norwegian Pollution Control Authority 2005a).

Since 1969, the thickness of the earth's ozone layer has been reduced by an average of 5 per cent at mid-latitudes. Over Oslo, records have shown an average annual reduction of 0.21 per cent in the thickness of the ozone layer in the period 1979-2003 (Norwegian Institute for Air Research 2004).

In 1987, an international agreement, the Montreal Protocol, was drawn up with the aim of reducing global production and consumption of ozone-depleting substances. If all countries comply with the requirements of the agreement, the ozone layer is expected to return to normal in 2050.

Figure 1.9. Imports of ozone-depleting substances to Norway. 1986-2004



[1] The ozone-depleting potential (ODP) varies from one substance to another, and the figures are totals weighted according to the ODP of each substance (ODP factors).
Source: Norwegian Pollution Control Authority.

For more information, see Chapter 6.3

Imports of ozone-depleting substances

- Imports of ozone-depleting substances to Norway have been very low in recent years. In 2004, a total of 19 ODP tonnes was imported, 92 per cent of which was HCFCs.
- Emissions are still being generated in connection with the use and replacement of old products that contain ozone-depleting substances, but these emissions are dropping as old products are phased out.
- Norway has met all its commitments under the Montreal Protocol and the EU targets for ozone-depleting substances. Measured in ODP tonnes, the country's consumption of ozone-depleting substances has been reduced by more than 99 per cent since 1986.

National targets – climate change, air pollution and noise

Climate change

1. Norway shall comply with its commitment under the Kyoto Protocol, which is that its greenhouse gas emissions in the period 2008-2012 must not be more than 1 per cent higher than in 1990.

Depletion of the ozone layer

1. Consumption of halons, all types of chlorofluorocarbons (CFCs), tetrachloromethane, methyl chloroform and hydrobromofluorocarbons (HBFCs) shall be eliminated.
2. Consumption of methyl bromide shall be stabilised in 1995 and phased out by 2005.
3. Consumption of hydrochlorofluorocarbons (HCFCs) shall be stabilised in 1995 and phased out by 2010.

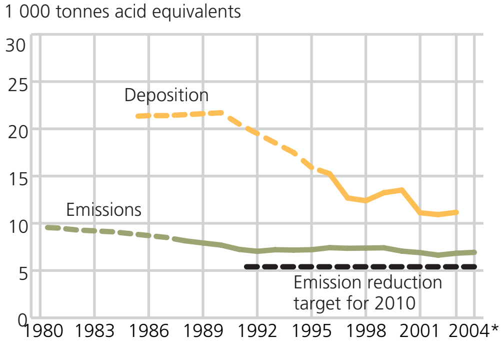
Long-range air pollution

Acid rain is still an environmental problem in Norway, even though reductions in emissions have reduced the extent of acidification. Acid rain is caused by emissions of sulphur and nitrogen compounds to air. These compounds can be transported over long distances, and emissions from other countries in Europe account for about 90 per cent of acid deposition in Norway. The southern half of the country is particularly affected by acid rain, although its impacts can also be seen in some areas of the eastern part of Finnmark county. The most obvious effect is damage to fish stocks, but acidification can also cause forest damage. Inputs of nitrogen oxides and ammonia can also cause eutrophication.

The areas of Norway where critical loads for acidification of surface water are exceeded have been gradually reduced. In 1980, critical loads were exceeded across roughly 30 per cent of the total area of Norway. In 2000, the percentage had dropped to 13. If all countries meet their commitments under the Gothenburg Protocol, this will drop further to about 7 per cent.

In its latest report on long-range transport of polluted air and precipitation, the Norwegian Institute for Air Research (2005) notes that concentrations of sulphur in air are lower than at any time since measurements started in 1973. A report summarising the results of the various monitoring programmes for long-range air pollution (Norwegian Pollution Control Authority 2005b) indicates that a similar trend can be observed in lakes and rivers in Norway, which are less acid than they were in 1973. The changes are greatest in the southernmost parts of the country, but even the regions that have been least affected by acid rain are showing improvements in water quality.

Figure 1.10. Emissions and deposition of acidifying substances (NO_x, SO_2 and NH_3) in Norway. 1980-2004*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority and Norwegian Meteorological Institute.

For more information, see Chapter 6.2.

Acid deposition and emissions

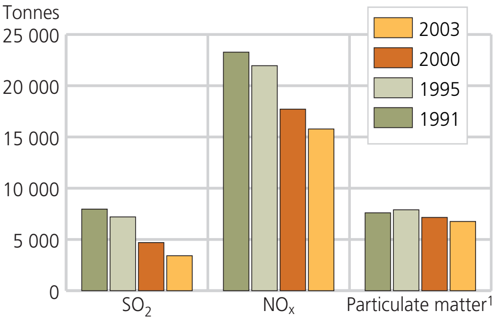
- The international agreements on reductions in emissions of long-range pollutants are now showing results. The deposition of acidifying substances in Norway is now significantly lower than 15 years ago.
- In the past three years (2001-2003) there have been only small changes in deposition rates.
- Norway's emissions have not been significantly reduced over the past few years, and the authorities' target for 2010 has not yet been reached. Nevertheless, acidification has been reduced, mainly as a result of lower inputs from abroad.

Local air quality

Clean air is important for people's health and quality of life. At times, local air pollution causes serious health and welfare problems in the largest towns and urban settlements in Norway. In the largest towns, a substantial proportion of the population is exposed to concentrations of pollutants that increase the risk of premature death and health problems such as respiratory infections, lung disease and cancer.

Some important pollutants that contribute to local air pollution are particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ground-level ozone (O_3), carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAHs), benzene (C_6H_6) and other aromatic compounds.

Figure 1.11. Emissions of particulate matter (PM_{10}[1]), SO_2 and NO_x in the 10 largest towns in Norway. Tonnes. 1991, 1995, 2000 and 2003



[1] PM_{10} = Particles of diameter < 10 µm.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

For more information, see Chapter 6.6.

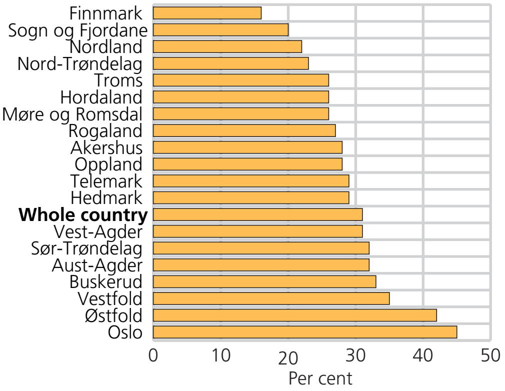
Emissions of harmful substances in urban settlements

- There has been a marked reduction in emissions of NO_x and SO_2 in the last 10 years. There has been a certain reduction of emissions of particulate matter towards the end of this period, but the level is not very different from 10 years ago.
- The most important causes of local air pollution today are road traffic and fuelwood use. Even with the projected growth in road traffic, emissions from this source will probably be gradually reduced in future because considerable reductions in emissions from individual vehicles are expected. Nevertheless, it may be difficult to achieve the national air quality target for nitrogen dioxide (NO_2) in 2010 in certain towns unless measures are introduced to reduce traffic.

Noise

Noise is one of the environmental problems that affects the largest number of people in Norway. According to the "noise annoyance index", which is an indicator of noise annoyance from various sources, about three-quarters of all noise annoyance is caused by road traffic. Industry, construction, air traffic and railways account for 4 per cent each. Surveys of living conditions carried out by Statistics Norway show that 5 per cent of the population have sleep problems as a result of noise. For more information on the noise annoyance index, see box 1.3.

Figure 1.12. Proportion of the population exposed to road traffic noise levels exceeding 55 dBA, by county. 2003*



Source: Statistics Norway's noise model and Directorate of Public Roads.

Distribution of road traffic noise by county

- About 1.4 million people in Norway are exposed to road traffic noise exceeding a 24-hour average of 55 dBA (decibels). In Oslo, almost half the population is exposed to noise exceeding this level.
- About 32 500 people in Norway were exposed to noise levels above 70 dBA in 2003. Almost half of these, 15 000 people, lived in Oslo.

National targets – climate change, air pollution and noise

Long-range air pollutants

1. Annual emissions of sulphur dioxide (SO_2) shall not exceed 22 000 tonnes from 2010 onwards.
2. Annual emissions of nitrogen oxides (NO_x) shall not exceed 156 000 tonnes from 2010 onwards, and annual emissions in the period up to 2010 shall not exceed the 1987 level (230 000 tonnes).
3. Annual emissions of volatile organic compounds (VOCs) shall not exceed 195 000 tonnes from 2010 onwards. In the period up to 2010, annual emissions shall not exceed the 1988 level (252 000 tonnes), and annual emissions from the entire mainland and the Economic Zone of Norway south of 62^0 N shall not exceed 70 per cent of the 1989 level (191 000 tonnes).
4. Emissions of ammonia (NH_3) shall not exceed 23 000 tonnes from 2010 onwards.

Local air quality

1. The 24-hour mean concentration of particulate matter (PM_{10}) shall not exceed 50 µg/m^3 on more than 25 days per year by 2005 and 7 days per year by 2010.
2. By 2010, the hourly mean concentration of nitrogen dioxide (NO_2) shall not exceed 150 µg/m^3 for more than 8 hours per year.
3. By 2005, the 24-hour mean concentration of sulphur dioxide (SO_2) shall not exceed 90 µg/m^3.
4. By 2010, the annual mean concentration of benzene shall not exceed 2 µg/m^3, measured as urban background concentration.

Noise

1. By 2010, noise annoyance shall be reduced by 25 per cent from the 1999 level.

Box 1.3. Noise and measurement of noise

The Storting has decided that by 2010, noise annoyance in Norway is to be reduced by 25 per cent from the 1999 level. Statistics Norway is developing a model that will make it possible to monitor developments in noise annoyance. The model calculates the number of people exposed to noise from various sources and transforms the figures into a noise annoyance index. The environmental authorities have decided to use the index to monitor progress towards the noise reduction target.

Noise annoyance index, by source of noise[1]. 1999 and 2003

	Index 1999	Index 2003	Percentages 2003	Change 1999-2003, per cent
Total, all sources	**563 283**	**573 547**	**100**	**2**
Road traffic[3]	423 690	446 862	78	5
Manufacturing	25 845	24 237	4	-6
Other industry	15 339	16 087	3	5
Air traffic	28 595	22 233	4	-22
Railways	31 827	25 542	4	-20
Construction[2]	21 079	21 678	4	3
Firing ranges (military)	..	..	..	..
Shooting ranges[3]	12 060	12 060	2	0
Motor racing tracks[3]	4 848	4 848	1	0
Products used outdoors	..	..	..	..

[1] In general, noise levels exceeding 50 dBA are used in calculating figures for the noise annoyance index. For some sources, a different lower limit is used: 55 dBA for road traffic, 48 dBA for manufacturing and other industry, and 30 dBA (free field) for shooting ranges.
[2] Figures for 1999 are from the report "Mulige tiltak for å redusere støy. Framskrivninger til 2010 og oppsummering på tvers av kilder" (Possible noise abatement measures. Projections and summary for all sources) (Norwegian Pollution Control Authority 2000). Figures for 2003 were calculated on the basis of the 1999 figures and adjusted for changes in the level of activity.
[3] No new index values were calculated. The 1999 value is also being used for 2003 for the moment. Source for the 1999 figure: Norwegian Pollution Control Authority (2000).
Source: Statistics Norway.

Road traffic the most important source of noise annoyance
Road traffic is much the most important source of noise annoyance in Norway, and according to preliminary figures, accounted for 78 per cent of noise annoyance in 2003. Manufacturing, construction, railways and air traffic accounted for four per cent each, and other industry for three per cent. The minimum noise levels used in calculations of the noise index are not the same for all sources. Different levels are used partly to take into account the varying characteristics of noise produced by different sources, which means that the degree of annoyance they cause varies, and partly because the data currently available do not permit calculations using the lowest noise levels. If the same minimum noise level was used for all other sources as for road traffic, the latter would dominate the index even more than it does at present.

Total noise annoyance increased
Despite a marked drop in noise annoyance from railways and air traffic, total noise annoyance in Norway rose by two per cent from 1999 to 2003. Noise annoyance caused by road traffic increased during this period because of a rise in the volume of traffic and in the number of people living in areas where there is heavy traffic. Since road traffic is responsible for such a large share of noise annoyance, the changes resulted in an overall increase in noise annoyance in Norway.

Noise annoyance from railways dropped by 20 per cent...
Railways accounted for four per cent of estimated noise annoyance in 2003. From 1999 to 2003, noise annoyance from this source dropped by 20 per cent. Several factors help to explain this reduction: a reduction in rail traffic, replacement of older trains with new, quieter models, rail grinding and changes in settlement patterns. Rail grinding is the most important of these, and this alone gave a reduction of 10 per cent in noise annoyance.

…noise annoyance from air traffic dropped by 22 per cent…
Air traffic accounted for 4 per cent of registered noise annoyance in 2003. The noise annoyance index for air traffic has dropped by 22 per cent from 1999 to 2003. This is related to a considerable drop in the number of landings and take-offs during this period: at civilian airports, the number of flights dropped by 23 per cent.

Cont.

..cont.

…and industrial noise also caused less annoyance

This year's calculations show that manufacturing accounted for four per cent of total noise annoyance. Noise annoyance from this source dropped by six per cent from 1999 to 2003. Noise from "other industry", which accounted for three per cent of total noise annoyance, rose by five per cent in the same period. However, these calculations are uncertain. To take account of the characteristics of industrial noise (which includes impulse noise), the minimum noise level used in calculations of the noise annoyance index for this source is somewhat lower (48 dBA) than for other sources.

About the model

Statistics Norway was commissioned by the Norwegian Pollution Control Authority to develop the model, and has done this in close cooperation with the Directorate of Public Roads, Norwegian Air Traffic and Airport Management, the Norwegian National Rail Administration and the Norwegian Defence Construction Service. A GIS model was developed to calculate and record noise levels outside individual dwellings throughout Norway. The model calculates data for noise exposure from various sources (measured as the number of people exposed to different noise levels, Leq) and noise annoyance (measured using the noise annoyance index) in Norway for 1999 and subsequent years. The model is based on existing noise surveys and additional calculations for dwellings that were not included in earlier surveys.

Changes in the past year

The method of calculating railway and road traffic noise has been adjusted to take into account the screening effect of buildings between dwellings and the noise source. The method of calculating industrial noise has also been changed. In addition, the formula for calculating the noise annoyance index has been adjusted for all three of these sources and for air traffic noise. These changes have also resulted in changes in the calculated noise annoyance figures for 1999.

Uncertainty

The calculations are generally uncertain. However, the level of uncertainty varies from source to source. In general terms, it is lowest for areas where noise levels are high and the model is largely based on existing surveys (for example around Oslo airport (Gardermoen) and areas surveyed using the model VSTØY, which is used by the Norwegian Public Roads Administration to calculate road traffic noise). The calculations for industrial noise are more uncertain. For these sources, the model is over-simplified, and the calculations are not based on existing surveys as they are for road traffic and air traffic noise.

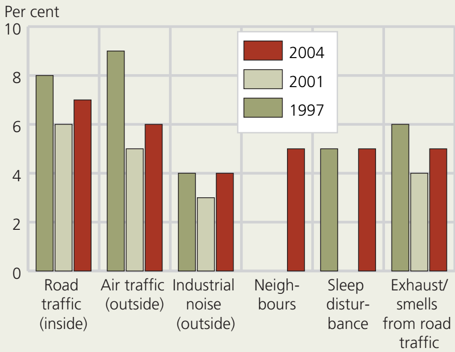
For the largest source of noise annoyance, road traffic, the level of uncertainty is considered to be lower for data taken from the VSTØY model than for data from Statistics Norway's supplementary calculations. Statistics Norway's calculations are considered to be most reliable for the national and county roads for which data on traffic volume is available from the National Road Database. For municipal roads, the figures are mainly calculated on the basis of general assumptions, which results in a higher level of uncertainty.

Survey of living conditions

The figure shows the proportion of the population who say that they are annoyed by noise. The figures are from Statistics Norway's surveys of living conditions. In 2004, seven per cent of the population, or more than 300 000 people, stated that they were annoyed by road traffic noise inside their homes, and six per cent that they were annoyed by air traffic noise outside their homes. There has been a marked drop in the proportion of the population who find air traffic noise annoying, probably because in 1998, Oslo Airport was moved from Fornebu to Gardermoen, considerably further away from the city. Five per cent of the population, or well over 200 000 people, stated that noise caused sleep disturbance.

For more information, see: Støyplage i Norge. 1999-2003: Veitrafikken årsak til økt støyplage. SSBmagasinet (Noise annoyance in Norway. 1999-2003: Road traffic causing increased noise annoyance): http://www.ssb.no/vis/magasinet/miljo/art-2005-08-25-01.html (in Norwegian only).

Percentage of population who say they are annoyed by noise from different sources, and percentage who suffer from sleep disturbance

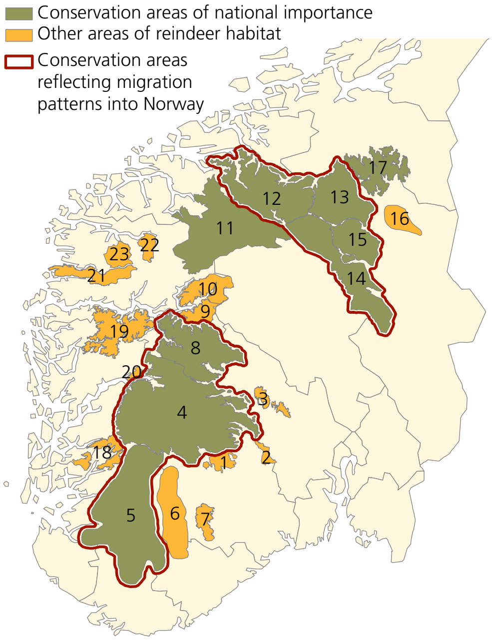


Source: Statistics Norway, Survey of living conditions.

Priority area 9: Regional planning and land-use policy

This priority area was introduced in the most recent white paper on the Government's environmental policy and the state of the environment in Norway (Report No. 21 (2004-2005) to the Storting). The white paper highlights the fundamental importance of a national land use policy for achieving sustainable management of Norway's total land resources and to create a satisfactory physical environment. The policy focuses on land as a basis for settlement and commercial development, for experiencing the natural surroundings and for recreational purposes, and on safeguarding the values inherent in the landscape and biological and cultural diversity.

Figure 1.13. Proposal for reindeer conservation areas in Norway



Areas of reindeer habitat
1 Brattfjell-Vindeggen
2 Blefjell
3 Nordefjell-Reinsfjell
4 Hardangervidda
5 Setesdal - Ryfylke
6 Setesdal Austhei
7 Vårmyr - Roan
8 Nordfjella
9 Lærdal - Årdal
10 Vest-Jotunheimen
11 Ottadalen
12 Snøhetta
13 Knutshø
14 Rondane
15 Sølnkletten
16 Tolga Østfjell
17 Forelhogna
18 Etne-Sauda
19 Fjellheimen
20 Oksenhalvøya
21 Sunnfjord
22 Svartebotnen
23 Førdefjella

Source: Norwegian Institute for Nature Research.

- Norway is the only country in Europe where there are intact high-mountain ecosystems with populations of wild reindeer. Because Norway is home to most of the wild reindeer in Europe, this is considered to be a species for which Norway has special responsibility.
- Changes in land use, particularly the construction of roads and railways and hydropower developments, have contributed to the fragmentation of wild reindeer habitat.
- In order to safeguard the remaining areas of wild reindeer habitat, a proposal has been drawn up to establish two reindeer conservation areas that reflect the pattern of reindeer migration into Norway and other conservation areas that are considered to be important for their survival in Norway in the future.

National targets – land regional planning and land use policy

1. Mountain areas shall be managed through a whole-landscape approach that safeguards their cultural and natural resources while providing opportunities for appropriate types of commercial development and outdoor recreation.
2. The environmental qualities of landscapes shall be safeguarded and developed through improved knowledge and targeted planning and land-use policy.
3. Areas of wild reindeer habitat shall be safeguarded.
4. The annual conversion of high-quality arable land for other purposes than agriculture shall be halved. Particularly valuable areas of cultural landscape shall be documented and management plans put in place by 2010.
5. Coordinated planning procedures, including evaluation of user and environmental interests, shall be followed for the establishment of energy generation plants requiring large areas of land.
6. The environmental and recreational qualities of the coastal zone shall be safeguarded, and easy access to the shoreline shall be provided for the general public.
7. Land-use policy for river systems shall be based on an integrated approach to management of the river landscape, zones adjoining watercourses and water resources.
8. Holiday housing shall be sited and designed to harmonise with the landscape and its environmental qualities, with a focus on resource use and aesthetic qualities.
9. Urban settlement development shall promote a high quality of life and good health through good urban planning and design, environmentally friendly transport and the provision of good, easily accessible outdoor areas.
10. Near housing, schools and day care centres, there shall be adequate opportunities for safe access and play

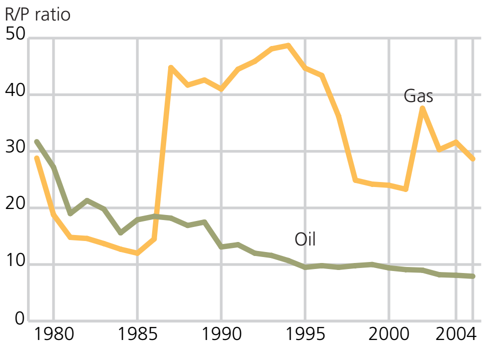
1.3. Natural resources

Many natural resources are important raw materials for industrial production. These resources, and the way they are used, are also of crucial importance for biological diversity. It is therefore essential that natural resources are managed sustainably and are not over-exploited. In this section, we consider some important natural resources that Norway is responsible for managing - oil and gas, hydropower, fish stocks, agricultural land and forests.

Oil and gas resources

Norway's oil and gas reserves correspond to just over 1 per cent of the world's total reserves. However, in 2004, Norway accounted for 3.9 per cent of the world's oil production and 2.9 per cent of gas production. The estimates of reserves are revised regularly and the figures may change markedly from one year to another. In addition, new fields are added to the list almost every year. The length of time that the remaining oil and gas reserves will last (at the current rate of production) is expressed as the R/P ratio, i.e. the ratio between the estimated petroleum reserves (defined as the remaining resources in fields that are already developed or where development has been approved) and production in a particular year.

Figure 1.14. R/P ratio[1,2] for Norwegian oil and gas reserves. 1978-2004



[1] The R/P ratio, or the ratio between reserves and production, indicates how many years it will take before the reserves are exhausted
[2] Because of a change in the classification system for petroleum resources, there is a break in the time series between 2000 and 2001.
Source: Energy statistics from Statistics Norway and Norwegian Petroleum Directorate.

R/P ratio for oil and gas reserves

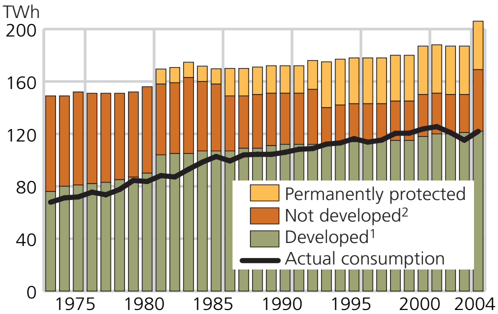
- The length of time that Norway's oil and gas reserves will last at the current rate of production, expressed as the R/P ratio, is calculated to be 8 years for oil and 29 years for gas.
- BP (2005) quotes the following R/P ratios for the whole world at the end of 2004: oil 41 years and natural gas 67 years.
- These figures do not include the total petroleum resources, which are much larger. They are defined as including all more or less certainly proven finds.

For more information, see Chapter 2: Energy.

Hydropower resources

Unlike petroleum resources, hydropower resources are renewable. Norway has Europe's largest hydropower resources, and hydropower was an important basis for the industrialisation of the country. The rich supplies of hydropower have a great influence on the energy mix. Almost 100 per cent of electricity production in Norway is based on hydropower. Some of the electricity that Norway imports is generated from other energy sources, but this accounts for only a very modest share of the total. In 2004, electricity accounted for 45 per cent of total domestic energy use outside the energy sectors (52 per cent if energy commodities used as raw materials are excluded: see Appendix, table B5 and figure 2.13). This is the highest percentage in the world.

Figure 1.15. Hydropower resources: developed[1], not developed[2] and protected. Actual electricity consumption. 1973-2004[3]



[1] Includes the categories under construction and licence granted.
[2] Includes the categories prior notification submitted and licence application submitted.
[3] The large rise in 2004 is explained by the inclusion of small power plants (capacity 50 – 10 000 kW).
Source: Norwegian Water Resources and Energy Directorate.

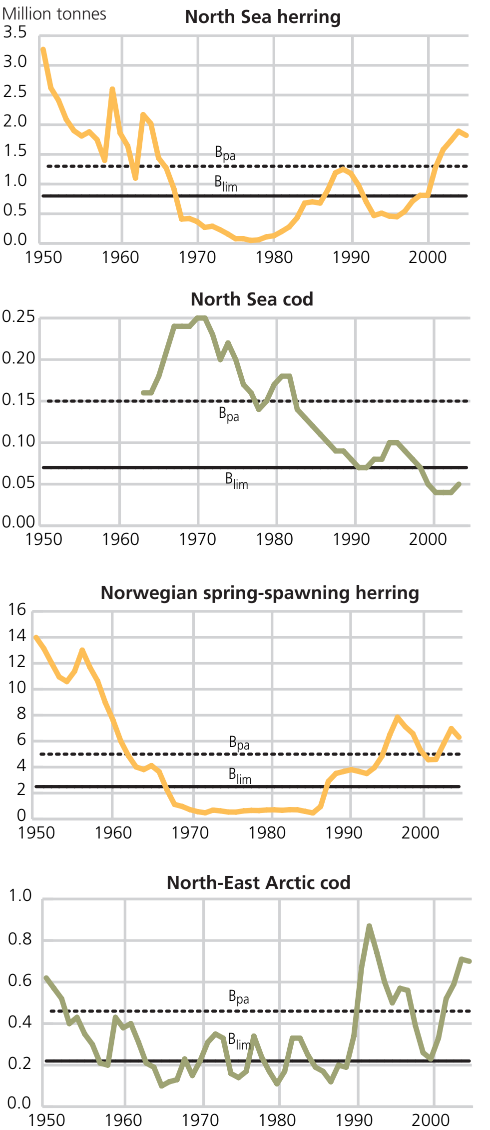
For more information, see Chapter 2: Energy.

- Norway's hydropower potential is evaluated on a continuous basis and depends on technological and economic factors. The calculated hydropower potential may therefore change from year to year. In addition, the resources in fact available vary from year to year depending on rainfall.
- In the last 30 years, electricity consumption has risen faster than production capability. In both 2002 and 2003, higher prices resulted in a drop in consumption. In 2004, prices were somewhat lower, and consumption rose again (see Chapter 2).
- Of Norway's total hydropower potential, about 40 per cent has not been developed, and about half of this is protected.

Fish stocks

In the Barents Sea and Norwegian Sea, the stocks of Northeast Arctic cod, saithe, haddock and Norwegian spring-spawning herring are at satisfactory levels. The capelin stock in the Barents Sea is very low and is classified as having reduced reproductive capacity. The stocks of red-fish (*Sebastes marinus* and *S. mentella*) and Greenland halibut are currently at low levels. The blue whiting stock seems to be in relatively good condition even though it has been heavily exploited in recent years. However, the current fishing pressure means that the stock is very vulnerable and is dependent on a continued high level of recruitment. New estimates indicate that the Northeast Atlantic mackerel stock is lower than it has been for many years. In the North Sea, stocks of demersal fish species such as cod, Norway pout and sandeel are in poor condition. The North Sea herring stock is above the precautionary level, and the stocks of haddock and saithe are also in good condition (Anon. 2005).

Figure 1.16. Actual spawning stocks and critical (B_{lim}) and precautionary (B_{pa}) reference points for four important fish stocks. 1950-2005



Source: ICES and Institute of Marine Research.

Spawning stocks

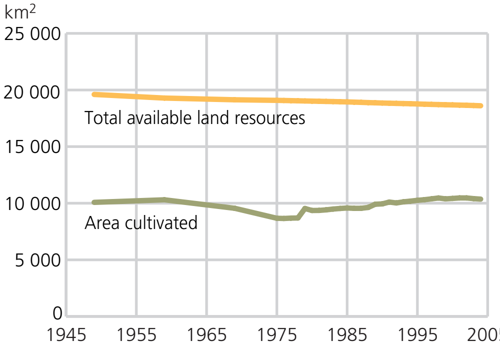
- The North Sea herring stock, 1.8 million tonnes, is well above the precautionary level. The reproductive capacity of the stock is now good, and the current level of harvesting is considered to be sustainable.
- The North Sea cod stock appears to have been greatly depleted, and the spawning stock is well below the level considered necessary for good recruitment.
- The spawning stock of Norwegian spring-spawning herring, about 6.3 million tonnes, is well above the precautionary level. Sound management seems to have given good results. The outlook for the stock seems to be good, but the lack of international quota agreements adds an element of uncertainty. The migratory pattern of this stock has changed in recent years, and most of the adults now overwinter out at sea.
- The spawning stock of North-East Arctic cod, about 700 000 tonnes in 2005, is also well above the precautionary level. Earlier maturation is an important reason for the rise in spawning biomass since 2000. There is significant illegal fishing of this cod stock. For 2004, unreported catches are estimated at 90 000 tonnes.

For more information, see Chapter 5: Fisheries, sealing, whaling and fish farming.

Agricultural areas

Norway has only limited land resources that are suitable for agricultural production. About 3 per cent of the country is cultivated, as compared with over 10 per cent in the world as a whole. Almost the same proportion of land is classified as cultivable, but these areas are generally less valuable than land that is already being cultivated. The scarcity of land resources means that the current self-sufficiency rate is between 40 and 50 per cent.

Figure 1.17. Cultivated land and available land resources in Norway. 1949-2004*



Source: Agricultural statistics, Statistics Norway and Grønlund and Høie (2001).

For more information, see Chapter 3: Agriculture.

Available land resources and cultivated land

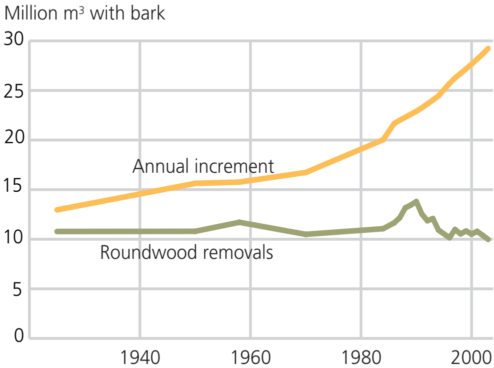
- In the past 100 years, the cultivated area of Norway has varied between 11 200 km² at the end of the 1930s and 8 700 km² in the 1970s, and is now about 10 400 km².
- The available land resources (cultivated and cultivable area) have dropped by almost 1 000 km² or 5 per cent from 1949 to 2004 as a result of irreversible conversion of agricultural land for non-agricultural uses. The proportion of the available resources actually cultivated was 56 per cent in 2004, as compared with 51 per cent in 1949.

Forest resources

The volume of the growing stock of forest has risen a great deal in the past century, resulting in an increase both in timber resources and in the potential value of forest as a CO_2 sink (this is not included in the Kyoto Protocol). The type of forest has also changed greatly during this period. Clear-cutting, silviculture, drainage, the construction of forest roads, the introduction of alien species and pollution are some of the factors that have had an impact on the forest as a natural resource and on biological diversity in forests.

The Norwegian monitoring programme for forest damage shows that in recent years, there has been a slight improvement in the health of forests measured as crown condition.

Figure 1.18. Roundwood removals and annual increment in Norwegian forest. 1925-2003



Source: Statistics Norway and Norwegian Institute for Land Inventory.

Roundwood removals and annual increment

- Since the early 1920s, roundwood removals in Norway have been less than the annual increment. About 80 per cent of the increment was harvested in 1925, but this had dropped to only 34 per cent in 2003.
- In recent years, only 40 to 60 per cent of the annual increment has been harvested. As a result, the volume of the growing stock has more than doubled since the 1920s.

For more information, see Chapter 4: Forest and uncultivated land.

1.4. The relationship between environment and economy – indicators for selected sectors

Anthropogenic pollution and disturbance of the natural environment are side effects of production and consumption, and usually result in growing pressure on the environment as the economy expands. For example, energy use and greenhouse gas emissions show a tendency to rise with economic growth. However, this relationship is not at all clear-cut.

An analysis of factors that have influenced emissions to air in Norway (Bruvoll and Medin 2003) showed that many types of emissions have been stable or decreased in the past 25 years. More efficient use of energy and increasing use of technology to control emissions have had most effect in counteracting rising emissions since 1980. A cleaner energy mix has also helped to moderate the growth in emissions, whereas changes in the relative size of production sectors have tended both to speed up and slow down the growth in emissions.

Box 1.4. Decoupling environmental pressures from economic growth

In its action plan for sustainable development, the Norwegian government has made it clear that its goal is to maintain economic growth and at the same time reduce the associated environmental pressures (Report No. 1 (2003-2004) to the Storting). There are two main ways in which pollution intensity can be lowered in Norway:

1. the resource efficiency and eco-efficiency of individual industries can be improved, so that they use smaller inputs of resources and generate less pollution per unit of production, and/or
2. structural changes can be made in the economy, so that less polluting industries and cleaner consumption grow at the expense of more polluting activities.

Decoupling is a term that is used to describe a situation where economic growth is greater than the growth in emissions or environmental pressure. In a wider perspective, it is important to remember that even if both of these changes are made, total emissions may rise if production increases. Moreover, structural changes may not result in a global reduction in emissions if pollution-intensive industries relocate from Norway to other countries.

Box 1.5. Economic growth - does it improve the environment?

Technological progress and changes in the energy mix have helped to reduce emissions of many pollutants in Norway in the last 30 years despite strong growth in production and consumption. The most optimistic view is that economic growth can continue without major environmental costs, mainly thanks to technological advances. Many environmentalists, on the other hand, are concerned that the growth in production and consumption may cause the collapse of ecosystems.

Model-based calculations by Statistics Norway do not give a clear answer to the question of what can be expected to happen in the next 25 years. Projections for the period up to 2030 indicate that emissions of most local and regional pollutants will level off or drop, see figure 1. Technological developments, environmental policy and changes in the relative size of production sectors will all play a part in moderating the growth in emissions, and economic growth will continue. However, the analyses show that greenhouse gas emissions will continue to rise, even if it is assumed that a stricter climate policy is introduced.

Emission trends in Norway will depend greatly on whether Norway introduces stricter climate policy measures at national level or links national measures to an international emissions trading system. By taking part in emissions trading, Norway could meet its emission reduction commitments by importing emission allowances from other countries where the costs of reducing emissions are lower. This solution would have less effect on emissions in Norway than measures to bring about the entire reduction in emissions in Norway.

Figure 2 shows the projected growth in emissions in Norway for three different climate-policy scenarios. Unilaterally raising the Norwegian CO_2 tax to almost three times its current level would halve the rate of growth of CO_2 emissions and also reduce growth in other emissions. The introduction of an international emissions trading system would primarily result in emission reductions in other countries, leaving Norway's emissions almost unchanged.

It is also interesting to look at the effect on projected emission trends for Norway's trading partners resulting from the relocation of emission-intensive production from Norway to other countries (see box 1.4). In the simulated growth trajectories, Norway increases its net imports of products from emission-intensive industries. The results indicate that economic growth in Norway will result in a less favourable trend in the world as a whole than the Norwegian emission inventory alone suggests, and may aggravate local environmental problems in other countries. In the case of greenhouse gases, emission leakages will counteract the environmental impacts in Norway of the country's own climate policy, since it makes no difference for the climate impact where emissions take place.

Figure 1. Observed emissions up to 2002 and projections up to 2030 assuming that climate policy remains unchanged. 1980 =1.0

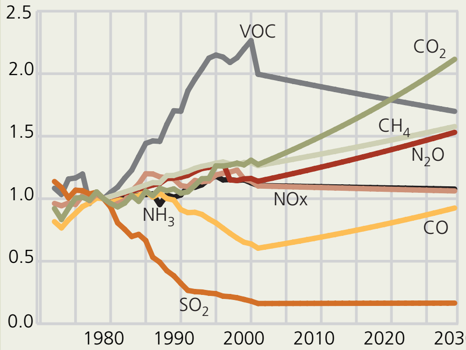
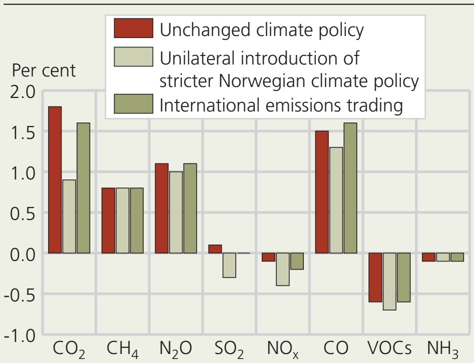


Figure 2. Average annual percentage changes in Norway's emissions in the period 2000-2030 for three scenarios: unchanged climate policy, unilateral introduction of a stricter Norwegian climate policy, and introduction of an international emissions trading system



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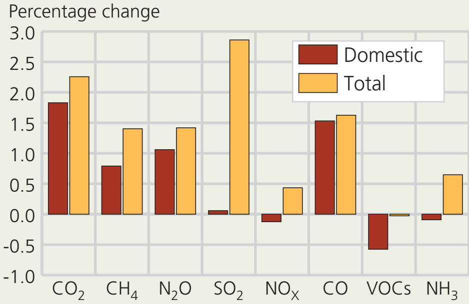
During the past 30 years, the opposite has been the case: Norwegian net imports have decreased, and so has the country's contribution to emissions abroad. The main explanation for this is strong growth in oil production and exports. This trend has given Norway responsibility for a rising proportion of the total emissions associated with global oil demand.

According to the model, decreasing output from the oil sector will have the opposite effect in the period up to 2030, and the increase in global emissions associated with Norway's economic growth will be larger than the increase in domestic emissions, see figure 3. Emissions from Norwegian offshore production will drop, and the global demand for oil products will have to be met by increasing oil and gas extraction in other countries. At the same time, Norway's imports of goods and services from pollution-intensive sectors will rise, and this will also result in higher emissions in other countries.

The modelling results indicate that Norwegian climate policy will have little effect on emission leakages resulting from Norway's foreign trade in goods and services. However, if the international emissions trading system involves undertakings by participating countries to make real emission reductions, Norwegian emissions trading will help to reduce emissions in other countries. Moreover, the introduction of an international agreement would ensure that other countries also reduced their emissions of both greenhouse gases and other pollutants that are associated with the same emission sources (for example SO_2, NO_x and CO).

Figure 3. Average annual percentage changes in emissions in the period 2000-2030 assuming Norway's climate policy remains unchanged. Changes in domestic emissions and total emissions (= changes in domestic emissions + changes abroad attributed to changes in Norwegian trade patterns)



For more information, see:
Bruvoll, A. and T. Fæhn (2005): Økonomisk vekst - medisin mot dårlig miljø? (Economic growth - does it improve the environment?), *Økonomisk Forum* No. 2, 34-43.
Bruvoll, A. and T. Fæhn (2005): Rett i hodet på naboen? Globale miljøvirkninger av norsk økonomisk vekst og miljøpolitikk (Dumping it on the neighbours? Global environmental impacts of Norway's economic growth and environmental policy), *Economic analyses* 2/2005, 27-34. Statistics Norway.

Changes in pollution intensity 2002-2003

From 2002 to 2003, both greenhouse gas emissions and emissions of acidifying substances in Norway rose more than value added. There was a particularly marked rise in CO_2 emissions, mainly as a result of higher gas production, greater use of fuel oils and higher emissions from road traffic and coastal shipping. This shows how a combination of a change in the energy mix (fuel oils rather than electricity) and changes in relative size of production sectors can result in faster growth in emissions than in the economy.

An encouraging development in the same period was the cut in emissions of gases that contribute to the formation of ground-level ozone. More than half of all emissions of non-methane volatile organic compounds (NMVOCs) in 2003 were generated by loading and storage of crude oil on the continental shelf. Emissions dropped because more oil was loaded at facilities where oil vapour is recovered. Other factors that contributed to this reduction were recovery of oil vapour at onshore loading facilities, lower sales of petrol and an increase in the number of cars fitted with catalytic converters. This shows how the development of effective technology to control emissions can make it possible to decouple economic growth from the rise in emissions of a specific pollutant, so that pollution intensity drops.

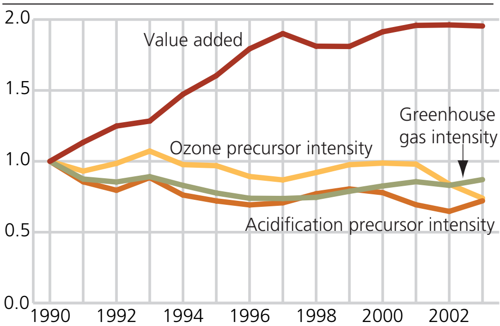
General economic developments

Measured in constant prices, Norway's gross domestic product (GDP) has grown every year since 1990. The Norwegian economy passed a cyclical peak in 1998, and since then growth has been weaker than it was in the mid-1990s. However, economic growth now appears to be picking up again, and according to the national accounts, mainland GDP expanded by 3.5 per cent in 2004.

Mining and extraction of crude oil and natural gas

In the period 1990-2003, value added in this sector rose by 95 per cent (measured in constant prices), and this in itself would tend to cause a rise in emissions. In 2003, these industries accounted for 13 per cent of Norway's value added. They also generated 11 per cent of Norway's emissions of acidifying substances, 22 per cent of its greenhouse gas emissions and 27 per cent of emissions of ozone precursors.

Figure 1.19. Emission intensities and value added (constant basic prices) for mining and quarrying and the extraction of crude oil and natural gas. 1990-2003*. Index: 1990=1



Source: National accounts and environment statistics, Statistics Norway (2005).

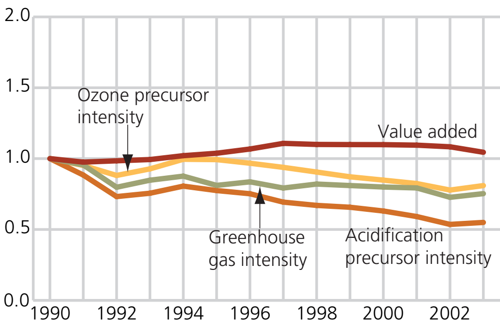
Mining and extraction of crude oil and natural gas: Environmental and economic indicators

- Greenhouse gas intensity (measured as emissions per NOK of value added) gives an idea of the eco-efficiency of an industrial sector. There was a fairly steady reduction in greenhouse gas intensity in mining and extraction of crude oil and natural gas between 1990 and 1997-1998. Since then, the trend seems to have been reversed.
- A shift in the production mix towards a higher proportion of gas and a lower proportion of oil has resulted in higher emissions of greenhouse gases and acidifying substances. This is because gas production is more energy-intensive than oil production and therefore generates more pollution.
- The substantial drop in total emissions of ozone precursors continued in 2003 (see box 6.11).

Manufacturing

Value added in manufacturing reached a peak in 1998, and is now showing a weak downward trend. This in itself may have reduced some environmental problems associated with emissions of pollutants. In 2003, manufacturing generated 7 per cent of Norway's emissions of acidifying substances, 23 per cent of its greenhouse gas emissions and 7 per cent of emissions of ozone precursors, and accounted for 11 per cent of Norway's total value added.

Figure 1.20. Emission intensities and value added (constant basic prices) for manufacturing in Norway. 1990-2003*. Index: 1990=1



Source: National accounts and environment statistics, Statistics Norway (2005).

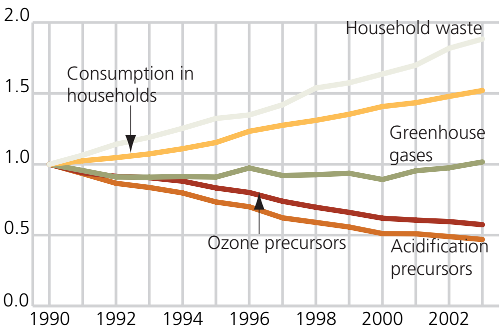
Manufacturing: Environmental and economic indicators

- From 2002 to 2003, emission intensity rose slightly for the three types of pollutants shown in figure 1.20. In absolute terms, emissions remained fairly stable, but since value added decreased at the same time, emission intensity rose.
- The high electricity prices in 2003 resulted in greater use of fuel oils rather than electricity in a number of onshore manufacturing industries. Both greenhouse gas emissions and emissions of acidifying substances rose from 2002 to 2003, largely because more fuel oil was used for combustion purposes.
- However, emission intensity dropped in certain industrial sectors. Greenhouse gas emissions from aluminium production dropped sharply from 2002 to 2003 despite a rise in production. This was mainly because one plant converted from Söderberg to prebake technology. Emission intensity is lower for prebake production technology.
- In the period 1990-2003, emission intensity for acidifying substances was almost halved. This was largely because SO_2 emissions were cut by means of technological improvements and the use of fuel with a lower sulphur content.

Households

Some environmental problems are closely related to household consumption, but the relationships are not clear-cut. In 2003, households accounted for 3 per cent of Norway's emissions of acidifying substances, 12 per cent of emissions of ozone precursors, 9 per cent of greenhouse gas emissions, and about 20 per cent of total waste generation. Household consumption in 2003 was NOK 688 billion.

Figure 1.21. Consumption (in constant prices), waste generation and emissions to air. Households. 1990-2003*. Index 1990=1



Source: National accounts and environment statistics, Statistics Norway (2005).

Households: Environmental and economic indicators

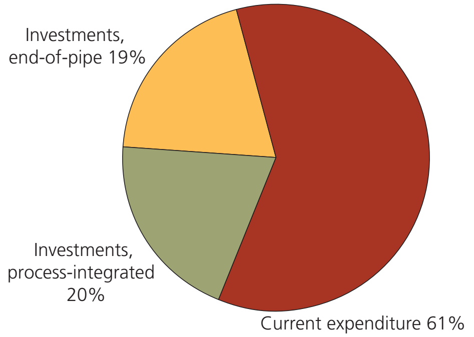
- Household consumption (measured at constant prices) has risen by 52 per cent during the period 1990-2003.
- Generation of household waste has also risen throughout the period, and at a faster pace than consumption. Household waste generation continued to rise more rapidly than consumption from 2002 to 2003, despite Norway's policy objective of keeping the rate at which waste generation grows below the rate of economic growth.
- Household greenhouse gas emissions rose above the 1990 level for the first time. This is mainly explained by the use of fuel oil for heating, but also by rising fuel consumption by private cars.

1.5. Environmental protection expenditure in manufacturing industries and mining and quarrying

Manufacturing industries and mining and quarrying excluding the oil and gas industry

Statistics for environmental protection expenditure in manufacturing industries and mining and quarrying have been drawn up, and preliminary figures have been calculated for the oil and gas industry. In 2002, 7.8 per cent of investments in the largest manufacturing and mining establishments were related to environmental protection.

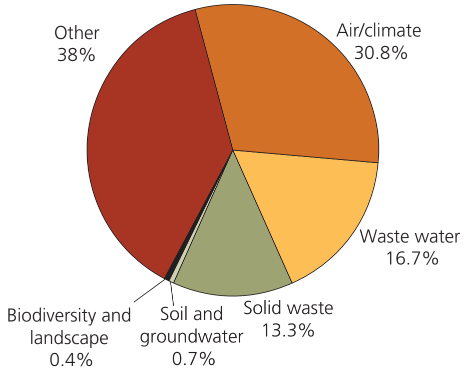
Figure 1.22. Investments and current expenditure. Manufacturing and mining and quarrying. 2002. Per cent



Source: Environmental protection expenditure statistics, Statistics Norway (2004).

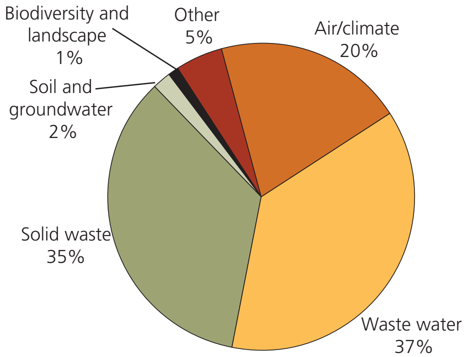
- The largest manufacturing and mining establishments invested a total of NOK 586 million in end-of-pipe equipment. This is equipment to treat, prevent, control or measure pollution. Examples of such equipment are filters, cooling systems, catalytic converters, incinerators, waste compactors, sedimentation tanks and noise barriers.
- In addition, the largest establishments reported that they had invested NOK 438 million in process-integrated technologies, i.e. solutions using cleaner technology in the production process itself. In 2002, such investments included waste management and reduction equipment, including production equipment that makes better use of raw materials and equipment for recycling cooling water. Investments of this kind generally improve the efficiency of production and have environmentally beneficial effects at the same time.
- The establishments also reported on environment-related current expenditure in 2002. This totalled NOK 1.3 billion. Examples of such expenditure are wage costs for employees who work on environmental issues, environmental reporting or discharge permits, purchases of external environmental services (consultants' fees, waste management and waste water treatment services) and the operation, maintenance and repair of environmental protection equipment.

Figure 1.23. Total investments in environmental protection measures, by environmental domain. 2002. Manufacturing and mining and quarrying. Percentages



Source: Environmental protection expenditure statistics, Statistics Norway (2004).

Figure 1.24. Current expenditure on environmental protection measures, by environmental domain. 2002. Manufacturing and mining and quarrying. Percentages



Source: Environmental protection expenditure statistics, Statistics Norway (2004).

- Environmental protection expenditure is classified on the basis of the type of pollution or problem area it is related to, or environmental domain: air/climate, waste water (including production water), waste, soil and groundwater, biodiversity and landscape and other pollution (see Appendix, table A1).

- The largest share of total environmental protection expenditure in 2002 was in the waste water domain, but waste and air/climate were also major sectors. In all, 79 per cent of environmental protection expenditure in the largest establishments was in these three environmental domains.

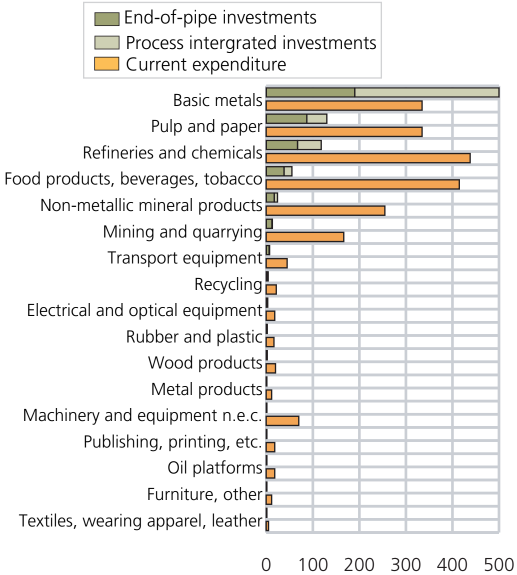
- For investments (end-of-pipe equipment and process-integrated technologies), the largest categories were the domain air/climate and the category "other". However, there were differences between the two investment types.

- Of investments in end-of-pipe technology, 45 per cent were in the domain air/climate. The second largest environmental domain for investments of this type was waste water, just ahead of waste.

- The domain air/climate also accounted for a certain proportion of investments in process-integrated technologies (17 per cent). This is because such investments often result in energy savings, which in turn will help to reduce emissions. However, the category "other" was much the largest here, and accounted for 72 per cent of all reported investments in process-integrated technologies. This is probably because such technology can often be related to several environmental domains, and it is difficult to split the investments between domains. It should also be noted that some large investments were reported in this category, and these are not necessarily representative of other years.

- For environment-related current expenditure, the largest categories were the domains waste water and waste. In all, 72 per cent of reported expenditure was in these two domains.

Figure 1.25. Investments and current expenditure for environmental protection in large establishments, by industry. 2002. NOK million



Source: Environmental protection expenditure statistics, Statistics Norway (2004).

- The 2002 survey only included the largest manufacturing and mining establishments. For the present, the figures have not been grossed up to represent the whole of this sector.
- About four per cent of the metal industry's investments in 2002 were in end-of-pipe technology, while the corresponding figure for the pulp and paper industry was almost 15 per cent. These figures show that investments by the metal industry in end-of-pipe technology were lower than the year before, whereas the proportion of such investments made by the pulp and paper industry almost doubled.
- For establishments that manufacture glass, cement and ceramic products, environmental protection investments accounted for eight per cent of the total in 2002. In most other industrial sectors, this type of investment makes up one to four per cent of total gross investments.
- For the metal industry and the pulp and paper industry, investments in process-integrated technologies also made up a substantial proportion of total investments, six and seven per cent respectively in 2002. Other sectors where process-integrated technologies accounted for a relatively high proportion of total investments (more than three per cent) were oil refining and the manufacture of chemicals and chemical products.
- Environment-related current expenditure made up well over half of all environmental protection expenditure. The proportion was particularly high in the food products and beverages industry. Environment-related current expenditure by the largest establishments in this sector totalled almost NOK 250 million in 2002. On average for all industries, environment-related current expenditure corresponded to NOK 10 000 per employee. The largest pulp and paper establishments reported a high level of current expenditure on environmental protection, corresponding to NOK 35 000 per employee. The next highest figures were in metal manufacturing and oil refining and chemical products, NOK 25 000-30 000 per employee.

Environmental protection expenditure in the oil and gas industry

The oil and gas industry has to meet a number of requirements relating to its environmental impact and including both emissions to air and discharges to the sea. Under the OSPAR Convention, Norway has undertaken to limit the oil content of water discharged on the continental shelf, and there is national legislation on other types of discharges. Norway has also entered into agreements on greenhouse gas emissions (see figure 6.2 and box 6.5) and on acidifying substances and substances that contribute to the formation of ground-level ozone (see figures 6.10, 6.11 and 6.15). The offshore oil and gas industry generates a substantial proportion of emissions of several of these gases, particularly greenhouse gases and NMVOCs: in fact, it accounts for almost 50 per cent of total NMVOC emissions. This situation means that requirements for the reduction or limitation of emissions in such agreements can have major consequences for the industry.

For example, the oil and gas industry incurs extra costs in implementing the measures needed to achieve emissions reductions. Preliminary estimates indicate that the industry invested almost NOK 500 million in end-of-pipe equipment in 2002. This is almost as much as the combined investments by manufacturing industries and mining and quarrying in mainland Norway.

The remaining chapters of this publication and the appendix of tables provide further information on Norway's natural resources and the environment and describe how they are affected by the activities of various economic operators.

1.6. Is Norway sustainable?

In December 2003, the Norwegian Government appointed an expert committee that was given the task of developing a set of indicators of sustainable development for Norway. The main purpose of the indicators is to provide information that can be used in evaluating and implementing the government's action plan for sustainable development, its National Agenda 21.

Few acute problems

In its report (Official Norwegian Report 2005:5), the committee proposed a set of 16 indicators including state and pressure indicators for several priority areas defined by the government and indicators of the state of different components of Norway's national wealth. The committee considered the following six priority areas:

1. Climate, ozone and long-range air pollution
2. Biodiversity and cultural heritage
3. Hazardous substances
4. Natural resources
5. Sustainable economy
6. Social conditions of direct significance for sustainable development

The indicators show that Norway has few acute problems, but does face challenges relating to future greenhouse gas emissions, public sector finances, exclusion from the labour market, and the target of global income equalisation through increased trade with the least developed countries. The indicators also show that it is particularly important to manage human resources satisfactorily. The labour force and its expertise will be the two most important sources of income in future, even in petroleum-rich Norway.

The committee's approach

The committee pointed out the difficulties involved in determining whether or not development is sustainable, since sustainability is about what will or may happen in the long term. The committee took the "capital approach" to the development of the indicator set. The reason for this is that our welfare today and in the future may be considered as the return on our total national wealth. This wealth consists of fixed assets such as machinery, tools and buildings, natural resources such as oil, gas, fish, forests and soil, environmental goods such as clean air and water, and last but not least, the labour force, knowledge and expertise that constitute human capital. If are to succeed in maintaining and preferably improving our welfare in the long term, the national wealth must be conserved or preferably increased. Policies that ensure sound management of the total national wealth are therefore an essential basis for sustainable development.

The national wealth consists of many different components that cannot necessarily be substituted for each other. It is therefore necessary to develop several indicators that can show trends in different components of the national wealth.

A number of serious obstacles to sustainable development are primarily of an international nature. The UN Millennium Development Goals, adopted in 2000, set a number of clear targets including the reduction of global poverty. Norway also has commitments under a number of global and regional environmental agreements. The proposed national indicator set for Norway therefore also includes indicators of Norwegian efforts and pressures exerted by Norway that are related to global challenges.

The committee considered it important to identify a limited number of indicators focusing on the most important economic, environmental and social issues and the links between them, so that the indicator set can be of direct practical use in policy development.

Follow-up

The committee proposed that Statistics Norway should be given the main responsibility for periodic updating of the indicators and presentation of the results. It is also important that these indicators are used when the government discusses long-term policy issues related to sustainable development, for example in central policy documents such as the National Budget.

Short presentation of the indicator set

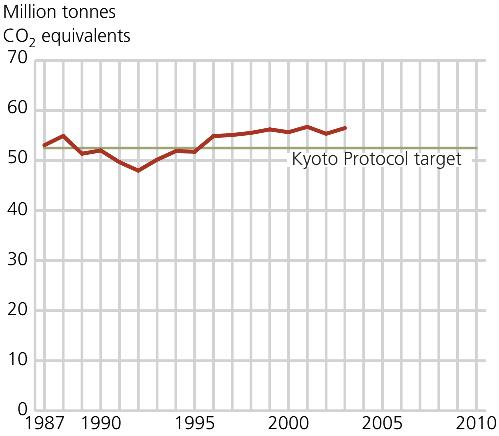
Brief descriptions of all the indicators are given below, together with figures illustrating status or trends: the material is taken from the committee's report, and it should be noted that in some cases more up-to-date information is now available.

Climate change

Indicator 1: Norwegian emissions of greenhouse gases compared with the Kyoto target

The report *Impacts of a Warming Arctic* drew attention to the fact that in the past few decades, the temperature increase in the Arctic has been nearly twice as fast as in the rest of the world. Climate change will have far-reaching effects on the environment, resources, society and economy. Not all the effects will be negative, but dealing with them can nevertheless pose major challenges for society.

Figure 1.26. Norwegian emissions of greenhouse gases compared with the Kyoto Protocol target. 1987-2003. Million tonnes CO_2 equivalents



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

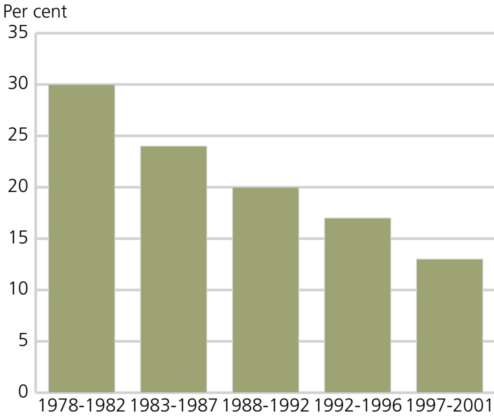
- Greenhouse gas emissions in Norway rose by 2 per cent from 2002 to 2003. The overall rise since 1990, the base year for the Kyoto Protocol, is 9 per cent. The rise in 2003 was almost entirely due to a 5 per cent increase in CO_2 emissions. This in turn is explained by higher emissions from the oil and gas industry on the continental shelf and onshore.
- High electricity prices in 2003 resulted in a sharp rise in fuel oil consumption, which in turn resulted in substantial CO_2 emissions. Emissions from the use of autodiesel in cars and marine gas oil by domestic shipping are also rising (see Chapter 6 Air pollution and climate change for updated figures).

Acidification

Indicator 2: Percentage of Norway's land area where critical loads for acidification have been exceeded

Acidification is still a serious environmental problem in Norway, even though emission reductions have improved conditions. The southern half of the country is particularly seriously affected by acid rain, but its impacts can also be seen in Sør-Varanger municipality in Finnmark county, where pollution originates from sources in northern Russia.

Figure 1.27. Percentage of Norway's land area where critical loads for acidification are exceeded



Source: Norwegian Institute for Water Research.

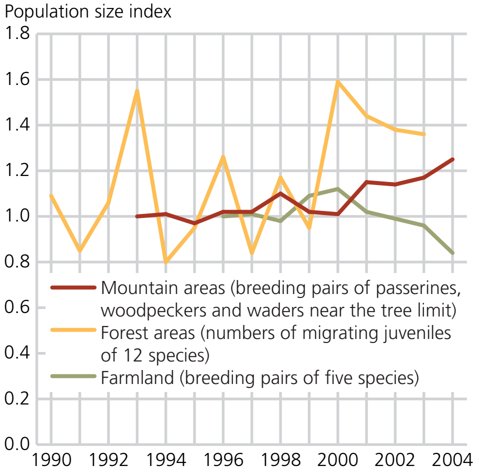
- At the beginning of the 1980s, critical loads were exceeded across 30 per cent of the total area of Norway. Emissions of acidifying gases in other parts of Europe have been reduced and consequently the pressure on the Norwegian environment has been reduced.
- In 2000, critical loads were exceeded across only 13 per cent of the total area of Norway. The greatest improvements have taken place in Eastern Norway. Even with the reductions in emissions expected by 2010, it has been calculated that critical loads will still be exceeded in an area corresponding to 7-8 per cent of the total area of Norway. Fish mortality and damage to fish stocks will therefore continue unless preventive measures such as liming are also kept up.

Terrestrial ecosystems

Indicator 3: Bird population index - Population trends of nesting wild birds

Trends in bird populations are considered to give a good indication of the state of their habitats. Birds represent different levels in the food chain, they are known to respond to relevant threat factors, and they are widely found in all habitats.

Figure 1.28. Population trends of nesting wild birds. Index



Source: Directorate for Nature Management. Based on preliminary and incomplete data.

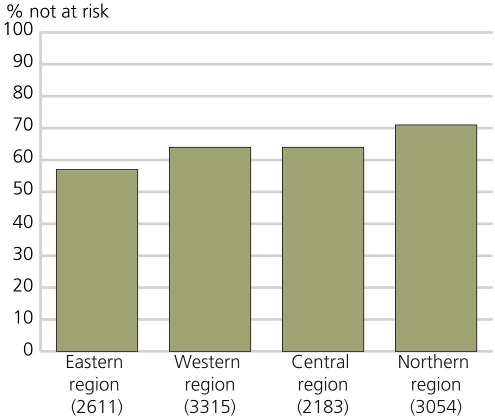
- In mountain areas, populations of nesting birds have increased. This trend is expected, given a warmer climate and a denser mountain forest. The figures for forest birds show large variations from year to year and no clear trend. The variations may reflect real fluctuations in populations, but could also be a result of the data collection method. Population trends are also uncertain in agricultural areas.
- The three data series shown are all based on incomplete data and are not representative of the country as a whole. This indicator needs further development to obtain better and more representative data.

Fresh-water and coastal ecosystems

Indicators 4 and 5: Inland water bodies and coastal waters classified as "clearly not at risk"

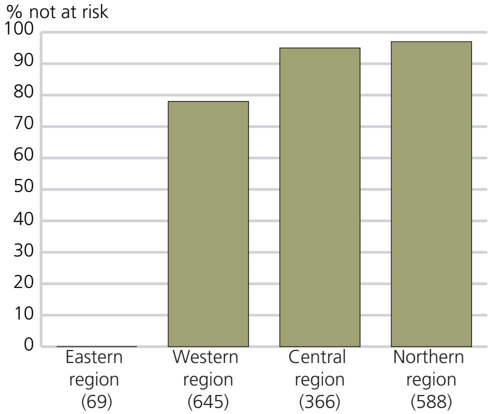
The choice of indicators for aquatic ecosystems is based on recommendations from the Directorate for Nature Management. These indicators are clearly policy-relevant, as they are related to the EU water framework directive. According to the directive, inland water bodies and coastal waters are to be classified by ecological status in five categories: high, good, moderate, poor and bad. Each member country must develop classification methods and monitoring systems.

Figure 1.29. Percentage of inland water bodies in Norway classified as clearly not at risk. By region[1]. 2004



[1] Number of localities investigated is given in parentheses
Source: Directorate for Nature Management and Norwegian Pollution Control Authority.

Figure 1.30. Percentage of coastal waters classified as "clearly not at risk". By region[1]. 2004



[1] Number of localities investigated is given in parentheses.
Source: Directorate for Nature Management and Norwegian Pollution Control Authority.

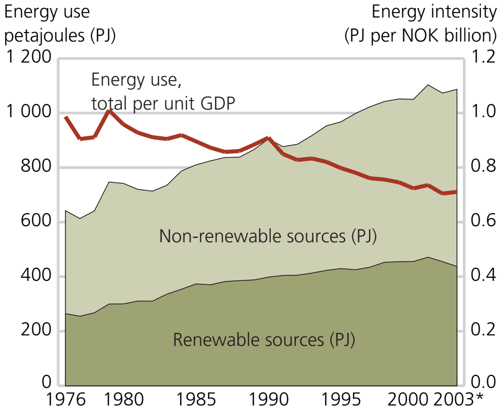
- Most inland water bodies and coastal waters in Norway are considered to be "clearly not at risk". This is particularly clear in the more sparsely populated northern, central and western parts of the country.
- The situation is less satisfactory in the eastern part of the country, especially in coastal waters. Here, none of the water bodies have been categorised as "clearly not at risk". However, these are preliminary results, and a number of the water bodies whose ecological status is uncertain will probably be classified as "good" after further assessment.

Efficiency of resource use

Indicator 6: Energy use per unit GDP

In modern economies, energy is an essential input factor, and regardless of the energy source used, energy production and use have some kind of impact as a result of emissions to air, water pollution, waste problems or alteration of the landscape and changes in biodiversity.

Figure 1.31. Energy use per unit GDP[1] and total energy use (PJ) for renewable and non-renewable energy sources. 1976-2003



[1] GDP at constant 2002 prices.
Source: Statistics Norway.

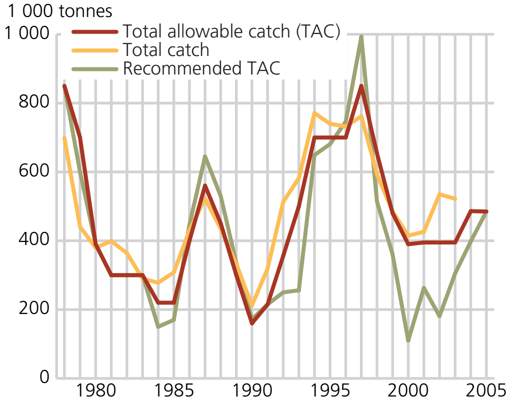
- Except for brief periods around 1980 and 1990, value added (measured as GDP) in the Norwegian economy has grown more strongly than domestic energy use, although energy use has also increased substantially.
- From 1976 to 2003, energy use increased by 69 per cent. However, GDP grew by 135 per cent in the same period. Energy intensity, measured as energy use per unit GDP, has therefore decreased in this period, so that energy use has become considerably more efficient.

Management of renewable resources

Indicator 7: Recommended quota, TAC actually set and catches of Northeast Arctic cod

Fishing has been an important basis for settlement and economic activity throughout Norway's history. Sustainable management of fish resources means that they must not be so heavily exploited that there is a danger of poor recruitment to the stocks. Without sufficient recruitment, there is no basis for long-term, sustainable harvesting of these resources.

Figure 1.32. Recommended quota, TAC actually set and catches of Northeast Arctic cod. 1978-2005



Source: Institute of Marine Research and ICES.

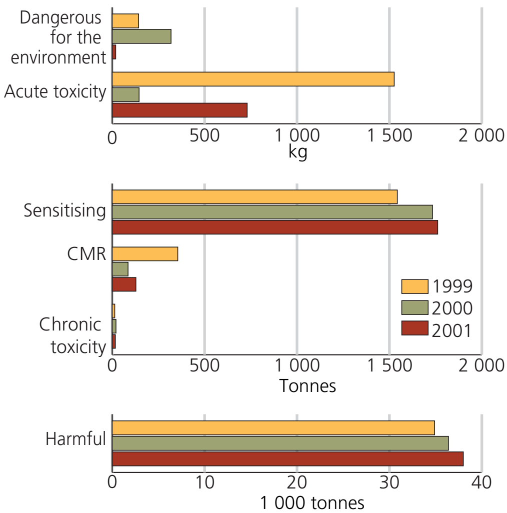
- The stock of Northeast Arctic cod is managed jointly by Norway and Russia. The TACs (total allowable catch) are now set according to new rules. Briefly, a 3-year horizon has been adopted for the TAC levels, there are rules for how much the TAC can vary in this period, and rules for how the TAC is to be set in relation to spawning stock size and fishing mortality.
- For the whole period 1978-2003, accumulated catches are about 600 000 tonnes above the TACs after adding estimated unreported catches to the registered catches for several years in the period. For the period as a whole, the registered catches correspond fairly closely to the TACs.

Hazardous substances

Indicator 8: Household consumption of hazardous substances

In recent years, there has been growing awareness of the links between exposure to hazardous substances and injury to human health. Such substances also have serious and often long-lasting environmental impacts. From a sustainable development perspective, this knowledge should have clear consequences for the way society responds to the emissions and use of hazardous substances.

Figure 1.33. Household consumption of hazardous chemicals, by danger categories[1,2]. 1999-2001



[1] Some products are classified in several danger categories, but are only included in one category in the statistics
[2] CMR = Carcinogenic, mutagenic or reprotoxic.
Source: Finstad and Rypdal 2003.

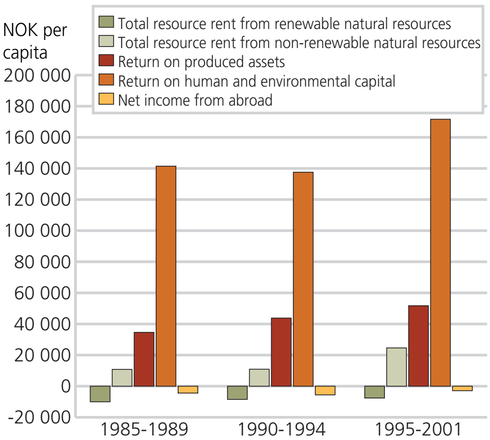
- Consumption of products containing carcinogenic, mutagenic and reprotoxic substances dropped by more than 60 per cent from 1999 to 2001. The main reason for this was a cut in consumption by the textile industry after the introduction of a tax on perchloroethylene in cleaning products.
- On the other hand, the consumption of products containing sensitising substances rose by 14 per cent from 1999 to 2001. This was mainly because of a rise in the consumption of paints and varnishes and of cleaning products that are classified as sensitising. The largest quantities of hazardous substances that households are exposed to are classified as "Harmful". This group includes products that may cause damage because they contain solvents, substances that are corrosive or irritant, etc. Total consumption of such products in 2001 was 38 000 tonnes, an increase of 9 per cent in the three-year period from 1999.
- Further development of this indicator is needed to improve data quality and representativity.

Sources of income

Indicator 9: Net national income per capita, by sources of income

The net national income (NNI) may be considered as the market-based return on our national wealth. Variations in NNI over time may therefore be an indication of changes in national wealth.

Figure 1.34. Net national income per capita, by sources of income. Five-year periods 1985-2001



Source: Statistics Norway.

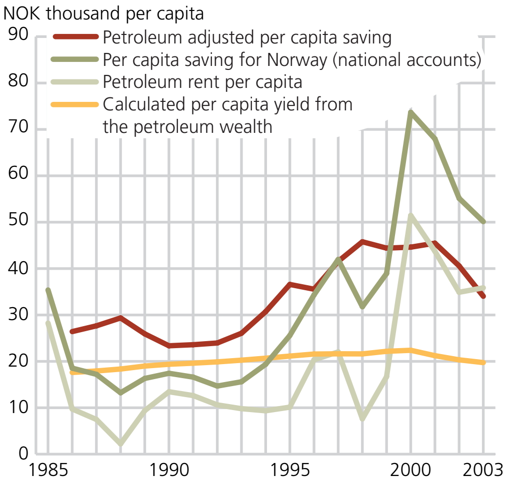
- The indicator shows that human capital and environmental capital are of the utmost importance for our economic welfare.
- The exploitation of non-renewable resources, mainly oil and gas, has become increasingly important since 1985, and is now approaching half of the return on produced assets.
- The resource rent from the primary industries agriculture, forestry and fisheries, has been negative, mainly as a result of subsidies to agriculture. However, the size of the deficit has decreased since 1985.

Sustainable consumption

Indicator 10: Non-petroleum saving

Are we consuming too much? Or to be more precise: has the Norwegian population consumed more during one year than we had reason to believe could be sustained over time? If the answer is yes, the level of consumption can in a sense be defined as unsustainable. The indicator "Non-petroleum saving" is intended to answer this question, even though several important aspects of consumption are not included.

Figure 1.35. Non-petroleum saving. 1985-2003. NOK 1000 per capita at constant prices (2000 NOK)



Source: Ministry of Finance and Statistics Norway.

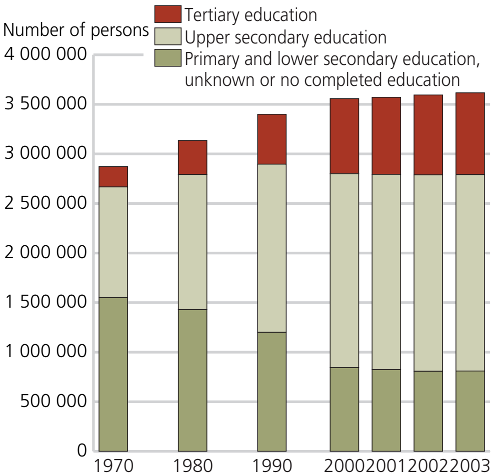
- Non-petroleum saving has been positive in the whole period under consideration. In economic terms, consumption in Norway seems therefore to have remained at a sustainable level.
- Figures for the return on our remaining petroleum wealth are based on expectations and are therefore uncertain. However, it should be noted that saving would have been positive throughout the period even if this return had been disregarded, i.e. if non-petroleum saving had been defined simply as saving minus the resource rent from petroleum activities.

Level of education

Indicator 11: Population by highest level of education completed

Human capital is a component of Norway's national wealth and makes a significant contribution to economic growth. The level of education in the population may be regarded as an indicator of the supply of qualified labour for the public and private sectors. The OECD report *The Well-being of Nations* states that "Education, training and learning can play important roles in providing the basis for economic growth, social cohesion and personal development."

Figure 1.36. Population (age 16 years and more) by highest level of education completed. 1970-2003



Source: Statistics Norway.

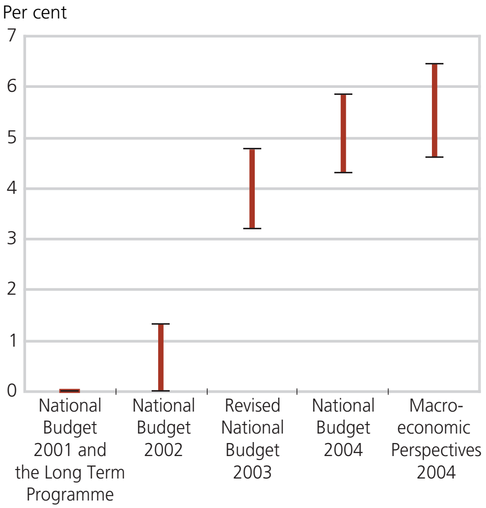
- The level of education of the Norwegian population has increased considerably over the last 30 years. In 1970 about 7 per cent of the population had a university-level qualification (tertiary education). By 2003, this had increased to 23 per cent - an increase of 16 percentage points during the last 33 years.
- During last 20 years of the period (1983-2003), the number of people with a doctorate has increased by 286 per cent (from 3 550 to 13 750 persons).
- At the other end of the scale, the share of people with only primary and lower secondary education has decreased by over 30 percentage points since 1970.

Sustainable public finances

Indicator 12: Generational accounts: Need to reduce public sector finances as a share of GDP

In Norway, the public sector plays an important role for total welfare, by facilitating economic activity in the private sector, providing basic educational health and social welfare services, and by maintaining an extensive social security system. The expenses for these systems must, over time, be financed within the limits of total public revenues. The generational accounts are an indicator of whether today's financial policy is sustainable in the long term. For this to be the case, the current value of public sector revenues must over time be roughly equal to the current value of public sector expenditure.

Figure 1.37. Generational accounts: need to reduce public finances as a share of GDP



Source: Ministry of Finance

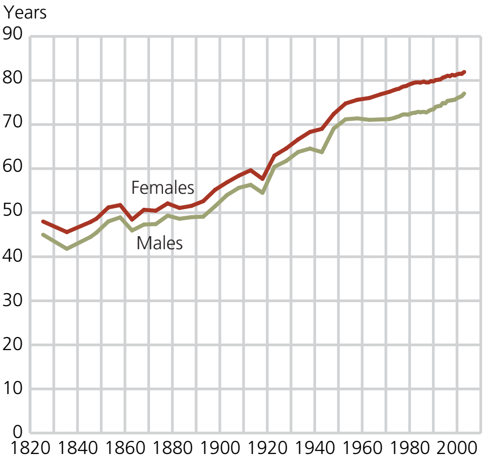
- The need to tighten public finances, as estimated in the generational accounts, has increased over time, partly as a result of altered assumptions concerning future developments in life expectancy.
- The latest estimates indicate a reduction in the order of NOK 75-105 billion (Report No. 8 (2004-2005) to the Storting). This is between 5 and 6 per cent of GDP for 2004.

Health and welfare

Indicator 13: Life expectancy at birth

Life expectancy is an indicator that captures a number of factors that are relevant to social welfare. Changes in the indicator can indirectly illustrate for example the priority given to the health sector and the quality of its services, changes in lifestyle, the quality of people's lives, diet, alcohol and drug abuse, accidents, etc.

Figure 1.38. Life expectancy at birth. 1825-2003



Source: Statistics Norway (Brunborg 2004).

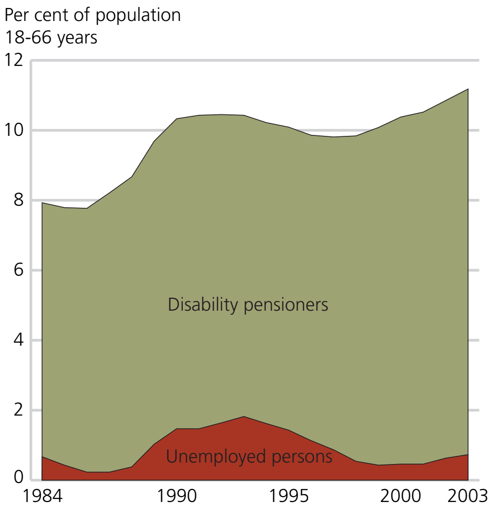
- Life expectancy in Norway has been increasing for nearly two hundred years and there is every indication that this trend will continue. Newborn boys can now expect to live until they are about 77 years old and newborn girls for almost 82 years - the highest figures ever for Norway.
- Population projections from Statistics Norway indicate that the Norwegian population will continue to age, almost regardless of what assumptions are made. Norway will therefore have a permanently higher share of older people in the population and higher pension and social security expenditure than today. This cannot be avoided by, for example, an increase in fertility or net immigration within realistic limits.

Exclusion from the labour market

Indicator 14: Long-term unemployed persons and disability pensioners

For most people, employment is an important key to social inclusion and for their self-esteem and feeling of being included and appreciated. This is true even in a country like Norway where there are well established social security arrangements for those who for various reasons are excluded from the labour market. People who are excluded from the labour market for a long time find it difficult to re-enter, for example because their qualifications are out of date or because of a gap in their work experience.

Figure 1.39. Long-term unemployed persons and disability pensioners as percentage of population. Age group 18-66 years. 1984-2003



Source: Statistics Norway.

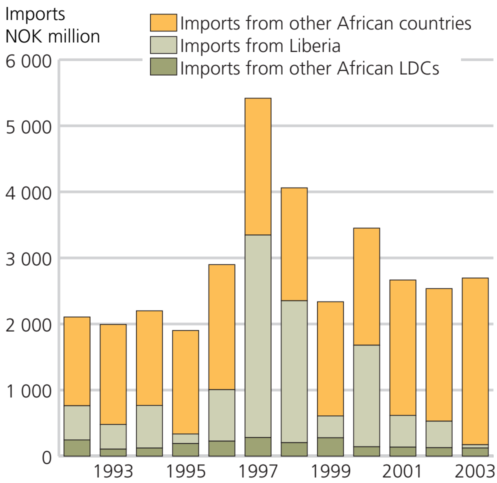
- During the economic downturn at the beginning of the 1990s, a relatively high percentage of adults were excluded from the labour market. This applied both to the long-term unemployed and to disability pensioners.
- There was a temporary decrease in exclusion from the labour market until 1998, but since then the percentage has increased again and reached 11 per cent of the population in 2003.

Global poverty reduction

Indicator 15: Imports from LDCs and other countries in Africa

If we are to succeed in advancing global sustainable development, the most important tasks will be to resolve environmental problems and reduce poverty. The overriding objective of the UN Millennium Development Goals, adopted in 2000, is the reduction of global poverty. Calculations by the World Bank show that economic growth is vital for poverty reduction. One of the most important means of promoting economic development in developing countries is to give them the opportunity to sell their goods and services to industrialised countries on equal terms with other countries. Other important measures are economic and technical assistance to improve education systems and health services.

Figure 1.40. Imports from LDCs[1] and other countries in Africa. 1992-2003. NOK million (constant 2003 prices)



[1] LDCs stands for least developed countries.
Source: Statistics Norway.

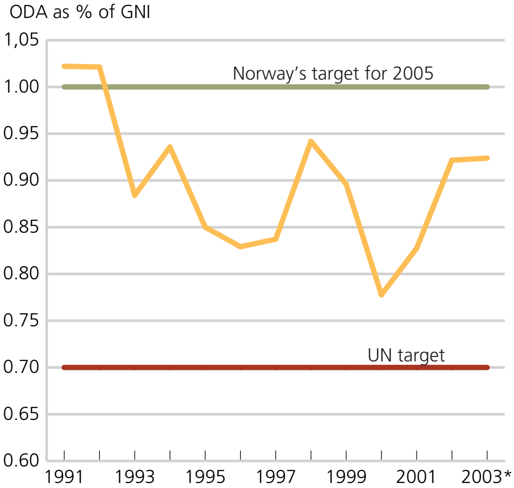
- Imports from Africa make up only a small percentage of total imports to Norway. There was a modest increase in the proportion of imports from Africa in the mid-1990s, but even then imports from Africa accounted for only 2 per cent of the total. Since then, imports from Africa have fallen to under 1 per cent of total Norwegian imports, with a value of NOK 2.7 billion in 2003.
- In 2003, imports from the least developed countries (LDCs) in Africa accounted for just under 0.1 per cent of total imports, the lowest level for more than 10 years.
- Liberia is classified as an LDC. Norwegian imports from African LDCs have been dominated by imports of second-hand ships from Liberia, which must be seen in the context of Norwegian shipowners' use of the international ship's register in Liberia. Imports from the other 32 LDCs in Africa have been very modest and quite stable throughout the period 1992-2003. In 2003 they accounted for 0.04 per cent of Norway's total imports, and the main products are flowers and metal ores.

Global poverty reduction

Indicator 16: Norwegian official development assistance as percentage of gross national income

The effect of development assistance on poverty reduction and economic development is much disputed. The dominant view seems to be that development assistance is effective, but only under certain conditions. It appears to have a poverty-reducing effect in countries with a high level of poverty but that also have a stable economic policy and well-functioning institutions.

Figure 1.41. Norwegian development assistance as a percentage of gross national income. 1991-2003



Source: Statistics Norway.

- Donor countries have repeatedly committed themselves to the target of contributing 0.7 per cent of gross national income (GNI) as official development assistance (ODA) to developing countries. The Norwegian government's target is to reach 1 per cent of GNI.
- In 2002 and 2003, Norway contributed over 0.9 per cent of GNI as official development assistance.

The remaining chapters of this publication and the appendix of tables provide further information on Norway's natural resources and the environment and describe how they are affected by the activities of various economic operators.

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2. Energy

Norway has rich energy resources, particularly in the form of oil, gas and hydropower, and energy extraction is far higher than the country's energy consumption. In addition, coal is extracted in Svalbard and Norway has a very high technical wind power potential. The production, transmission and use of energy cause various pressures on the environment. A large proportion of global air pollution is generated by the combustion of coal, oil and gas.

In 2004, extraction of energy commodities in Norway was more than 9 times higher than domestic consumption. Most of this is extraction of oil and gas, which accounted for 95 per cent of the total. Given the current rate of extraction, the calculated crude oil reserves on the Norwegian continental shelf will be exhausted in 8 years' time and the gas reserves in 29 years' time. The ratio between reserves and production, called the R/P ratio, changes over time since the lifetime of the remaining resources depends on the rate of extraction, on new finds, on decisions concerning the development of proven fields, and, for fields that are on stream, on improvements in the recovery factor and on the production profile. Norway has 0.8 per cent of the world's oil reserves, but accounted for 3.9 per cent of world oil production in 2004. The Norwegian oil reserves are thus being exhausted more rapidly than those in the rest of the world. The high rate of extraction means that this is the industry in Norway that generates most foreign exchange earnings. According to the national accounts, petroleum extraction accounted for about 20 per cent of GDP and 46 per cent of Norway's export revenues in 2004. This is a slight increase from the year before. Oil and gas is to a large extent being converted from wealth in the form of natural resource assets to financial assets abroad through the Government Petroleum Fund (from 1 January 2006 part of the Government Pension Fund).

Hydropower is Norway's other major energy resource, although electricity production from this source corresponded to only about 4 per cent of petroleum extraction in 2004, expressed as energy content. However, hydropower is a renewable energy source, unlike petroleum resources, which are depleted as they are extracted. In 2004, Norway produced 110 TWh of electricity, as against 107 TWh the year before. Net imports totalled 11.4 TWh. Mean annual production capability when water inflow to the reservoirs is normal is 119 TWh. Production has been relatively low in connection with the recharging of the reservoirs after a period when precipitation was low. For most of the period since autumn 2002, reservoir levels have been below normal, but the median level of filling was reached in autumn 2005.

Consumption of energy commodities (the energy sector included) increased by 2 per cent in 2004. In the last 20-30 years, energy use has grown considerably more slowly than general economic growth (see Chapter 1.4 on the relationship between environment and economy).

Energy production and use has major environmental impacts. In 2003, extraction of oil and gas generated 31 per cent of Norway's total greenhouse gas emissions. Hydropower developments in watercourses have a significant impact on biological diversity, the cultural landscape and outdoor recreation. About 61 per cent of Norway's hydropower potential has now been developed or is under construction or licensing. Recently, increasing attention has also been focused on the environmental problems associated with wind power.

2.1. Resource base and reserves

World fossil energy reserves

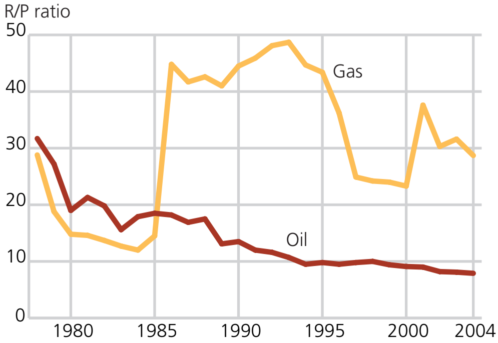
- Reserves are defined here as resources that are fairly certainly recoverable given the current economic and technological framework.
- BP (2005) quotes the following R/P ratios (estimates for the ratio between the remaining reserves and the current annual rate of production) for the whole world at the end of 2004: oil 40.5 years, natural gas 66.7 years and coal 164 years. The two countries with the largest oil and gas reserves, Saudi Arabia and Russia, each have about a quarter of the world total. The US has a similar share of the world's coal reserves.
- The estimated reserves of oil and gas are higher than at the beginning of 2004, while the estimated coal reserves are lower.

Table 2.1. World reserves of fossil energy commodities as of 1 January 2005

	Oil		Gas		Coal	
	Billion tonnes	Per cent	Billion tonnes o.e.	Per cent	Billion tonnes	Per cent
World	**161.9**	**100**	**161.6**	**100**	**909.1**	**100**
North America[1]	8.0	4.9	6.6	4.1	254.4	28.0
Latin America	14.4	8.9	6.4	4.0	19.9	2.2
Europe incl. former Soviet Union	19.0	11.7	57.6	35.7	287.1	31.6
Middle East	100.0	61.8	65.5	40.6	0.4	0.0
Africa	14.9	9.2	12.7	7.8	50.3	5.5
Asia and Oceania	5.5	3.4	12.8	7.9	296.9	32.7
OPEC	121.5	75.0	..	..	..	..
OECD	10.9	6.7	13.5	8.4	373.2	41.1
Norway	1.3	0.8	2.2	1.3	..	..

[1] Including Mexico
Source: BP 2005.

Figure 2.1. R/P ratio[1,2] for Norwegian oil and gas reserves. 1978-2004



[1] The R/P ratio, or the ratio between reserves and the current annual rate of production, indicates how many years it will take before the reserves are exhausted.
[2] Because of a change in the classification system for petroleum resources, there is a break in the time series between 2000 and 2001.
Source: Energy statistics from Statistics Norway and Norwegian Petroleum Directorate.

Norwegian petroleum reserves

- Resources include all estimated petroleum deposits, whereas reserves include only recoverable resources in fields that are already developed or where development has been approved. The estimates of reserves in producing fields are revised annually, and new fields are included in the estimates almost every year (see Appendix, tables B1 and B2). Norway started production of crude oil and natural gas in 1971, and by 31 December 2004, a total of 4 044 million Sm^3 o.e. oil and gas had been sold and delivered from the Norwegian continental shelf. The remaining reserves are calculated at 3 930 million Sm^3 o.e. (Norwegian Petroleum Directorate 2005). In the past, estimates of remaining reserves have regularly been revised upwards.

- According to the Petroleum Directorate's figures, the R/P ratios for Norway's reserves were 7.9 years (oil) and 28.7 years (gas). The R/P ratios change as new fields are approved for development and the quantities in already developed fields are re-evaluated.

Box 2.1. Energy content and energy units

Average energy content, density and efficiency of energy commodities[1]

Energy commodity	Theoretical energy content	Density	Fuel efficiency: Manufacturing and mining	Fuel efficiency: Transport	Fuel efficiency: Other consumption
Coal	28.1 GJ/tonne	..	0.80	0.10	0.60
Coal coke	28.5 GJ/tonne	..	0.80	-	0.60
Petrol coke	35.0 GJ/tonne	..	0.80	-	-
Crude oil	42.3 GJ/tonne = 36,0 GJ/m^3	0.85 tonne/m^3	..	..	..
Refinery gas	48.6 GJ/tonne	..	0.95	..	0.95
Natural gas (2004)[2]	40.1 GJ/1000 Sm^3	0.85 kg/Sm^3	0.95	..	0.95
Liquefied propane and butane (LPG)	46.1 GJ/tonne = 24,4 GJ/m^3	0.53 tonne/m^3	0.95	..	0.95
Fuel gas	50.0 GJ/tonne	..	..	..	..
Petrol	43.9 GJ/tonne = 32,5 GJ/m^3	0.74 tonne/m^3	0.20	0.20	0.20
Kerosene	43.1 GJ/tonne = 34,9 GJ/m^3	0.81 tonne/m^3	0.80	0.30	0.75
Diesel oil, gas oil and light fuel oil	43.1 GJ/tonne = 36,2 GJ/m^3	0.84 tonne/m^3	0.80	0.30	0.70
Heavy distillate	43.1 GJ/tonne = 37,9 GJ/m^3	0.88 tonne/m^3	0.80	0.30	0.70
Heavy fuel oil	40.6 GJ/tonne = 39,8 GJ/m^3	0.98 tonne/m^3	0.90	0.30	0.75
Methane	50.2 GJ/tonne	..	..	..	..
Wood	16.8 GJ/tonne = 8,4 GJ/solid m^3	0.5 tonne/solid m^3	0.65	-	0.65
Wood waste (dry wt)	16.25-18GJ/tonne=6,5-7,2GJ/solid m^3	0.4 tonne/solid m^3	..	..	..
Waste	10.5 GJ/tonne	..	..	..	..
Electricity	3.6 GJ/MWh	..	1.00	1.00	1.00
Uranium	430-688 TJ/tonne	..	..	..	..

[1] The theoretical energy content of a particular energy commodity may vary. The figures therefore indicate mean values.
[2] Sm^3 = standard cubic metre (at 15 °C and 1 atmospheric pressure).
Source: Energy statistics, Statistics Norway, Norwegian Petroleum Industry Association, Norwegian Association of Energy Users and Suppliers, Norwegian Building Research Institute.

Energy units

	PJ	TWh	Mtoe	Mbarrels	MSm^3 o.e. oil	MSm^3 o.e. gas	quad
1 PJ	1	0.278	0.024	0.18	0.028	0.025	0.00095
1 TWh	3.6	1	0.085	0.64	0.100	0.090	0.0034
1 Mtoe	42.3	11.75	1	7.49	1.18	1.055	0.040
1 Mbarrels	5.65	1.57	0.13	1	0.16	0.141	0.0054
1 MSm^3 o.e. oil	36.0	10.0	0.9	6.4	1	0.90	0.034
1 MSm^3 o.e. gas	40.1	11.1	0.9	7.1	1.12	1	0.038
1 quad	1 053	292.5	24.9	186.4	29.29	26.33	1

1 Mtoe = 1 million tonnes (crude) oil equivalents

1 Mbarrels = 1 million barrels crude oil (1 barrel = 0.159 m^3)

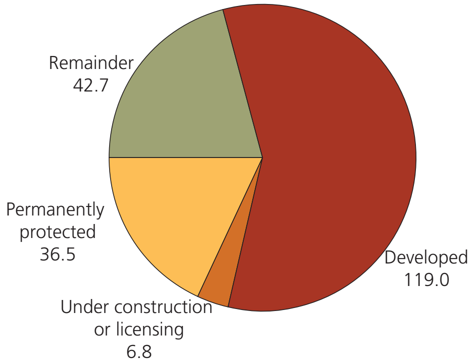
1 MSm^3 o.e. oil = 1 million Sm^3 oil

1 MSm^3 o.e. gas = 1 billion Sm^3 natural gas

1 quad = 10^{15} Btu (British thermal units)

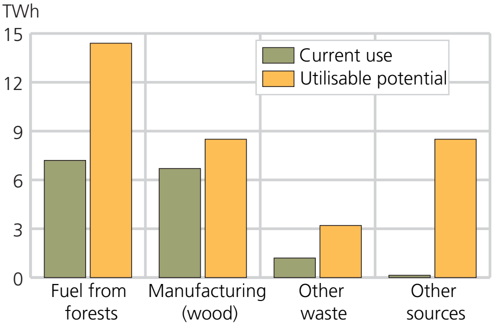
Source: Energy statistics, Statistics Norway and Norwegian Petroleum Directorate.

Figure 2.2. Norway's hydropower resources as of 1 January 2005[1]. TWh per year



[1] From 2005 onwards, power plants of capacity 50-10 000 kW have been included. As a result, the resource estimate has been revised upwards by about 10 per cent.
Source: Norwegian Water Resources and Energy Directorate.

Figure 2.3. Bioenergy in Norway. Current use and utilisable potential



Source: Eid Hohle 2001.

Norwegian hydropower resources

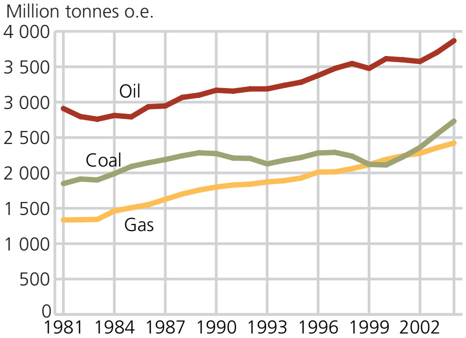
- As of 1 January 2005, Norway's hydropower potential totalled 205.1 TWh per year (see Appendix, table B3), and 58 per cent of this, 119 TWh, has been developed.
- Environmental restrictions and the need to consider profitability make it uncertain how much of the remaining hydropower potential is likely to be developed.
- The only large river in Norway that is untouched by hydropower developments is the Tana in Finnmark.
- Hydropower accounts for almost 100 per cent of electricity production in Norway, as compared with 19 per cent for the world as a whole (World Energy Council 2001).
- Norway has the world's highest per capita hydropower production, and is ranked as number six in the world by absolute hydropower production.

Bioenergy resources in Norway

- Annual consumption of bioenergy resources (wood, wood waste, black liquor, pellets, briquettes) in Norway is about 15 TWh, and the utilisable potential is calculated to be about 35 TWh (Eid Hohle 2001). The utilisable potential indicates how much can be utilised when ecological, technical and economic constraints are taken into account.
- It would be possible to double the consumption of fuel derived from forests, including fuelwood and wood chips, and there is a smaller unused biofuel potential from manufacturing (pulp and paper industry and manufacture of wood products).
- Bioenergy sources that are barely used today offer a total potential of 8.5 TWh. These include energy crops (fast-growing trees and grasses), straw, landfill gas and biogas from manure.

2.2. Extraction and production

Figure 2.4. World production of coal, crude oil and natural gas. 1981-2004



Source: BP 2005.

World production of fossil energy commodities

- In 2004, total global extraction of fossil energy commodities increased by 5 per cent from the year before to over 9 000 million tonnes oil equivalents. This is 48 per cent higher than in 1981. This upward trend has been particularly marked in the last few years - the rise from 2000 to 2004 was 14 per cent. Oil accounted for 43 per cent of the total, while coal and natural gas accounted for 30 and 27 per cent respectively.
- The US is one of the three largest producers of all three fossil energy commodities (see table 2.2).
- Since 2000, there has been a considerable increase in coal production in China, which now accounts for more than one third of world coal production. North America and Europe (including the whole of Russia: much of Russia's gas is produced in Siberia) account for two thirds of all gas production.
- Oil production is highest in the Middle East, but otherwise more evenly distributed across the different geographical regions.

Box 2.2. Commonly used prefixes

Name	Symbol	Factor
Kilo	k	10^3
Mega	M	10^6
Giga	G	10^9
Tera	T	10^{12}
Peta	P	10^{15}
Exa	E	10^{18}

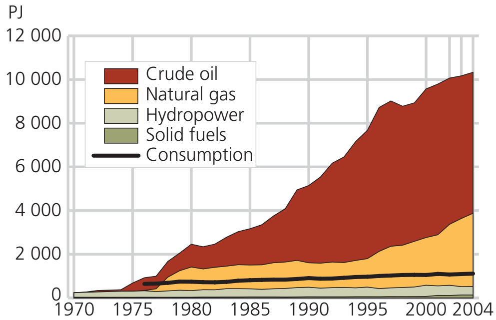
Table 2.2. World production of fossil energy commodities in 2004

	Oil		Gas		Coal	
	Million tonnes	Per cent	Million tonnes o.e.	Per cent	Million tonnes o.e.	Per cent
Regions						
World	3 867.9	100.0	2 422.4	100.0	2 732.1	100.0
OPEC	1 588.2	41.1	..	..	..	..
OECD	976.7	25.3	988.7	40.8	1 006.9	36.9
North America[1]	668.0	17.3	686.5	28.3	606.3	22.2
Latin America	342.0	8.8	116.2	4.8	44.1	1.6
Europe incl. former Soviet Union	850.7	22.0	946.4	39.1	434.4	15.9
Middle East	1 186.6	30.7	251.9	10.4	0.6	0.0
Africa	441.1	11.4	130.6	5.4	140.3	5.1
Asia and Oceania	379.5	9.8	290.8	12.0	1 506.3	55.1

Major producers		
Oil	Mill.tonnes	Per cent
Saudi-Arabia	505.9	13.1
Russia	458.7	11.9
USA	329.8	8.5
Iran	202.6	5.2
Mexico	190.7	4.9
China	174.5	4.5
Venezuela	153.5	4.0
Norway	149.9	3.9
Canada	147.6	3.8
Gas	Mill.toe	Per cent
Russia	530.2	21.9
USA	488.6	20.2
Canada	164.5	6.8
UK	86.3	3.6
Iran	77.0	3.2
Algeria	73.8	3.0
Norway	70.6	2.9
Indonesia	66.0	2.7
Netherlands	61.9	2.6
Coal	Mill.toe	Per cent
China	989.8	36.2
USA	567.2	20.8
Australia	199.4	7.3
India	188.8	6.9
South Africa	136.9	5.0
Russia	127.6	4.7
Indonesia	81.4	3.0
Poland	69.8	2.6
Germany	54.7	2.0

[1] Including Mexico.
Source: BP 2005.

Figure 2.5. Extraction and consumption[1] of energy commodities in Norway. 1970-2004*

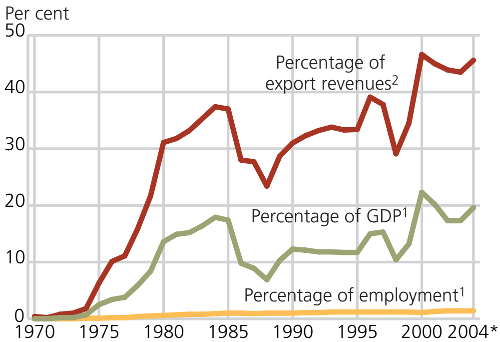


[1] Including the energy sectors, excluding international maritime transport.
Source: Energy statistics, Statistics Norway, Norwegian Petroleum Directorate and Norwegian Water Resources and Energy Directorate.

Total extraction of energy commodities in Norway

- There was a slight increase in total extraction of energy commodities in Norway from 2003 to 2004. Oil and gas extraction accounted for 95 per cent of the total in 2004. Gas production has reached record levels in recent years, and rose by 7 per cent from 2003, while crude oil production dropped by 1 per cent. Extraction of solid fuels has also increased in recent years and has almost doubled since 2000. This is a result of high coal production in Svalbard (see separate paragraph below).
- The level of hydropower production increased by almost 3 per cent from 2003 to 2004, but was still lower than in the period 1997-2002. Production has been relatively low in connection with recharging of the reservoirs from the low degree of filling recorded in 2002 and 2003. However, it should be noted that production in 2002 was the second highest ever recorded.
- In 2004, extraction of primary energy commodities was nine times higher than domestic consumption (see Appendix, table B11).

Figure 2.6. Oil and gas extraction. Percentage of exports, gross domestic product (GDP) and employment. 1970-2004*

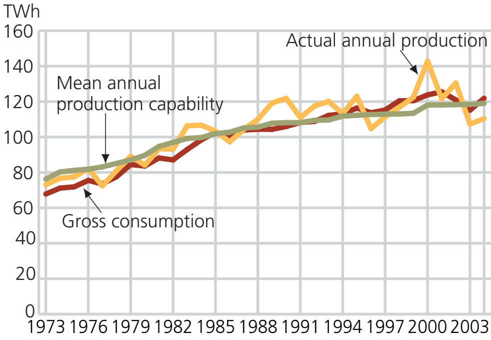


[1] Including services.
[2] Oil and gas only.
Source: National Accounts, Statistics Norway.

Crude oil and natural gas in an economic perspective

- Extraction of oil and gas is Norway's most important industry measured in terms of export revenue and value added (proportion of GDP). In 2004, oil and gas accounted for 46 per cent of the value of the country's total exports. The volume of exports dropped by 3.5 per cent from the year before, while the value increased by 20 per cent.
- Value added in the petroleum sector corresponded to 20 per cent of GDP, but only about 1 per cent of total labour input was directly related to oil and gas extraction.

Figure 2.7. Mean annual production capability, actual hydropower production and gross electricity consumption in Norway. 1973-2004

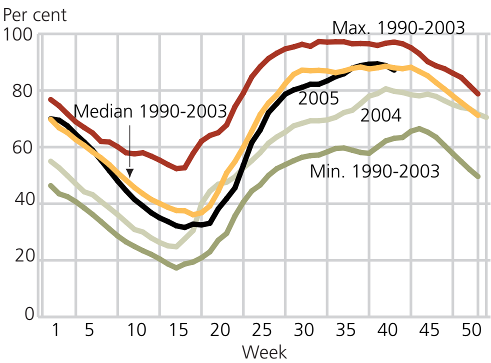


Source: Norwegian Water Resources and Energy Directorate and Energy statistics, Statistics Norway.

Electricity

- Electricity production in Norway in 2004 totalled 110 TWh, an increase of about 3 per cent from the year before (see Appendix, table B8).
- Production was almost 9 TWh lower than the mean annual production capability (i.e. production in a year with normal precipitation). The mean annual production capability rose by 0.58 TWh from the year before.
- In 2004, there was an import surplus of 11.4 TWh, the highest ever recorded.
- Hydropower accounts for about 99 per cent of electricity production in Norway. In recent years, several wind farms have been constructed, but despite the focus on this source of energy, wind power production still only totals 250 GWh.

Figure 2.8. Degree of filling of Norway's reservoirs during the year, 2004 and 2005. Minimum, maximum and median values for the period 1990-2003. Percentages



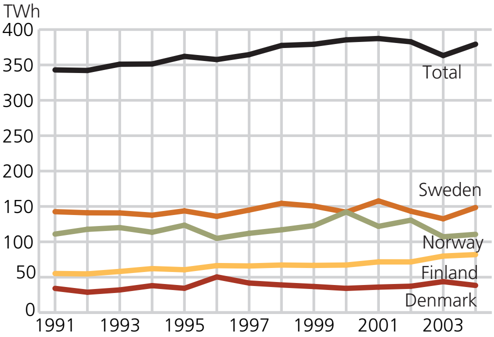
Source: Norwegian Water Resources and Energy Directorate.

Degree of filling of the reservoirs

- Water inflow to the reservoirs is of crucial importance for the level of electricity production. Inflow is unevenly distributed over the year, and is normally lowest in winter, when the demand for power is highest. It is therefore necessary to store water in order to be able to produce electricity in winter. The degree of filling of the reservoirs can vary a great deal both between seasons and between years as a result of variations in precipitation and the demand for electricity.

- At the beginning of 2005, the total energy capability of Norway's reservoirs was about 84 TWh, or about 70 per cent of annual mean production.
- The degree of filling was below the median for 1990-2003 in 2004, with the exception of a period in spring. With high water inflow and a high level of electricity imports, the degree of filling reached a more normal level towards the end of the year, and at the beginning of 2005 the reservoirs contained water corresponding to 12 TWh of electricity more than the year before (Norwegian Water Resources and Energy Directorate 2005). The degree of filling was also below the median level for 1990-2003 from late winter 2005, reaching the median level again in mid-September.

Figure 2.9. Electricity production in the Nordic countries. 1991-2004

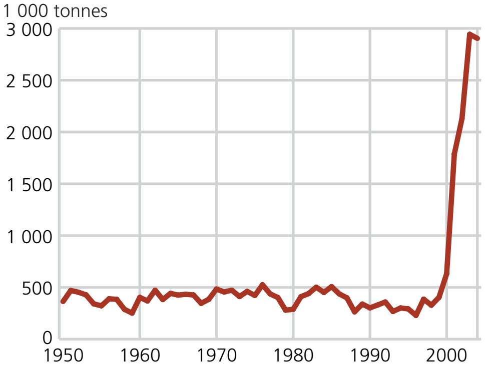


Source: Nordel's secretariat (various years).

Electricity production in the Nordic countries

- Energy production in the other Nordic countries influences the electricity balance in Norway. In 2004, Norway was a net importer for the second year in a row: imports totalled 15.3 TWh and exports only 3.8 TWh. Finland was also a net importer, while Sweden and Denmark exported more electricity than they imported (Nordel 2005).
- The Norwegian import surplus of 11.4 TWh in 2004 came largely from Sweden (8.9 TWh) and Denmark (2.3 TWh).

Figure 2.10. Extraction of coal in Svalbard. 1950-2004



Sources: Historical Statistics, Statistics Norway and Store Norske Spitsbergen Kulkompani.

Norwegian extraction of coal in Svalbard

- Coal production in Svalbard has been rising steeply since the new Svea Nord mine started operations in 2002. The Svea coal deposit is the largest ever found in Svalbard, and the mine can be operated very efficiently. In 2004, almost 3 million tonnes of coal was extracted, which is equivalent to more than 90 per cent of total production in the period 1990-1999.
- Total production between 1916, when Norwegian coal mining in Svalbard started, and 2004 is 34.6 million tonnes of coal. At the end of 2004, the reserves of what is defined as marketable coal totalled 43.4 million tonnes, which corresponds to 15 years' production at the 2004 rate of extraction.
- As a result of a fire in the Svea Nord mine in summer 2005, production in 2005 is expected to be considerably lower than in the preceding years.
- Ordinary production at the Svea Nord mine began after a decision by the Storting in December 2001 to continue Norwegian coal mining. The company responsible is Store Norske Spitsbergen Grubekompani, a newly-established subsidiary of Store Norske Spitsbergen Kulkompani, which was founded in 1916 to engage in coal mining in Norway. The new company made a profit during the first year of ordinary production, whereas Norwegian coal production had always previously been dependent on government support.
- 4 per cent of the coal sold in 2004 was delivered to the Norwegian cement industry and 1 per cent was used for energy production in Svalbard. The rest was exported to nine European countries, over half of it to Germany. Of the total sales, 42 per cent was used for energy production and the rest in manufacturing industries.

2.3. Environmental impacts of production and use of energy

Table 2.3. Emissions to air from the energy sectors as a proportion of total Norwegian emissions. 2003*. Percentages

Greenhouse gases (expressed as CO_2 equivalents)	**31**
Carbon dioxide (CO_2)	37
Methane (CH_4)	14
Nitrous oxide (N_2O)	1
Acidifying substances (expressed as acid equivalents)	**23**
Sulphur dioxide (SO_2)	15
Nitrogen oxides (NO_X)	31
Ammonia (NH_3)	0
Heavy metals	
Lead (Pb)	2
Cadmium(Cd)	4
Mercury (Hg)	7
Arsenic (As)	5
Chromium (Cr)	6
Copper(Cu)	1
Total PAH	1
Dioxins	8
Other pollutants	
Non-methane volatile organic compounds (NMVOCs)	61
Carbon monoxide (CO)	2
Particulate matter	2

Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

For more information, see Chapter 6: Air pollution and climate change and the information on oil discharges from petroleum activities on the Norwegian continental shelf in Chapter 1 (figure 1.4).

Emissions to air from the energy sectors

- The energy sectors are responsible for a large proportion of emissions to air in Norway, particularly in the case of CO_2, NO_X and NMVOCs.
- The most important source of CO_2 and NO_X emissions in the energy sectors is gas turbines on offshore installations. In the 1990s, they generated annual CO_2 emissions of 5-7 million tonnes. From 1999 to 2004, these emissions rose by 45 per cent to 9.6 million tonnes. Annual emissions of NO_X from this source have increased at a similar rate, and reached 35 000 tonnes in 2004.
- The most important source of NMVOC emissions is evaporation during loading of crude oil offshore. These emissions rose a great deal during the 1990s, and reached a peak in 2001. Since 2002, they have been considerably reduced because of the quantity of oil loaded has dropped while the amount of oil loaded at facilities with VOC recovery equipment has risen. In 2004, emissions totalled 131 000 tonnes, 48 per cent less than in 2001.
- In 2003, 15 per cent of Norway's total emissions of SO_2 were generated by the energy sectors. Oil refining alone accounted for 8 per cent, mainly in the form of process emissions. From 1990 to 2003, emissions from the energy sectors were almost halved, but since total emissions were cut even more, the energy sectors accounted for a larger proportion of the total in 2003 than in 1990.

Box 2.3. Environmental pressures caused by the extraction and use of energy

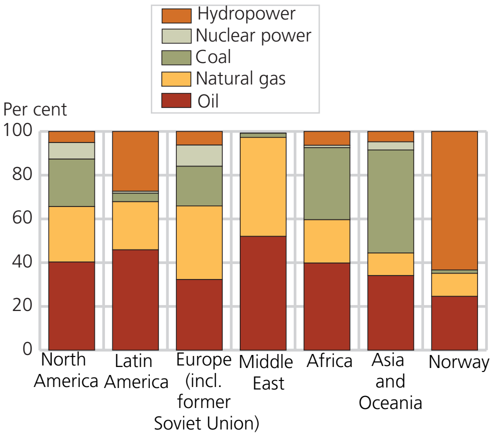
Emissions to air occur during the extraction, transport and use of oil and gas products. These can result in climate change, acidification, the formation of ground-level ozone and local air pollution (see Chapter 6: Air pollution and climate change). Emissions to air from the energy sectors in 2003 are shown in table 2.3.

Discharges of oil and chemicals to the sea occur during the extraction and transport of oil and gas products. They may for example injure fish, marine mammals and birds.

Infrastructure development takes place during the development of new capacity for energy generation, and includes the construction of dams, roads, onshore installations and transmission lines. Hydropower production also results in variable water levels in reservoirs and changes in discharge volumes in rivers. These developments can have an impact on biological diversity and the value of cultural monuments, the cultural landscape and recreational areas.

2.4. Energy use

Figure 2.11. Energy use by energy carrier (excluding bioenergy) in different regions. 2004

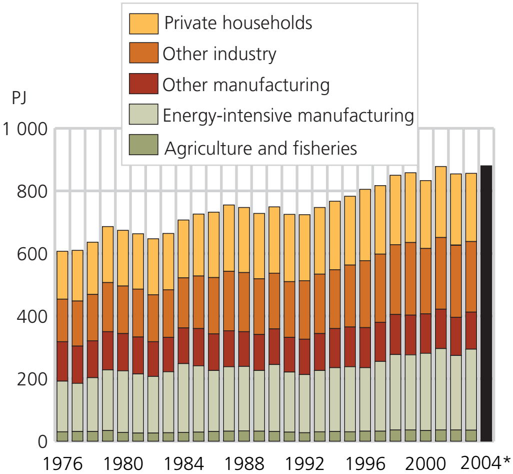


Source: BP 2005.

World energy use

- In 2004, global consumption of energy commodities (excluding bioenergy) totalled 10 224 million tonnes oil equivalents, 4.3 per cent more than the year before. Europe (including the former Soviet Union), North America and Asia/Oceania each accounted for about 30 per cent of this (BP 2005). Consumption was highest in the US and China, which accounted for 23 and 14 per cent respectively of global consumption. China's energy use has been increasing rapidly in recent years, rising by 15 per cent from 2003 to 2004, and by more than 80 per cent from 2000 to 2004. The energy commodity that showed the largest rise in consumption from 2003 to 2004 was coal (6 per cent); this was largely due to the steep rise in consumption in China.
- The energy mix varies greatly from one country to another: in 2004, Asia/Oceania accounted for half of all coal consumption, while 80 per cent of all nuclear power and 70 per cent of natural gas consumption was in Europe (including the former Soviet Union) and North America. The proportion of hydropower in the energy mix was highest in Norway (63 per cent), followed by Brazil, with 39.
- Bioenergy is estimated to make up 15 per cent of total world energy use and is an important source of energy in most developing countries: in some, such as Ethiopia and Nepal, bioenergy accounts for as much as 95 per cent of energy use (Eid Hohle 2001).

Figure 2.12. Domestic energy use[1] by consumer group. 1976-2004*



[1] Excluding the energy sectors and international maritime transport. Including energy carriers used as raw materials.
Source: Energy statistics, Statistics Norway.

Energy use in total and split by consumer group

- In 2004, Norway's total energy use (including energy commodities used as raw materials, excluding international maritime transport) was 1 107 PJ, including 227 PJ in the energy sectors (see Appendix, tables B5 and B6). The energy sectors include oil and gas extraction, gas terminals, oil refineries, coal extraction and the production of electricity and district heating.
- Consumption of energy commodities, excluding the energy sectors and international maritime transport, totalled 880 PJ in 2004, an increase of 2.8 per cent from the year before (preliminary figures). Energy use rose by an average of 1.3 per cent per year from 1976 to 2004. In the same period, GDP excluding the oil and gas sector expanded by an average of about 2.4 per cent per year.
- Energy-intensive manufacturing and the category "other industry" are the consumer groups where energy use has risen most in the period 1976-2003. Since these groups are dependent on cyclical changes, the rise has been uneven. Energy use by households has risen steadily, except for a decrease in 2003, while energy use in agriculture and fisheries and in "other manufacturing" has remained almost unchanged.

Box 2.4. Household electricity consumption for various end uses

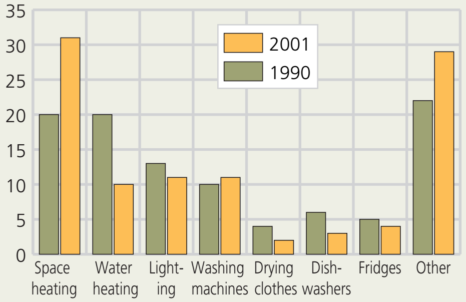
Existing estimates of household energy consumption for various end uses are based on an analysis from 1990. This indicates that about 65 per cent of electricity consumption and 75 per cent of energy consumption are used for space and water heating. These results were calculated using an engineering model. New calculations have been made using an econometric model and data from surveys carried out in 1990 and 2001, and there are marked differences in the results. In particular, the proportion of consumption used for space heating is considerably lower.

The results given by the econometric model for 1990 and 2001 are based on data from the 1990 energy survey and the 2001 consumer expenditure survey. Average total electricity consumption per household was about the same in both years (a rise of only three per cent).

Electricity consumption for space heating was about 11 percentage points higher in 2001 than in 1990, see the figure. There are several explanations for this. Outdoor temperatures were much lower in 2001 than in 1990. In addition, the price of electricity was lower than that of oil in 2001, whereas the reverse was true in 1990. Moreover, the proportion of households with oil-fired heating equipment dropped from 1990 to 2001, while the proportion with electrical heating equipment rose. The proportion of households with electric heaters or floor heating rose from 92 to 98 per cent, while the proportion with oil-fired heating dropped from 30 to 15 per cent. Outdoor temperatures were 23 per cent above normal in 1990 but 2-3 per cent below normal in 2001. The price of oil was 29 per cent higher than the price of electricity in 2001, but 12 per cent lower in 1990.

Between 1990 and 2001, electricity consumption for water heating dropped by about 50 per cent, partly because the proportion of households owning dishwashers rose. This probably reduced the amount of hot tap water used for manual dishwashing. Other reasons for the decrease may be the higher real price of electricity, more frequent use of showers rather than baths, and tendency to wash floors by dry mopping rather than using water. Electricity consumption by washing machines rose by 17 per cent, although the proportion of households owning washing machines was unchanged. Improvements in efficiency suggest that there should be a downward trend in electricity consumption. The rise in consumption must therefore be a result of changes in the pattern of use: for example washing at higher temperatures, a higher frequency of use, machine washing of woollens, and greater use of prewash options. Electricity consumption per tumble dryer/drying cupboard dropped by more than half from 1990 to 2001, despite a slight rise in the proportion of households with such appliances, and average energy consumption for drying clothes dropped by 55 per cent. A considerably larger proportion of households had dishwashers in 2001 than in 1990, but their energy efficiency has improved so much that energy consumption by dishwashers was cut by half. Electricity consumption by fridges excluding fridge freezers dropped by 28 per cent, mainly because the proportion of households with fridge freezers rose steeply during the period.

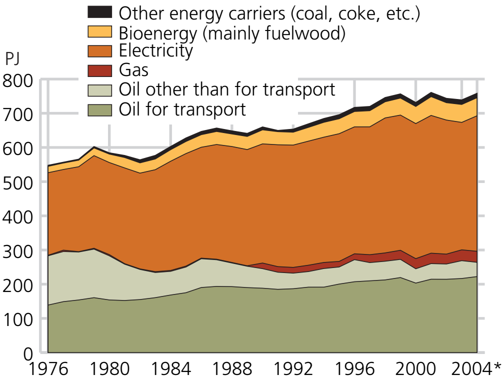
Household electricity consumption for various end uses in 1990 and 2001. Percentages



Project funding:
Norwegian Water Resources and Energy Directorate and Enova SF.

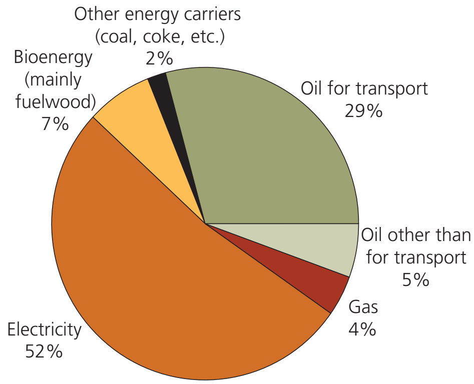
For more information, see:
Larsen, B.M. and R. Nesbakken (2005): *Formålsfordeling av husholdningenes elektrisitetsforbruk i 2001. Sammenligning av formålsfordelingen i 1990 og 2001* (Household electricity consumption for various end uses in 2001: comparison of results for 1990 and 2001). Reports 2005/18. Statistics Norway.

Figure 2.13. Energy[1] use by energy carrier. 1976-2004*



[1] Excluding energy carriers used as raw materials and in the energy sectors, and international maritime transport.
Source: Energy statistics, Statistics Norway.

Figure 2.14. Energy use by energy carrier. Percentages of total. 2004*

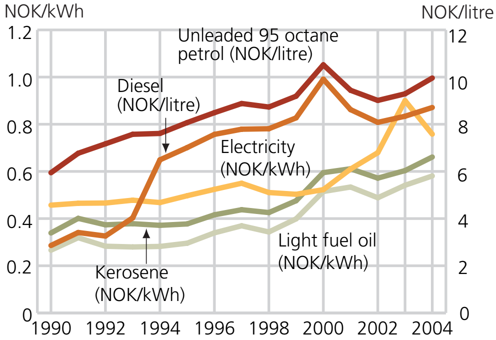


Source: Energy statistics, Statistics Norway.

Consumption by energy commodity

- Total oil consumption, excluding the energy sectors and international maritime transport, dropped by about 9 per cent in the period 1976-2004, despite a rise of 60 per cent in the consumption of oil for transport in the same period (see Appendix, table B5).
- Transport now accounts for 82 per cent of total oil consumption, as compared with 47 per cent in 1976. Consumption of transport oils is increasing.
- Consumption of oil for stationary purposes had dropped to less than one third of the 1976 level by 1992. The downward trend continued until 2000, but since then consumption has risen slightly.
- Electricity consumption has risen from 241 PJ in 1976 to 396 PJ in 2004. This is a rise of 64 per cent. Consumption dropped by 4.5 per cent from 2002 to 2003, but rose again by more than 6 per cent from 2003 to 2004. The rise for households and service industries was 4.3 per cent. Consumption in these sectors has varied a good deal in recent years because customers have switched between oil and electricity for heating purposes. The rise in electricity consumption from 2003 to 2004 was a response to lower electricity prices than the previous year. See Appendix, tables B8 and B9.

Figure 2.15. Price trends for electricity, kerosene, fuel oil, diesel and petrol. 1990-2004. NOK per kWh and litre, current prices

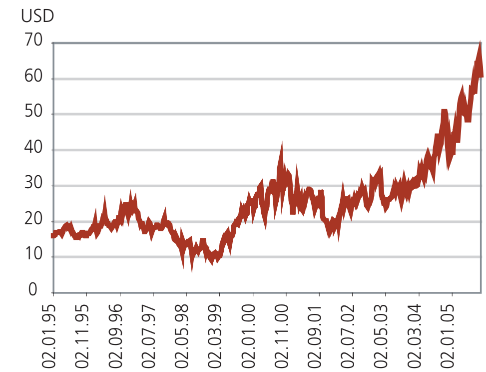


Source: Energy statistics, Statistics Norway, Norwegian Water Resources and Energy Directorate and Norwegian Petroleum Industry Association.

Prices

- The listed prices (average prices from the Norwegian Petroleum Industry Association) of both heating kerosene and light fuel oil rose from 2003 to 2004. Because electricity prices dropped, electricity consumption rose, even though the price of both oil products per energy unit was lower than for electricity in this period.
- Lower taxes resulted in a drop in the price of petrol and autodiesel from 2000 to 2002. Taxes on these products were raised from 2002, and prices have therefore increased again.

Figure 2.16. Spot price of Brent Blend. 1995-2005. USD



Source: Petroleum Intelligence Weekly.

- The average spot price of Brent Blend was just under USD 53 per barrel for the first nine months of 2005, as compared with USD 38 and 29 per barrel in 2004 and 2003 respectively.
- The sharp increase in oil prices is explained by a combination of several factors. Economic growth, and therefore oil demand, has remained high in several parts of the world. In addition, OPEC production has been high, leaving little extra production capacity within the cartel. This has resulted in greater concern about the consequences of a drop in production and resulted in large purchases of oil on the futures market.

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Useful websites

Statistics Norway - Electricity, gas and water supply:
http://www.ssb.no/english/subjects/10/08/
Statistics Norway - Energy balance and energy accounts:
http://www.ssb.no/english/subjects/01/03/10/energiregn_en/
Statistics Norway - Extraction of oil and gas:
http://www.ssb.no/english/subjects/10/06/20/
Statistics Norway - Petroleum sales:
http://www.ssb.no/english/subjects/10/10/10/petroleumsalg_en/
British Petroleum (World Energy Review): http://www.bp.com/centres/energy/
International Energy Agency: http://www.iea.org/
Ministry of Petroleum and Energy: http://www.odin.dep.no/oed/
Norwegian Water Resources and Energy Directorate: http://www.nve.no/
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3. Agriculture

The total size of agricultural areas in use has remained stable at a time when the importance of agriculture to the national economy has declined. There have been major structural changes in farming that have affected the relationship between agriculture and the environment.

Agriculture interacts with the environment in many ways. Farming results in environmental changes both to farmed land, such as alterations in biotopes and landscapes, and to adjacent areas in the form of runoff of nutrients into water bodies and emissions to air from agricultural processes. There has been a particular focus on eutrophication of water bodies caused by nutrient enrichment. The open cultural landscape has largely been created by farming, and is continuously being formed by the farming methods used. The agricultural sector manages substantial biological and cultural assets in the form of cultivated animal and plant resources, buildings and types of landscapes. These represent environmental qualities that most people perceive as positive, but that modern farming methods can put at risk. Consequently, agricultural policy has given more weight to these factors in recent years, while the focus on production objectives has been toned down.

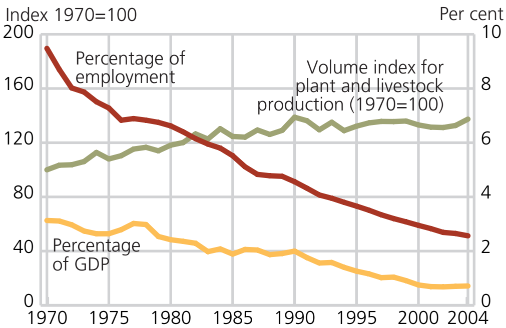
At the same time farming areas are also affected by outside environmental pressures such as pollution, including ozone and heavy metals, and pressures to convert farmland for development.

One of the most important objectives of farming is to safeguard the national food supply (Report No. 19 (1999-2000) to the Storting). The food production potential in Norway is primarily restricted by the climatic conditions and the availability of land resources suitable for farming. Consequently, protecting agricultural land resources has high priority. The impact of farming methods on the quality of agricultural products and thus on human health - involving factors such as the nutritional content of food, pesticide residues and animal diseases that are transmissible to humans - must also be taken into consideration in agricultural policy.

This chapter takes a closer look at the natural resource base (land resources) and activities in the agricultural sector that have environmental impacts in the form of changes in the landscape and emissions to water and air. A brief summary of the economic importance of agriculture as an industry is also included.

3.1. Main economic figures for agriculture

Figure 3.1. Trends in agricultural production volume (index 1970=100) and share of employment and GDP. 1970-2004*



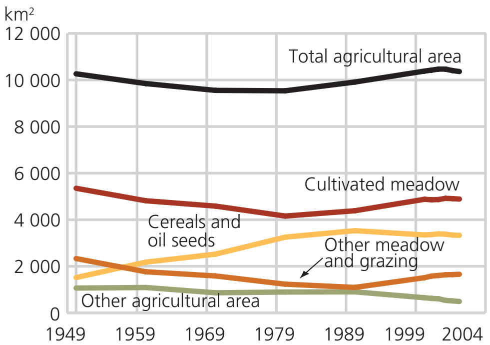
Source: Budget Committee for Agriculture (2005) and Norwegian National Accounts, Statistics Norway

Agriculture in an economic perspective

- From 1970 to 2004, employment fell by over 60 per cent (from over 140 000 to 50 300 normal full-time equivalents). In comparison, manufacturing employment fell by approximately 31 per cent.
- Agriculture's share of GDP fell from 3.1 to 0.7 per cent. In comparison, manufacturing declined from 19 to 8 per cent.
- Agricultural production has increased by about 37 per cent (Budget Committee for Agriculture 2005). However, production volume has not increased since 1990.

3.2. Land resources

Figure 3.2. Agricultural area in use. 1949-2004*

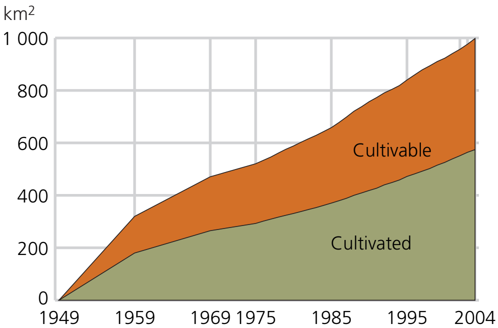


Source: Agricultural statistics, Statistics Norway.

Agricultural area

- Since 1949, total agricultural area has varied between 8 700 and 10 500 km². The current area is about 10 400 km². The agricultural area accounts for 3.4 per cent of Norway's land area.
- At the end of the 1990s, there was a substantial increase in the area of surface cultivated meadow and fertilised pasture. This was probably related to stricter requirements with regard to the minimum area for manure spreading and the transition from support based on production to support based on the area farmed.

Figure 3.3. Accumulated conversion of cultivated and cultivable land[1]. 1949-2004*



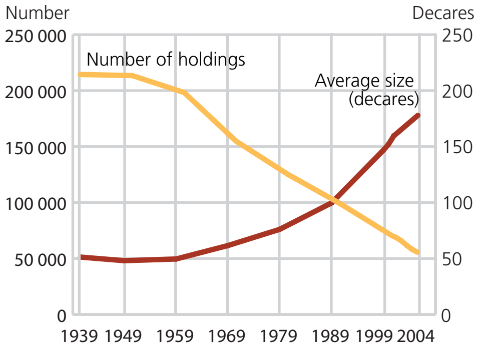
[1] For the period 1949-1975 data is only available for cultivated areas that were converted. The area of cultivable land converted in this period has been estimated on the basis of the ratio between cultivable and cultivated land converted 1976-1997.
Source: Agricultural censuses, Statistics Norway and Ministry of Agriculture and Food.

Conversion of cultivated and cultivable land and new cultivation

- The most important threat to agricultural land resources is its conversion for purposes that prevent future agricultural production.
- An estimated 998 km², or about 5 per cent of the total area suitable for agriculture, has been converted for such purposes since 1949.
- Due to new cultivation, the total agricultural area has not decreased. In the 1950s, 1960s and 1970s, an annual average of about 80 000 decares was brought under cultivation on the basis of government grants. Since the grant scheme was discontinued, a significant decrease in new cultivation activities has been recorded, and the annual average for the years 1999-2001 was somewhat less than 12 000 decares.

3.3. Size of holdings and cultural landscape

Figure 3.4. Number of holdings and their average size of utilized agricultural area (decares[1]). 1939-2004*



[1] 1 decare = 0.1 hectare
Source: Agricultural statistics, Statistics Norway.

Holdings - number and size

- The number of holdings in Norway has been reduced to about a fourth since 1959; this is equivalent to a loss of 9 holdings a day. Figures for the last two to three years indicate a rising rate of farm closures.
- The average size has almost quadrupled, as the total agricultural area in use shows little change. Much of the land on abandoned holdings is initially taken over as additional land by the remaining holdings, often as rented area. In 2003, 32 per cent of agricultural area in use was rented, an increase of 1 percentage point since 1999.

Box 3.1. Structural changes and the cultural landscape

Major structural changes have taken place in agriculture over the last few decades, and they have followed three distinct trends:
- The agricultural area is divided among fewer and larger holdings
- Each holding produces fewer products (specialisation at holding level)
- Production of important products is concentrated to a greater extent in certain regions (specialisation at regional level).

All these trends have changed the conditions for nutrient cycles in the agricultural system and the way farming shapes the cultural landscape. Requirements relating to the means of production have also been affected: this also applies to buildings, which are an important part of Norway's cultural heritage.

Larger holdings, technological advances such as increased size of machinery and tools, and greater pressure to increase earnings are all factors that tend to lead to an increase in the size of fields. An increase in the size of fields reduces the length of ecotones and results in less variation in the landscape within a given area. This reduces biological diversity and gives the agricultural landscape a more monotonous appearance.

3.4. Pollution from the agricultural sector

Table 3.1. Emissions to air from agriculture. Greenhouse gases and acidifying substances. 2003*

	Emissions from agriculture. 1 000 tonnes	Percentage of total emissions in Norway
Greenhouse gases	4 958[1]	9.2
Carbon dioxide (CO_2)	4.2	1.0
Nitrous oxide (N_2O)	8.2	48
Methane (CH_4)	94.9	39
Acidifying substances	1.3[2]	19.1
Ammonia (NH_3)	120.2	89
NO_X	5.3	2.4
SO_2	0.1	0.5

[1] CO_2-equivalents.
[2] Acid equivalents.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Emissions to air

Emissions to air where agriculture is an important source:

- *Nitrous oxide* (N_2O): nitrogen runoff, use of commercial fertiliser and manure, livestock, biological nitrogen fixation, decomposition of plant material, cultivation of mires and deposition of ammonia. Calculations of nitrous oxide emissions from agriculture show a high level of uncertainty (see Chapter 6).
- *Methane*(CH_4): livestock. Between 80 and 90 per cent is released directly from the gut.
- *Ammonia* (NH_3): animal manure (about two-thirds), the use of commercial fertiliser and treatment of straw with ammonia.

Box 3.2. Pollution from the agricultural sector

Farming results in air and water pollution. Agriculture is a major source of discharges of nutrients to water (nitrogen and phosphorus) (see further details in Chapter 8). In 2003, agriculture accounted for about 45 and 57 per cent respectively of anthropogenic phosphorus and nitrogen inputs to what is termed the North Sea area (the coastal area between the Swedish border and Lindesnes). These inputs are described in more detail in Chapter 8. Eutrophication is a particularly serious problem locally in water recipients where much of the surrounding land is agricultural.

Measures to limit runoff of nutrients can be divided into three main groups:
- Better fertiliser management to reduce the surplus of nutrients in soils
- Better cultivation systems to protect soils against erosion
- Technical measures, such as improving drainage, enlarging manure storage facilities, etc.

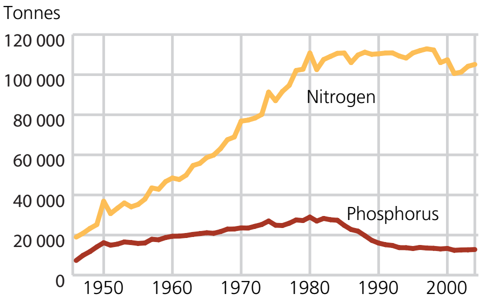
Farming also makes a substantial contribution to emissions of ammonia (NH_3), methane (CH_4) and nitrous oxide (N_2O) to air (see Table 3.1 and Appendix, Tables F3-F5). Emissions of ammonia result in acid rain, while methane and nitrous oxide are greenhouse gases (see Chapter 6). No measures have as yet been implemented to reduce emissions to air from the agricultural sector. The use of pesticides in farming also results in various forms of pollution.

Box 3.3. Measures to prevent soil erosion

A large proportion of pollution from the agricultural sector is a result of erosion, i.e. transport of soil with surface water runoff from fields. Most erosion takes place on fields that are ploughed in autumn. When ploughed in autumn, fields are left for up to three-quarters of the year with no plant cover to protect the soil from rain and melt-water. In the long term, erosion also reduces the production capacity of the soil.

To reduce soil erosion, the authorities provide grants for areas that are vulnerable to erosion on condition that the farmers leave them under stubble during the winter, i.e. do not till these areas in autumn. This support scheme also applies to some other types of areas such as areas lightly harrowed in autumn, directly sown autumn cereals, autumn cereals sown after light harrowing and catch crops. Support is provided because crop yields are expected to be lower in the following season without autumn tillage. In the long run, however, reducing soil loss will help to maintain soil quality, with a potentially positive impact on future crop yields.

Figure 3.5. Sales of nitrogen and phosphorus in commercial fertilisers. 1946-2004

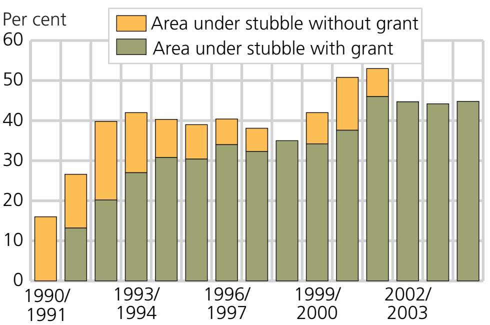


Source: Agricultural statistics, Statistics Norway, and Norwegian Food Safety Authority.

Application of commercial fertiliser

- As a rule, heavy application of fertiliser results in poor utilisation of the nutrients and may therefore increase pollution in lakes and rivers. The amount of fertiliser applied is therefore increasingly determined on the basis of soil samples and recommended standards. Since 1998 a fertilisation plan has been mandatory for holdings that apply for production grants.
- Since the early 1980s, the use of phosphorus fertiliser has been halved. In 2000 and 2001, the amount of nitrogen fertiliser used was 10 per cent lower than in the peak years 1996-1998, but showed a moderate rise again in 2003 and 2004.

Figure 3.6. Proportion of cereal acreage left under stubble[1] in autumn. 1990/1991-2004/2005*

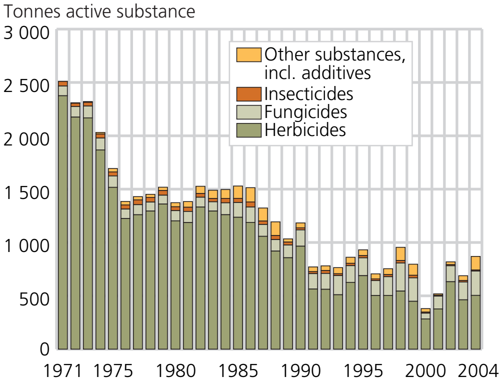


[1] Total area under stubble not recorded in 1998/99, 2002/03, 2003/04 and 2004/2005.
Source: Agricultural statistics, Statistics Norway, and Ministry of Agriculture and Food.

Soil management

- The area under stubble (i.e. area that is not tilled between harvesting and spring) increased from 16 per cent in 1990-1991 to 42 per cent in 1992-1993. The area remained at about this level until 2000, but increased to 53 per cent in 2002.
- The same trend has been evident for the proportion of the area under stubble for which support is granted. The increase in 2000-2001 and 2001-2002 may perhaps have been a result of weather conditions that made tillage difficult.

Figure 3.7. Sales of chemical plant protection products, measured in tonnes of active substance. 1971-2004

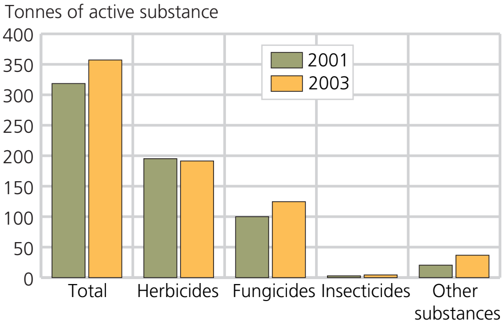


Source: Norwegian Food Safety Authority.

Use of plant protection products

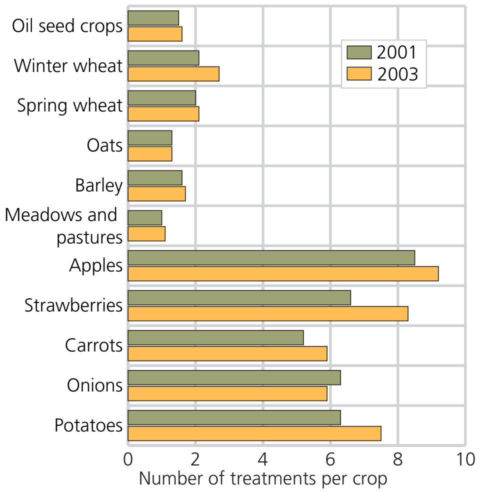
- The sales statistics apply to sales by importers to distributors and do not therefore show actual annual usage.
- Statistics for the past few years reflect changes in the tax system. The introduction of a new system in 1999, which included a tax increase, and a further tax increase in 2000 resulted in a high level of imports at the end of 1998 and 1999. As a result, sales were low in 2000 and 2001.
- A new change in the tax system entered into force on 1 October 2004. The tax on plant protection products was also raised by 25 per cent from 1 January 2005. The figures for 2004 show unusually large imports of fungicides and growth regulators.

Figure 3.8. Use of plant protection products, by type of product. 2001 and 2003. Tonnes of active substance



Source: Agricultural statistics, Statistics Norway (Gundersen 2004).

Figure 3.9. Average number of treatments for crops in surveys. 2001 and 2003

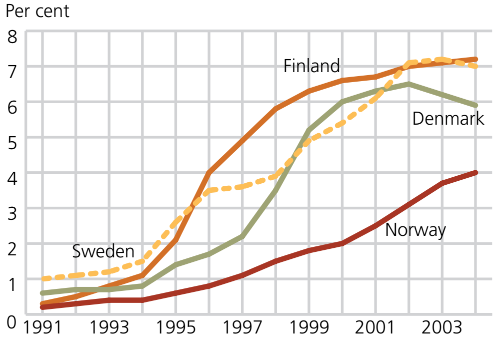


Source: Agricultural statistics, Statistics Norway (Gundersen 2004).

- Statistics Norway conducted surveys in 2001 and 2003 to provide statistics on the actual use of pesticides. Pesticides were used on a third of Norway's farmland in 2003.
- Measured by the total amount of active substances, the use of pesticides in agriculture rose by 12 per cent from 2001 to 2003. It is assumed that the increase in use of fungicides and growth regulators was mainly due to the weather. The amount of fungicides used increased by 25 per cent, while the amount of "other products", which includes growth regulators, rose by 80 per cent.
- Crops are vulnerable to pests to a varying extent. Among the crops in the survey, the number of treatments varied from an average of 1.1 in meadows and pastures to 9.2 in apple production.
- From 2001 to 2003, the number of treatments increased for all crops except onions. The largest increase was for strawberries, where the average number of treatments increased from 6.6 to 8.3.

3.5. Ecological farming

Figure 3.10. Areas farmed ecologically or in the process of conversion in the Nordic countries. Percentage of total agricultural area. 1991-2004



Source: Debio (Norway), KRAV (Sweden), Danish Plant Directorate (Denmark), Plant Production Inspection Centre (Finland).

Ecologically cultivated area in the Nordic countries

- Ecological farming increased in all the Nordic countries in the 1990s. Norway, with 4 per cent in 2004, has the lowest percentage, as against 6-7 per cent in the other Nordic countries.
- The Norwegian authorities' target is that 10 per cent of the agricultural area is to be ecologically farmed by 2009.

Box 3.4. Ecological farming

Ecological farming (or organic farming) is a collective term for various farming systems based on some common principles:
- No use of commercial fertiliser or chemical/synthetic pesticides
- Cultivation of a variety of crops and diversified crop rotation
- Cultivation systems should have a preventive effect on disease and pests
- Organic material recycled as far as possible
- Balance between livestock numbers and areas of farmland with respect to fodder production and use of manure.

Ecological agriculture has certain environmental advantages over conventional farming systems:
- Less loss of nutrients and thus less pollution
- More varied agricultural landscape and therefore greater species diversity in and around agricultural areas
- No pesticide residues in soils or products
- Product quality often perceived as higher.

Ecological agriculture is considerably more labour-intensive than conventional agriculture, and yields are generally lower. Product prices are higher, but there are fewer sales channels.

The Agricultural Agreement has included support schemes for ecological farming practices since 1990. Requirements relating to ecological agricultural production are laid down in regulations issued by the Ministry of Agriculture and Food, and the organisation Debio is responsible for inspection and control. Each holding run on ecological principles must be approved by Debio and must be inspected at least once a year.

More information: Henning Høie (henning.hoie@ssb.no, environmental impacts of agriculture) and Ole Rognstad (ole.rognstad@ssb.no, agriculture).

Useful websites

Statistics Norway agricultural statistics: http://www.ssb.no/english/subjects/10/04/
Statistics Norway national accounts: http://www.ssb.no/english/subjects/09/01/
Centre for Soil and Environmental Research:
http://www.jordforsk.no/
Debio: http://www.debio.no/
Ministry of Agriculture and Food: http://odin.dep.no/land/
Norwegian Agricultural Authority: http://www.slf.dep.no/
Norwegian Agricultural Economics Research Institute: http://www.nilf.no/
Norwegian Food Safety Authority: http://www. mattilsynet.no
Norwegian Crop Research Institute: http://www.planteforsk.no/
Norwegian Institute for Land Inventory: http://www.nijos.no/

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Budget Committee for Agriculture (2005): *Volum- og prisindekser for jordbruket. Regnskapsåra 1959-2003* (Volume and price indices for agriculture. Accounting years 1959-2004). Norwegian Agricultural Economics Research Institute.

Gundersen, G. I. (2004): *Bruk av plantevernmidler i jordbruket i 2003* (Use of plant protection products in agriculture in 2003. [In Norwegian with English abstract]). Reports 2004/21, Statistics Norway.
http://www.ssb.no/emner/10/04/10/rapp_plantevern/rapp_200421/

Report No. 19 (1999-2000) to the Storting: *Om norsk landbruk og matproduksjon* (Norwegian agriculture and food production). Ministry of Agriculture and Food.

4. Forest and uncultivated land

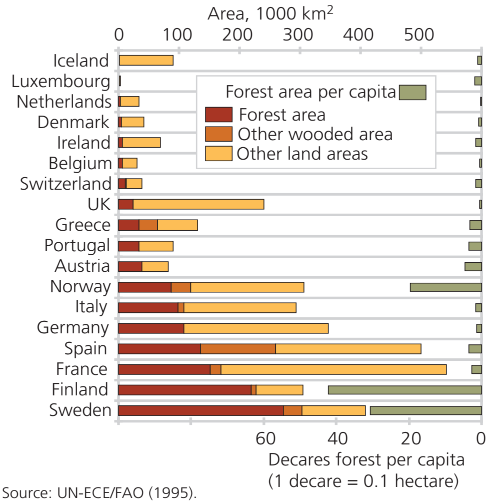
The Norwegian forest contains a wide variety of resources and environmental qualities. In terms of the economy, forests are primarily important as a source of raw materials for the sawmilling and pulp and paper industries. The forest, with its biological diversity, also has considerable intrinsic value as an ecological resource and as an outdoor recreation area for an increasingly urbanized population. This provides a basis for utilizing the resources of uncultivated areas for tourism as well.

Interests in forests and forest resources continue to lead to conflicts between different groups of forest users. In order to reduce the adverse effects on ecology of timber production and its disadvantages to recreational users, the forestry industry itself and the authorities have in recent years placed greater emphasis on multi-use considerations.

This chapter describes the forestry industry and the importance of forest and uncultivated areas in a wider perspective. The growing stock in Norway has increased considerably for many years because the rate of roundwood removals has been lower than the natural increment. This accumulation of carbon in forests has resulted in an annual uptake of CO_2 by forest that is equivalent to about 44 per cent of Norway's total anthropogenic CO_2 emissions each year. This is one of the topics described here, together with the biological diversity of forests and their sensitivity to environmental pressures such as climate change and air pollution. Game species, the large predators and reindeer husbandry are also discussed.

4.1. Distribution of forests in Norway and Europe

Figure 4.1. Forest area and total land area in EU and EFTA countries



Source: UN-ECE/FAO (1995).

Forested area

- There is about 75 000 km² of productive forest in Norway (Norwegian Institute of Land Inventory 1999), or 24 per cent of the total land area of Norway. Almost half of this forested area is managed in combination with agricultural operations.
- About 1.1 million km² or 36 per cent of the total area of the EU countries is forested. Sweden and Finland have the largest areas of forest. With Norway, these countries have the largest area of forest relative to population.
- Forestry and forest industries employ 2.2 million persons in the EU area today (UN/ECE-EC 2000).

Box 4.1. Protection of forests in Norway

Norway's forests need protection even though both the total area of forest and the amount of timber forests contain are rising. Modern, efficient forestry has made large areas of forest more uniform, and has reduced the area of forest that is allowed to develop without human intervention. Different habitats contain specially adapted species of insects, plants and other organisms. Forest protection is therefore necessary to maintain diversity in forests and rare types of habitats.

An estimated 22 000 forest plant and animal species have been recorded in Norway, and about 1 400 of these are rare or endangered (Directorate for Nature Management 1999). Norway has ratified the Convention on Biological Diversity, which was adopted by the UN Conference on Environment and Development in 1992, and is therefore required to take steps to identify and monitor its biological diversity.

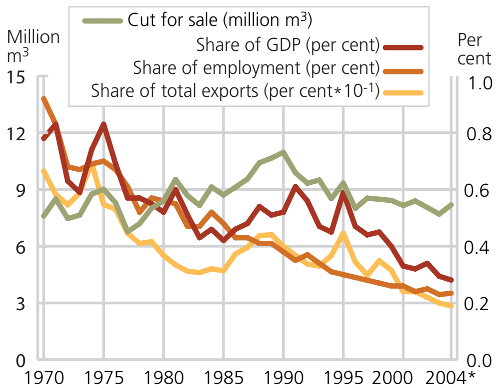
At the end of 2004, a total of 914 km² or 1.2 per cent, of the productive forest area in Norway was protected. Included in this figure are protected forest areas in the national parks (Directorate for Nature Management 2005).

By comparison, 3.7 per cent of the total area of productive forest in Sweden was protected in 2000. The corresponding figure for Finland was 4.1 per cent in 2002 (Swedish Environmental Protection Agency 2005 and METLA 2004).

In November 2003, the Norwegian Parliament discussed Report No. 25 (2002-2003) to the Storting, *The Government's environmental policy and the state of the environment in Norway*. This report includes plans for a further increase in the protection of forests. Work is now organised according to a three-track strategy: traditional forest protection, forest protection on state-owned land and voluntary forest protection in collaboration with the Norwegian Forest Owners' Federation.

4.2. Forestry

Figure 4.2. Forestry: share of exports, employment and GDP. Annual roundwood removals. 1970-2004*

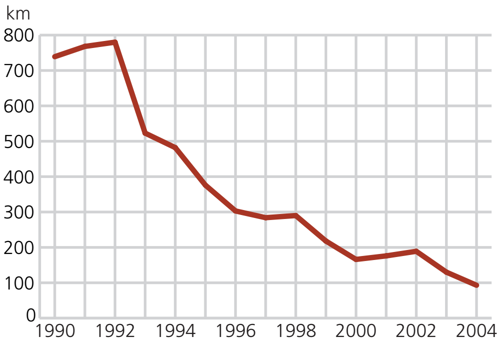


Source: National accounts and forestry statistics, Statistics Norway.

Roundwood removals and economic importance

- In 2004, forestry's share of total employment was 0.23 per cent. This is equivalent to 4 600 full-time equivalents, down from 13 700 in 1970. Employment declined in relative terms by about the same as in agriculture.
- Forestry's share of Norway's GDP dropped from 0.78 per cent in 1970 to 0.28 per cent in 2004. Forestry's share of GDP has declined less sharply than that of agriculture.
- The gross value of the roundwood removed for commercial purposes in 2004 was NOK 2.6 billion, and wood and wood processing products worth NOK 11.5 billion were exported from Norway.

Figure 4.3. Annual construction of new forest roads for year-round use. 1990-2004



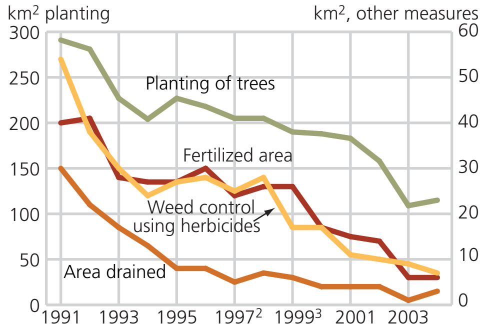
Source: Forestry statistics, Statistics Norway.

Forest roads

- For many years, the construction of forest roads has been an important contributory cause of the reduction in the size and number of wilderness-like areas in Norway (SSB/SFT/DN 1994).
- However, the rate of construction of forest roads has dropped from 780 km forest roads for year-round use in 1992 to 93 km in 2004.
- A total of NOK 123 million was invested in forest roads in 2004, and NOK 43 million of this was in the form of public grants, NOK 12 million less than in 2003.

For the size of wilderness-like areas, see Chapters 1 Status and important trends and 9 Land use.

Figure 4.4. Silviculture measures[1] that have an environmental impact. 1991-2004*



[1] The figures refer to silviculture funded by the Forest Trust Fund and/or government grants.
[2] No figures are available for the county of Finnmark.
[3] No figures are available for the county of Troms.
Source: Forestry statistics, Statistics Norway.

Silviculture

- There has been a decrease in silviculture activities since the beginning of the 1990s. Public funding for such activities was discontinued in 2003.
- The planting of trees is the largest single silviculture investment. A total of NOK 77 million was invested in planting in 2004, and 115 km^2 were planted.
- There may be several reasons for the decline in the use of chemical herbicides: increased focus on environmental considerations in forestry, restrictions on the use of spraying, annulment of grants and reduced profitability in forestry.
- The county of Nord-Trøndelag accounted for 40 per cent of all forest drainage in 2004.

Box 4.2. Environmental inventories in forests - biodiversity

Forestry planning and sufficient information about forests and the environment form the main basis of long-term, sustainable forest management. Forestry planning, which is funded by government grants, is carried out in accordance with regulations concerning government grants for forestry planning, which include various provisions relating to purpose, requirements for standards and inventory methods, organisation, etc. Registration of biological diversity is now included in forestry planning. Forestry planning aims to obtain localised information to enable forest owners to base their activities on documented facts about forest areas, resources and areas of environmental value. Forestry plans are primarily intended as a tool for owners to generate value-added based on the rational use of forestry resources and sustainable forest management and to function as the basis for annual plans and operations.

It is important that the registration of biodiversity in forests included in forestry planning is conducted according to clearly defined instructions so that the registration can be documented and verified and the results are objective and comparable. This is important in order to ensure that the work of registration maintains a clear and reliable profile, and because the various environmental considerations will always involve consequences for commercial activities.

The environmental inventory method used in forestry planning is based on extensive research and documentation of ecological relationships, and clearly indicates how the method was developed and the specific data to be registered. In spring 2000, the registration project (coordinated by Skogforsk, a key forestry research institute under the Ministry of Agriculture and Food) presented the results of three years' field work and analyses relating to biodiversity in forests. On the basis of the project's scientific results, a registration methodology was developed to capture important environmental qualities in connection with forestry plans drawn up on request from individual forest owners. The project was funded by the Ministry of Agriculture and Food, and government support is provided for forest owners who request forestry plans that include registration of biodiversity. The registration scheme was fully operational from 2001, and after four seasons about 20 km^2 had been registered. In 2005, NOK 25 million was allocated for forestry planning including environmental inventories.

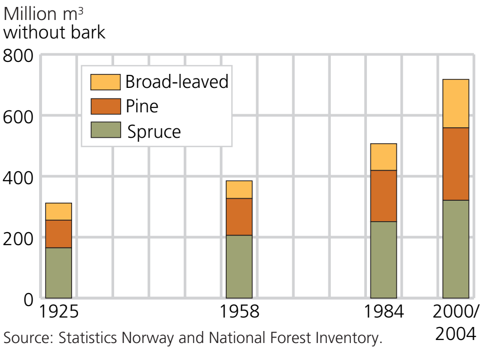
A booklet is available describing the registration method and courses have been held for forestry planners and other users. The Norwegian Institute of Land Inventory (NIJOS) has contributed to the establishment of a practical registration procedure. The booklet is available on the Skogforsk website (http://www.skogforsk.no/files/71.pdf). NIJOS, in cooperation with the Norwegian Institute for Nature Research, has evaluated the registrations carried out so far. Their main conclusion is that environmental registration is very useful in identifying biological assets and as a basis for establishing suitable management units, but that there is room for improvement in, for example, data processing procedures in order to further increase the efficiency of environmental registration.

A joint project has been conducted by NIJOS and the Directorate for Nature Management on the use of data collected using environmental registration as a basis for the identification, delimitation and documentation of areas suitable for habitat type classification. The purpose of this project was to adapt the methods used for environmental inventories in forests so that data can more easily be used to classify habitat types according to the Directorate's manual.

As work on environmental registration continues, new information can be expected to emerge that will be valuable in connection with the environmental adaptations implemented by the forestry industry in accordance with government policy and the Living Forests Standards. This work is also relevant to the national programme to survey and monitor biological diversity (Ministry of Agriculture and Food 2005).

4.3. Increment and uptake of CO_2 by forest

Figure 4.5. Volume of the growing stock. 1925, 1958, 1984 and 2000/2004

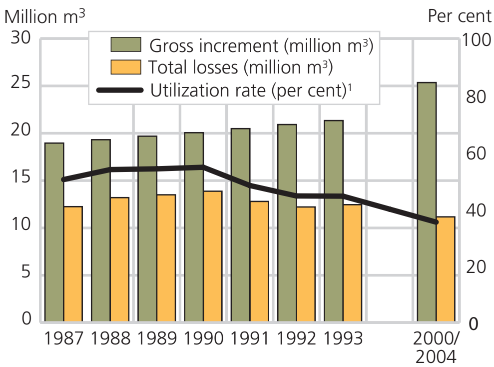


Source: Statistics Norway and National Forest Inventory.

Total growing stock

- Data from inventories carried out by the Norwegian Institute of Land Inventory and calculations carried out by Statistics Norway show that in the period 2000/2004 the volume of the growing stock in Norway was 719 million m^3.
- The volume of the growing stock below the coniferous forest line has more than doubled since 1925.

Figure 4.6. Gross increment, total losses and utilization rate of the growing stock[1]. 1987-2000/2004



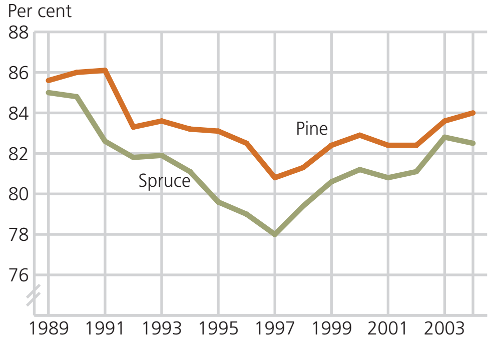
[1] Utilization rate is defined here as the volume of roundwood removals in relation to gross increment.
Source: Forestry statistics, Statistics Norway.

Increment and utilization rate of the growing stock

- In 2003, the net increment (annual increment minus roundwood removals and calculated natural losses) in the growing stock was 14.0 million m^3, or 1.9 per cent of the total volume (see Appendix, table D1).
- The increase in the biomass (branches and roots included) of forests in 2003 resulted in an uptake of carbon by forest that corresponded to 19 million tonnes of CO_2 or about 44 per cent of the total anthropogenic CO_2 emissions in Norway.
- Estimates of carbon pools in dead wood and soil have been made. Carbon levels have increased by an amount corresponding to 4 million tonnes of CO_2 or 10 per cent of total anthropogenic emissions in 2003 (Rypdal et al. 2005).

4.4. Forest damage

Figure 4.7. Mean crown condition for spruce and pine. 1989-2004



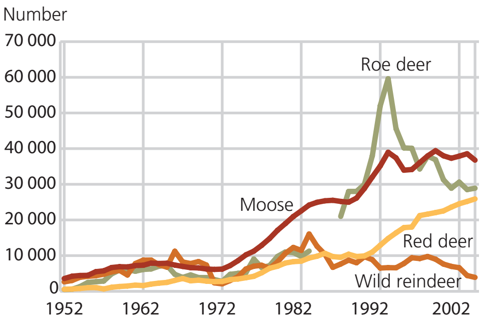
Source: Norwegian Institute of Land Inventory (2005).

Forest damage in Norway

- Crown density is an indicator of the forest's state of health. Since surveys began in 1989, decreasing crown density was the trend until 1997. Since then, the condition for both spruce and pine has improved.
- In 2004, surveys showed an improvement in crown condition for pine and a slight decline for spruce.
- Mean crown density was 82.5 per cent for spruce and 84.0 per cent for pine in 2004.
- The crown colour of spruce was greener in 2004 compared with the year before. The status for pine was recorded as unchanged, while birch was somewhat yellower.

4.5. Game species

Figure 4.8. Number of moose, red deer, wild reindeer and roe deer killed. 1952-2004

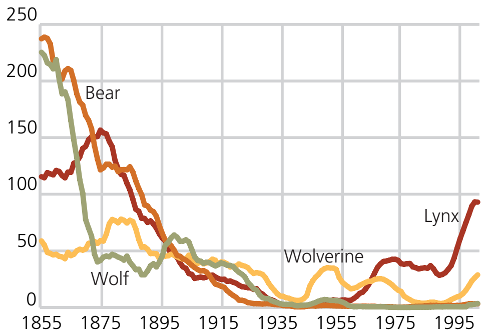


Source: Hunting statistics, Statistics Norway.

Cervids

- The numbers of forest-living cervids have risen considerably in the last 20-30 years, particularly as a result of clear-cutting and selective shooting.
- The grazing pressure exerted by large populations of cervids influences the vegetation, and this can affect the landscape and biological diversity.
- The total yield in 2004 was 4 885 tonnes of moose meat, 1 486 tonnes of venison and 129 tonnes of wild reindeer meat (see also Appendix, table D3).

Figure 4.9. Number[1] of predators killed. 1885-2003



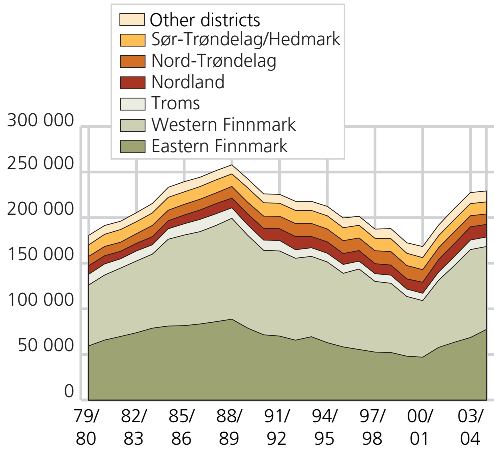
[1] 1Average number past ten years.
Source: Hunting statistics, Statistics Norway.

The large predators

- Relentless hunting of all four species of large predators had almost exterminated wolves and bears by the middle of the 20th century. Wolves and bears were protected throughout Norway in 1971 and 1973 respectively.
- In recent years, wolf numbers have recovered again in Scandinavia. It is uncertain whether they have spread southwards from northern Scandinavia and Russia or whether reproduction by the few resident animals that were never exterminated has raised their numbers.
- Today, licensed hunters are permitted to take wolverines in Norway, and lynx hunting is regulated by means of quotas (see also Appendix, table D4). In 2005, licenses for wolf hunting were also issued.

4.6. Reindeer husbandry

Figure 4.10. Trends in the size of the spring herd. 1979/80-2004/05*

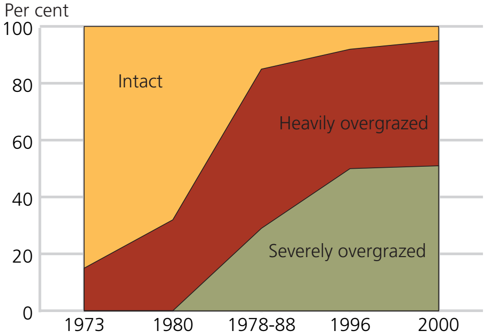


Source: Norwegian Reindeer Husbandry Association.

Geographical scope and economic importance

- Reindeer husbandry is a small sector in national terms, but shares user interests with others in an area equivalent to 40 per cent of the total area of Norway.
- There was a large reduction in the size of the spring herd (stock size before calving starts in May) in Finnmark in the period 1988/89-2000/01. This was a result of management measures implemented because of overgrazing, increased losses to predators and several winters with difficult climatic conditions at the end of the 1990s. In the past four years, the size of the reindeer stock in Finnmark has increased substantially due to good calving seasons, primarily due to very favourable climatic conditions during the winter season.

Figure 4.11. State of lichen resources in Finnmark. 1973-2000



Source: NORUT.

Reindeer husbandry and the environment

- Parts of Finnmark have been so overgrazed that both the environment and the future of the industry are threatened.
- In 2000, half of the grazing areas were defined as severely overgrazed, more than 40 per cent as heavily overgrazed and only 5 per cent as intact. This indicates a dramatic deterioration compared with previous measurements, although the methods used are not entirely comparable.

4.7. Management of uncultivated areas

Table 4.1. Processing of applications for exemptions under the Act relating to motor traffic on uncultivated land and in water courses. Whole country. 2001-2004

	Number of applications processed by the municipalities	Number approved	Percentage approved
2001[1]	12 674	11 863	94
2002[1]	14 186	13 255	93
2003[1]	13 208	12 557	95
2004	18 025	15 926	88

[1] In reporting municipalities, between 80 and 95 per cent of the municipalities have reported.
Source: Statistics Norway 2005.

Motor traffic

- Motor traffic in uncultivated areas is in principle prohibited. However, under the Act relating to motor traffic on uncultivated land and in watercourses, local government authorities may grant exemptions from the Act, allowing the use of motor traffic for certain purposes. No data on actual traffic is available, but KOSTRA (a system for reporting and publishing local government information) provides information on the use of exemptions by local government authorities.
- In all, 88 per cent of all applications for exemption were granted in 2004. Even though the percentage of applications granted decreased, the number of exemptions granted was at its highest since KOSTRA reporting started in 2001 due to the high number of applications.
- See also Chapter 9, Land use, where municipal land use management and building activity in the coastal zone (100-metre belt) is described.

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Useful websites

Statistics Norway forestry statistics: http://www.ssb.no/english/subjects/10/04/20/
Statistics Norway, hunting statistics: http://www.ssb.no/english/subjects/10/04/10/
Norwegian Forest Research Institute: http://www.nisk.no/
Norwegian Institute for Land Inventory: http://www.nijos.no/
Norwegian Reindeer Husbandry Association: http://www.reindrift.no/
The Living Forests Project: http://www.levendeskog.no/Engelsk_Default.asp

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5. Fisheries, sealing, whaling and fish farming

Stocks of several important demersal fish species in the North Sea are still at very low levels. The same is true of the Barents Sea capelin stock. On the other hand, the spawning stocks of Norwegian spring-spawning herring and Northeast Arctic cod are both considered to be well within safe biological limits. In 2004, production of farmed salmon increased to 566 000 tonnes.

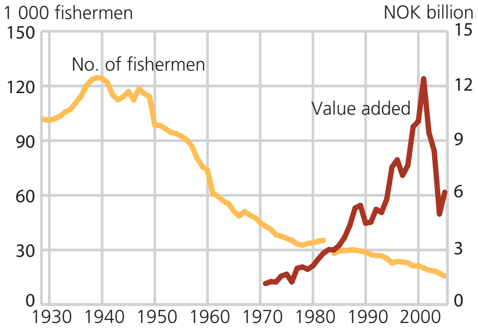
In the Barents Sea and Norwegian Sea, the stocks of Northeast Arctic cod, saithe and haddock and Norwegian spring-spawning herring are at satisfactory levels. The Barents Sea capelin stock is very low and is classified as having reduced reproductive capacity. The stocks of redfish (*Sebastes marinus* and *S. mentella*) and Northeast Arctic Greenland halibut are at present at low or uncertain levels. The blue whiting stock seems to be in relatively good condition even though it has been heavily exploited in recent years. However, the current fishing pressure means that the stock is very vulnerable and is dependent on a continued high level of recruitment. The Northeast Atlantic mackerel stock is lower than it has been for many years. Temperatures were expected to be above normal in the upper water masses in the Barents Sea and Norwegian Sea in the first six months of 2005, increasing the likelihood of good year classes of herring, cod and haddock (Anon. 2005).

In the North Sea, stocks of several demersal fish species such as cod, Norway pout and sandeel are in poor condition. However, the North Sea herring stock is above the precautionary level, and the stocks of haddock and saithe are also in good condition. The temperature in the North Sea was relatively high during the first six months of 2005, indicating that recruitment to the North Sea cod stock was likely to be low. However, other fish stocks may have benefited from the higher temperatures (Anon. 2005).

The total world catch from marine fisheries was 81 million tonnes in 2003, a decrease of about 3 million tonnes compared with the year before. According to FAO, about 52 per cent of major fish stocks for which data is available are fully exploited, while 16 per cent are overexploited. It is estimated that 8 per cent of the fish stocks have been substantially depleted. The remaining 24 per cent are regarded as moderately exploited or underexploited, and this is where there is a potential for the expansion of marine fisheries.

The new environmental action plan from the Ministry of Fisheries and Coastal Affairs (2005) presents targets and measures to safeguard the marine environment and coastal heritage. A white paper on industrial and commercial development of marine resources (Report No. 19 (2004-2005)) describes a framework for greater wealth creation from marine resources and maintaining settlement along the coast, and sets out the government's goals and policy proposals.

Figure 5.1. Value added[1] in the fishing, sealing and whaling industry 1970-2004, and number of fishermen 1928-2004



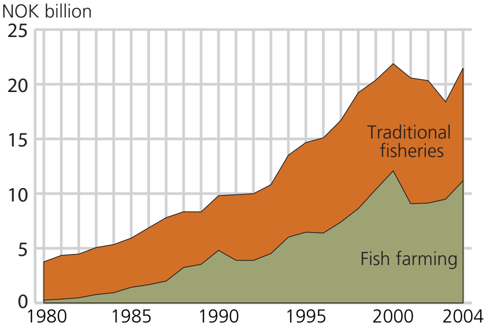
[1] Value added in basic values. Current prices.
Source: Directorate of Fisheries and National Accounts, Statistics Norway.

5.1. Principal economic figures for the fisheries

GDP and employment

- According to the Norwegian national accounts, fishing, sealing, whaling and fish farming contributed NOK 6.2 billion, or 0.4 per cent, to Norway's gross domestic product (GDP) in 2004.
- The fishing industry accounted for 0.7 per cent of total employment in 2004. At the end of 2004, 15 733 fishermen were registered in Norway. The number of fishermen has dropped by about 87 per cent since the late 1930s. Since 1990, the reduction has been 43 per cent. The fish farming industry employs about 4 000 people.

Figure 5.2. First-hand values in traditional fisheries and fish farming. 1980-2004



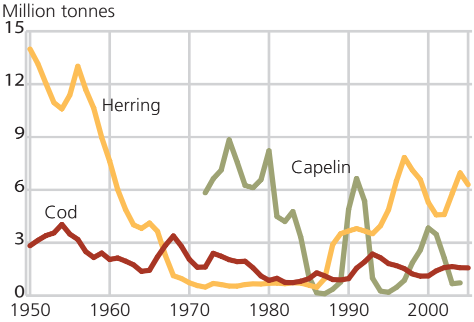
Source: Directorate of Fisheries and Fisheries statistics, Statistics Norway.

Production and prices

- Both catch quantities and first-hand prices were poor in the traditional Norwegian marine fisheries in 2003. A general fall in demand and a strong Norwegian krone were the main reasons for the low prices (Statistics Norway 2005a).
- From 2003 to 2004, there was a slight decline in total catch quantity, but prices rose considerably. For example, the price of cod increased by 15 per cent.
- Figures from the national accounts indicate that production dropped by 7 per cent from 2003 to 2004 (measured in constant prices) in the traditional fisheries, whereas it increased by 6 per cent in the fish farming industry.
- In 2004, the first-hand value of catches rose by 15 per cent in the traditional fisheries and by about 18 per cent in the fish farming industry (salmon and trout).
- The fish farming industry has been in a very difficult financial situation for the past two-three years. The export price for fresh salmon, which is much the most important export commodity, dropped by 33 per cent from 2000 to 2003. Nevertheless, the quantity exported rose by 19 per cent in the same period. Preliminary figures for 2004 indicate a price rise of almost 7 per cent from 2003 to 2004, and a continued rise in the quantity exported.

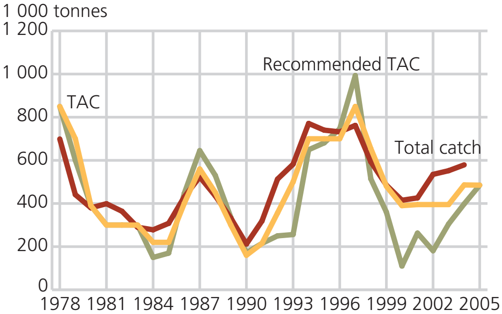
5.2. Trends in stocks

Figure 5.3. Trends for stocks of Northeast Arctic cod[1], Norwegian spring-spawning herring[2] and Barents Sea capelin[3]. 1950-2005



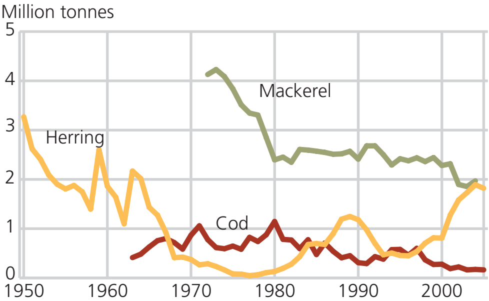
[1] Fish aged three years and over. [2] Spawning stock. [3] Fish aged one year and over.
Source: ICES and Institute of Marine Research, Bergen.

Figure 5.4. Recommended TACs, TACs actually set and catches[1] of Northeast Arctic cod. 1978-2005



[1] Unreported catches were estimated at 90 000 tonnes in 2002 and 2004 and 115 000 tonnes in 2003.
Source: ICES and Institute of Marine Research, Bergen.

Figure 5.5. Trends for stocks of cod in the North Sea[1], North Sea herring[2] and mackerel[2,3]. 1950-2005



[1] Fish aged one year and over. [2] Spawning stock. [3] Southern, western and North Sea mackerel.
Source: ICES and Institute of Marine Research, Bergen.

Barents Sea-Norwegian Sea

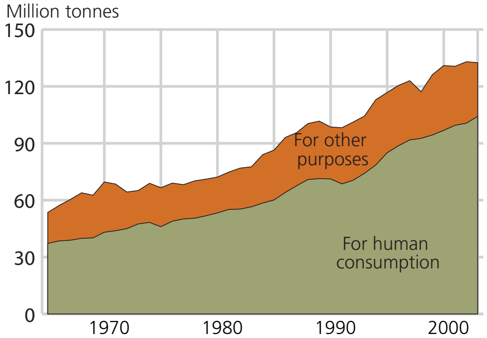
- The spawning stock of Norwegian spring-spawning herring was estimated to be 6.3 million tonnes in 2005. The stock is above the precautionary reference point.
- The total stock of capelin in the Barents Sea in autumn 2004 was estimated to be 0.7 million tonnes. The collapse of this stock has been caused by weaker recruitment, higher natural mortality and reduced individual growth.
- The total stock of Northeast Arctic cod was estimated to be about 1.6 million tonnes in 2005.
- From 1998 to 2004, the TAC (total allowable catch) for Northeast Arctic cod was considerably higher than the level recommended by marine scientists. The recorded catches corresponded fairly closely to the TACs, but illegal fishing represents a serious problem.
- The TAC for 2005 was 485 000 tonnes. This was the level recommended by the International Council for the Exploration of the Sea (ICES), and was set according to new rules for calculating the annual TAC.

North Sea

- In recent years, the North Sea herring stock has developed satisfactorily. The spawning stock was estimated to be about 1.8 million tonnes in 2005.
- The cod stock is still low. The total stock is estimated to be below 200 000 tonnes.
- The total spawning stock of mackerel has decreased since 1998. The stock size has been adjusted downwards a good deal in the most recent estimates. The current estimate is about 2 million tonnes, or about one million tonnes below the previous estimate.

5.3. Fisheries

Figure 5.6. World fisheries production[1], by main uses. 1965-2003



[1] Production data does not include marine mammals (seals, whales, etc.) or plants. Aquaculture is included.
Source: FAO.

World catches

- Production in the world's fisheries, including both inland and marine catches and aquaculture production, has increased substantially: from slightly more than 50 million tonnes in 1965 to about 133 million tonnes in 2003.
- The proportion used for human consumption in 2003 was 79 per cent. Table 5.1 shows production split by type.
- The species with the highest total catch in 2003 was Peruvian anchovy (*Engraulis ringens*) at 6.2 million tonnes: this figure was 3.5 million tonnes lower than in 2002 (see also Appendix, table E8).

Box 5.1. Reference points for the spawning stock of some important fish stocks

The International Council for the Exploration of the Sea (ICES) and its Advisory Committee on Fishery Management (ACFM) have defined reference points for the levels of different species' spawning stocks and fishing mortality. These are important tools for the authorities in their efforts to take a precautionary approach to fisheries management. The critical spawning stock reference point (B_{lim}) is considered to be a danger level below which there is a high probability of poor recruitment. The level is defined on the basis of historical stock data and current theories on the dynamics of fish stocks. The precautionary reference point (B_{pa}) is somewhat higher, and can be interpreted as a warning level: if a spawning stock falls below this level the authorities should consider taking steps to allow the stock to recover to a higher and safer level in order to safeguard sustainable fisheries.

The table below shows B_{lim} and B_{pa} for some important stocks, and their estimated spawning stocks in 2004.

Stock	B_{lim} (critical reference point) 1 000 tonnes	B_{pa} (precautionary reference point) 1 000 tonnes	Estimated spawning stock 2004 1 000 tonnes
Northeast Arctic cod	220	460	710
Northeast Arctic saithe	136	220	600
Norwegian spring-spawning herring	2 500	5 000	6 970
North Sea herring	800	1 300	1 890
North Sea cod	70	150	$< B_{lim}$
North Sea saithe	106	200	260
Whiting	225	315	Not estimated
Mackerel (total stock)	No biological basis for definition of limit	2 300	1 970

Source: Institute of Marine Research and ICES.

Table 5.1. World fisheries production. 2003

	1 000 tonnes	Per cent
Total production	**132 524**	**100**
Marine fisheries	81 278	61.3
Freshwater fisheries	8 942	6.7
Aquaculture (fish, crustaceans, etc) in marine waters	18 063	13.6
Aquaculture (fish, crustaceans, etc.) in inland waters	24 241	18.3

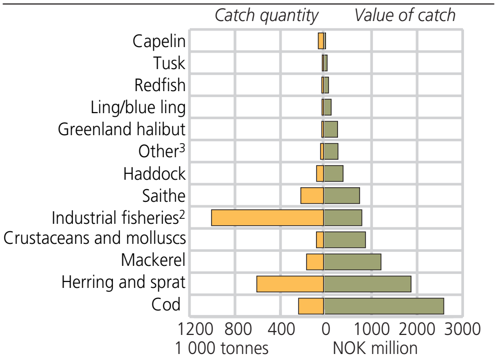
Source: FAO.

Box 5.2. More about stock trends and fisheries management

- In 2005, the stock of *Norwegian spring-spawning herring* was well above the precautionary level defined by marine scientists. The strong 2002 year class indicates that the future for the stock is promising.
- The decline in the total stock of *Barents Sea capelin* from 2002 to 2003 is due to weak recruitment, increased natural mortality and reduced individual growth. This collapse of the stock is not considered to have been caused by fishing. Predation by cod and herring on capelin and capelin larvae is an important cause of the higher natural mortality. The Norwegian-Russian Fisheries Commission decided, as recommended by the ICES Advisory Committee on Fishery Management, to close the fishery for Barents Sea capelin in winter 2005.
- The spawning stock of *Northeast Arctic cod* - around 700 000 tonnes in 2005 - is well above the precautionary level, but the fishing mortality is still considered to be too high. One important reason for the increase in spawning biomass after 2000 is earlier maturation.
- The stock of *coastal cod* is declining. The size of the stock has dropped from about 300 000 tonnes in 1994 to 60 000 tonnes in 2005. Unless harvesting is reduced considerably over the next few years, the total stock and the spawning stock are both expected to decline further. ICES recommended zero fishing in 2005, but the Joint Norwegian-Russian Fisheries Commission nevertheless set a quota of 21 000 tonnes.
- The spawning stock of *North Sea herring* was substantially depleted in the period 1989-1993, from a level of about 1.2 million tonnes to about 500 000 tonnes. The poor state of the stock in 1990s was a result of years of overfishing. There have been positive developments in recent years as a result of higher recruitment and strict management, so that fishing mortality of mature herring has been low and catches of young herring have been limited. The current spawning stock is well above the precautionary level. A decrease in spawning stock size is expected as the weak year classes 2002-2004 enter the fishery.
- Several of the stocks of demersal fish in the North Sea have remained low for many years. The *cod stock in the North Sea* has been heavily fished, and the spawning stock is at an all-time low. ICES has recommended a zero catch of cod, but Norway and the EU have nevertheless set quotas. The stock size of *whiting* is uncertain. The stocks of saithe and haddock have shown positive trends in recent years. The spawning stocks of Norway pout and sandeel are considered to be at low levels. Both these species are short-lived, and it is difficult to give reliable long term prognoses.
- For management purposes, the spawning stocks of *mackerel* from the three spawning grounds (the North Sea, south-west of Ireland and off Spain and Portugal) are now considered as one stock (Northeast Atlantic mackerel). These stocks mix on feeding grounds in the North Sea and Norwegian Sea. The largest component of the stock is found off Ireland. The estimated stock size has been substantially reduced compared with the 2003 ICES estimate, and the stock is now considered to be below the precautionary level.

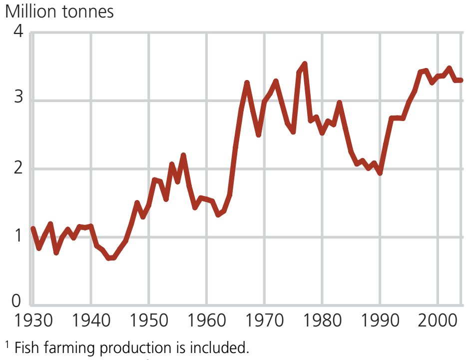
Source: *Marine Resources and Environment 2005* (Anon. 2005). See also Box 5.1 and Appendix, table E1.

Figure 5.7. Norwegian catches[1] by groups of fish species, molluscs and crustaceans. 2004



[1] Catches delivered by Norwegian vessels in Norway and abroad.
[2] Includes greater and lesser silver smelt, Norway pout, sand eel, blue whiting and horse mackerel.
[3] Includes the categories hake/pollack/whiting, other flatfish, other demersal fish, miscellaneous deepwater species and other, unspecified fish.
Source: Directorate of Fisheries.

Figure 5.8. Total production[1] in Norwegian fisheries. 1930-2004



[1] Fish farming production is included.
Source: Directorate of Fisheries and Fisheries statistics, Statistics Norway.

Norwegian catches

- In 2004 the total catch in Norwegian fisheries (including crustaceans, molluscs and seaweed) was 2.7 million tonnes, and the value of the catch was NOK 10.4 billion. The total catch was about 30 000 tonnes lower than in 2003, but the value was about NOK 1.5 billion higher.
- Cod is the species with the highest catch value.
- Measured by catch size, industrial fisheries for species such as Norway pout, blue whiting and sandeels dominated in 2004. The catch of blue whiting reached a record high of 958 000 tonnes. The catch of sandeels was higher than in 2003, but still small. The catch of Norway pout was also modest in 2004, and no fishing for this species was allowed in 2005.
- The total catch in Norwegian fisheries is now two to three times higher than in the 1930s.
- Total production in the fisheries and fish farming in 2004 was slightly more than 3.3 million tonnes, of which 2.7 million tonnes was in traditional fisheries.
- The highest level of catches in the traditional fisheries in the period since 1930 is 3.5 million tonnes in 1977. In the same year, more than 2 million tonnes capelin was caught.

Box 5.3. World catches and Norwegian catches

Total catches in the world's marine fisheries in 2003 dropped by almost 3 million tonnes from the year before to about 81 million tonnes. There was a moderate increase in catches in inland fisheries, to 8.9 million tonnes.

The catches in the Southeast Pacific decreased by over 3 million tonnes compared with 2002. Total landings of *anchoveta* decreased by 3.5 million tonnes, while the catch of *Chilean jack mackerel* was about the same as the year before. Together with South American pilchard (*Sardinops sagax*), these two species make up about 80 per cent of the catches in the Southeast Pacific. There were no dramatic changes in catches in other marine areas. The Northwest Pacific is the world's most productive fishing area, and catches have varied between 20 and 24 million tonnes since the end of the 1980s. Total catches in the Northeast Atlantic have remained stable at about 11 million tonnes for a number of years.

According to FAO (2004), 52 per cent of major fish stocks for which data is available are fully exploited, while 16 per cent are overexploited. It is estimated that 8 per cent of the fish stocks have been depleted or are recovering from depletion.

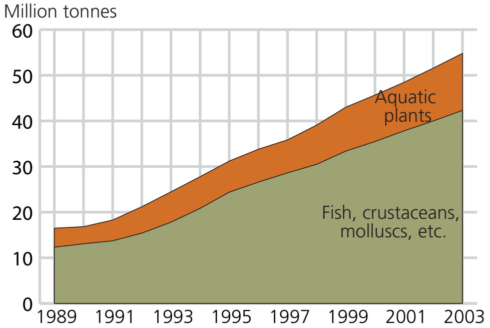
In 2003, world aquaculture production (excluding plants) rose by 2.4 million tonnes (6 per cent).

Norway ranks as number 10 among the world's largest fishing nations (excluding farmed production), with a total catch of 2.6 million tonnes in 2003. At the head of the list are China (16.8 million tonnes), Peru (6.0 million tonnes), the US (4.9 million tonnes), Indonesia (4.7 million tonnes) and Japan (4.6 million tonnes). See also Appendix, tables E7 and E8. According to the FAO yearbook of fisheries statistics (FAO 2005), Chinese capture data is considered to have been overestimated since the early 1990s. The data is now being reviewed and may be revised downwards. In the Norwegian fisheries, the catch of herring in 2004 was about 50 000 tonnes higher than in 2003, and the value of the catch increased by NOK 600 million to NOK 2.0 billion. The catch of cod increased by more than 10 000 tonnes from 2003, and the value of the catch rose by about NOK 440 million to NOK 2.8 billion. The mackerel catch dropped by about 6 000 tonnes and its value was NOK 1.3 billion. The catch of capelin dropped from 249 000 tonnes to 49 000 tonnes with a value of NOK 47 million. There was no fishery for Barents Sea capelin in 2004. The shrimp catch was 59 000 tonnes and its value was NOK 809 million. The Norwegian catch of blue whiting was 0.96 million tonnes. There is no international agreement regulating fishing for blue whiting in international waters, so that the fishery has been almost unregulated. Total landings reached 2.3 million tonnes in 2004. The catch of sandeels is still low, but there was a moderate increase to about 49 000 tonnes in 2004.

See also figures 5.6 and 5.8 and Appendix, table E2.

5.4. Aquaculture

Figure 5.9. World aquaculture production. 1989-2003

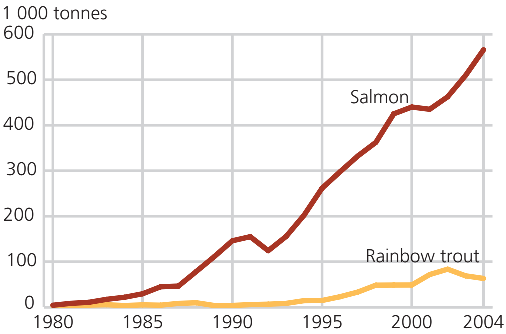


Source: FAO.

World aquaculture production

- In 2003, world aquaculture production totalled 42.3 million tonnes fish, crustaceans, molluscs, etc. corresponding to about 47 per cent of the total catch in marine and inland fisheries for that year.
- Production of aquatic plants totalled 12.5 million tonnes in 2003.
- World aquaculture production has more than trebled since 1989.

Figure 5.10. Fish farming. Volume of salmon and rainbow trout sold. 1980-2004

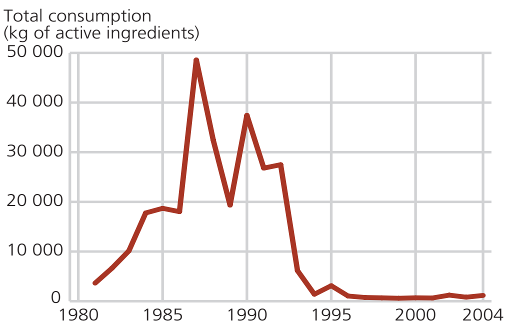


Source: Fisheries statistics, Statistics Norway.

Salmon and trout farming in Norway

- Production of farmed salmonids has increased dramatically since the industry was established in the early 1970s. In 2004, salmon production (sold quantity) totalled 566 000 tonnes.
- Production of trout was about 63 000 tonnes in 2004.
- In 2003, Norwegian production of Atlantic salmon accounted for about half the total global production of this species (1.1 million tonnes). Over 80 per cent of farmed salmon is exported.

Figure 5.11. Consumption of medicines[1] (antibacterial agents) in fish farming. 1982-2004



[1] Based on sales figures from pharmaceutical wholesalers and feed suppliers.
Source: Norwegian Institute of Public Health.

Fish health in salmon farming

- Health problems include viral, bacterial and parasitic diseases, and other problems such as winter ulcers, gill inflammation, heart and skeletal muscle inflammation and deformities.
- The consumption of antibacterial agents was highest in 1987, when it reached 49 tonnes. Consumption in 2004 was 1 159 kg, which is an increase of 350 kg from 2003 and equivalent to between 1 and 2 g per tonne slaughtered fish (see Appendix, table E3).

Box 5.4. More about aquaculture production

In 2003, world aquaculture production of fish, crustaceans, molluscs, etc. totalled almost 42 million tonnes, and freshwater production accounted for 57 per cent of this (see also table 5.1). In addition, 12.5 million tonnes of aquatic plants were produced. China is by far the largest aquaculture producer, accounting for almost 70 per cent of total production (animals and plants) in 2003.

The species farmed in the largest volume was the Pacific oyster (4.4 million tonnes), followed by a number of species of carp. On a list of 28 farmed species of which over 150 000 tonnes were produced in 2003, Atlantic salmon ranked tenth and mussels twentieth. World production of Atlantic salmon in 2003 was more than 1.1 million tonnes.

Although salmon is the dominant species in Norwegian fish farming in terms of both volume and value, there is also increasing interest in several other species. Mussel farming is gaining ground. According to preliminary figures from the Directorate of Fisheries, production in 2004 was 3 100 tonnes. There is a very large potential for the production of mussels in Norwegian waters, both from a biological and environmental point of view and in terms of resources. According to FAO, 472 000 tonnes of mussels were produced on a global basis in 2003.

Production of other fish species than salmon and trout for human consumption is still relatively modest in volume. In 2004, 350 tonnes of farmed Arctic char, 3 170 tonnes of cod and 630 tonnes of halibut were sold in Norway (Statistics Norway 2005b).

According to the Directorate of Fisheries, total losses from sea-water rearing units in 2004 were 27 million fish (25 million salmon and 2.5 million trout). This included 340 000 salmon and 11 000 trout that were reported to have escaped from fish farms. Other losses are attributed to mortality, fish discarded at slaughtering plants and unknown causes.

Box 5.5. Some important diseases and health problems associated with fish farming

This information on the incidence of disease in salmon farming in 2004 is based on figures in *Annual report on the coastal zone and aquaculture 2005* (Boxaspen et al. 2005). Serious diseases include the following:

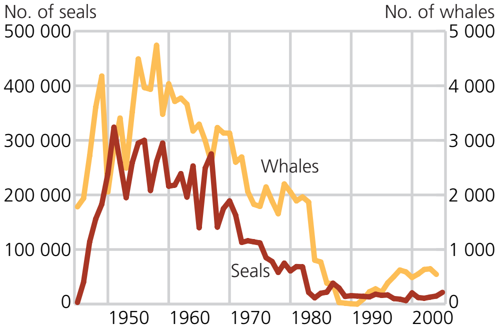
- Furunculosis, caused by the bacterium Aeromonas salmonicida (new cases registered in 2004: 1 salmon farm, 1 case of wild salmon in a river, 1 trout hatchery).
- Bacterial kidney disease (BKD), caused by the bacterium Renibacterium salmoninarum (new cases registered in 2004: 1 fish farm).
- Infectious salmon anaemia (ISA), a virus disease (new cases registered in 2004: 16 fish farms).
- Infectious pancreatic necrosis (IPN), a virus disease (new cases registered in 2004: 172 fish farms).

New diseases have also emerged, such as heart and skeletal muscle inflammation in salmon. This disease was first diagnosed in 1999. In 2004, 54 new cases were diagnosed. This disease appears to be one of the most rapidly increasing problems for the industry. Pancreas disease (PD) attacks the pancreas and the heart and skeletal muscle. The disease seems to be spreading, and was registered at 44 marine localities in 2004, about twice as many as in 2003. It was registered for the first time at fish farms in Troms and Finnmark in 2003, and in Nordland and Rogaland in 2004. Pancreas disease results in mortality, reduced growth and poorer-quality meat, and can cause very high losses for fish farms.

In 2004, 19 rivers were registered as being infected by the parasite *Gyrodactylus salaris*.

5.5. Sealing and whaling

Figure 5.12. Norwegian sealing and whaling[1]. 1945-2005



[1] In the period 1988-1992, scientific whaling only.
Source: Directorate of Fisheries.

- In 2004, the total seal catch was 14 746 animals (9 895 harp seals and 4 851 hooded seals). In 2004 there was no Norwegian sealing in the East Ice. Preliminary figures for 2005 indicate a total catch of 17 711 harp seals (7 205 in the West Ice and 10 506 in the East Ice) and 3 786 hooded seals. The value of the catch in 2004 was NOK 4.3 million.
- The quota for the small whale hunt in 2004 was 670 animals, and the catch was 544 animals. The quota for 2005 was set at 797 animals (basic quota 670 with the addition of the unused part of the quota from 2004). The value of the small whale catch in 2004 was about NOK 21 million.

Box 5.6. Sealing and whaling

Norwegian *sealing* has essentially been based on two species, harp seals and hooded seals, and has taken place in the Newfoundland area (until 1983), the West Ice (off Jan Mayen) and the East Ice (drift ice areas at the entrance to the White Sea). The most recent estimates for stocks of harp seals are 350 000 year-old and older animals in the West Ice and about 1.8 million in the East Ice. The stock of hooded seals in the West Ice numbers about 120 000 animals (Anon. 2005). Since the early 1980s, catches of seals have been small, varying between 10 000 and 40 000 animals per season.

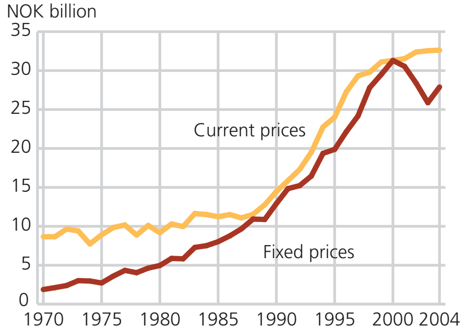
Norwegian catches of *small whales* have consisted mainly of minke whales. The traditional commercial hunt was discontinued after the 1987 season, but was resumed in 1993, when 226 whales were taken.

The *Northeast Atlantic minke whale stock* (which includes animals on the whaling grounds in the North Sea, along the Norwegian coast, in the Barents Sea and off Svalbard) is estimated at 80 500 animals. The most recent estimate for the minke whale stock in the *Jan Mayen area* is 26 700 animals (Anon. 2005).

In 2004, the Norwegian government presented the white paper *Norway's policy on marine mammals* (Report No. 27 (2003-2004) to the Storting). Its purpose was to present a proposal for a new, coherent, active management regime for marine mammals, based on modern principles for the management of species, habitats and ecosystems. It also forms part of Norway's efforts to implement the ecosystem approach to the management of its marine resources.

5.6. Exports

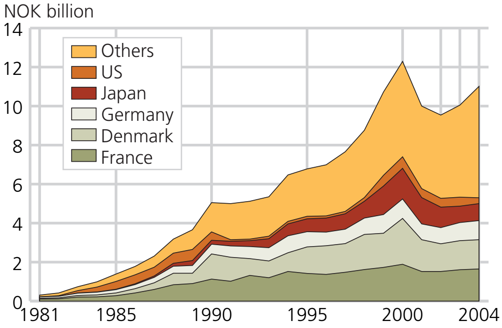
Figure 5.13. Value of Norwegian fish exports. Current and fixed prices (2000 NOK). 1970-2004



Source: National accounts, Statistics Norway.

- In 2004, Norway exported about 2 million tonnes of fish and fish products to a value of NOK 28 billion (see Appendix, tables E4 and E5). Exports to EU countries accounted for 55 per cent of the total.
- According to FAO, Norway was in 2003 the world's third largest exporter of fish in terms of value behind China and Thailand, and ahead of the United States, Canada, Denmark, Spain and Vietnam. The value of Norway's fish exports corresponded to about 6 per cent of the value of total world fish exports (see Appendix, table E7).

Figure 5.14. Exports of salmon[1], by main importing countries. 1981-2004. Current prices



[1] Mostly farmed fish, although other salmon is also included.
Source: External trade statistics, Statistics Norway.

- Salmon exports totalled NOK 11 billion in 2004. This is an increase of NOK 1 billion from 2003 (see Appendix, table E6).
- Denmark and France have for a number of years been the most important importers of Norwegian farmed salmon. Exports to Denmark (NOK 1.5 billion) and France (NOK 1.7 billion) increased moderately from 2003 to 2004.
- China is a new, interesting market for salmon, although the value of exports in 2004 was only NOK 114 million.

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Useful websites

Directorate of Fisheries: http://www.fiskeridir.no/
FAO - UN Food and Agriculture Organization: http://www.fao.org/
Institute of Marine Research: http://www.imr.no/
International Council for the Exploration of the Sea: http://www.ices.dk/
Statistics Norway - Fishery statistics: http://www.ssb.no/english/subjects/10/05/

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Report No. 39 (2004-2005) to the Storting: *Om dei fiskeriavtalane Noreg har inngått med andre land for 2005 og fisket etter avtalane i 2003 og 2004* (Concerning the fisheries agreements Norway has concluded with other countries for 2005 and fishing according to the agreements in 2003 and 2004). Ministry of Fisheries and Coastal Affairs.

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Statistics Norway (2005): Fiskeristatistikk 2002-2003 (Fishery statistics 2002-2003). NOS (Official Statistics of Norway) D 321.

6. Air pollution and climate change

Preliminary calculations show that in 2004, greenhouse gas emissions in Norway were about 11 per cent higher than in 1990, and more than 1 per cent higher than in 2003. The increase in greenhouse gas emissions since 1990 is mainly due to the growth in emissions from oil- and gas-related activities, which rose by 77 per cent in the same period. There was also a 34 per cent increase in emissions from road traffic, which is related to a rise in the level of economic activity.

Norwegian emissions of greenhouse gases, acidifying substances and hazardous substances (heavy metals and persistent organic pollutants) contribute to a number of environmental problems, for example climate change, acidification, depletion of the ozone layer and the formation of ground-level ozone. Some emissions result in local environmental problems, whereas other pollutants are transported in the atmosphere and give problems elsewhere (see boxes 6.2, 6.3, 6.7, 6.8, 6.9, 6.10 and 6.12).

International cooperation is very important as a means of reducing emissions that have regional or global effects. In addition to taking part in international environmental cooperation generally, Norway is party to various multilateral environmental agreements, and is committed to reducing emissions of the most important air pollutants.

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) quantifies the commitments of industrialised countries under the Convention to reduce their greenhouse gas emissions. After it had been ratified by the required number of countries, the Protocol entered into force on 16 February 2005. Of the important industrialised countries, the US and Australia have not ratified the Protocol. Under the Protocol, each industrialised country has an assigned amount of emissions for the period 2008-2012 and undertakes to reduce or limit emissions to achieve this. The assigned amount is defined as a percentage of the country's greenhouse gas emissions in 1990, and varies from 92 to 110 per cent of emissions in 1990. According to the Protocol, Norwegian greenhouse gas emissions may be a maximum of 1 per cent higher than the 1990 level in the period 2008-2012 after emissions trading and other mechanisms for reducing emissions have been taken into account (see box 6.5).

There are eight protocols under the Convention on Long-Range Transboundary Air Pollution. One of them is the Gothenburg Protocol, which is intended to reduce acidification, eutrophication and the formation of ground-level ozone by introducing emission ceilings for sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3) and NMVOCs (non-methane volatile organic compounds). The Sofia Protocol laid down emission targets for NO_x and was a forerunner of the Gothenburg Protocol. Norway has also undertaken to reduce its emissions of certain other substances under the LRTAP Convention. Under the Protocol on Heavy Metals, Norway is committed to reducing its emissions of lead, cadmium and mercury, and under the Protocol on Persistent Organic Pollutants (POPs), is committed to reducing emissions of various substances including polycyclic aromatic hydrocarbons (PAHs) and dioxins.

The Norwegian emission inventory (see box 6.1) makes it possible to identify the major sources of each pollutant and to follow emission trends over time. This information is important when considering which measures to implement and evaluating their effects.

Box 6.1. The Norwegian emission inventory

Norway's emission inventory is produced by Statistics Norway and the Norwegian Pollution Control Authority. The inventory includes all the most important pollutants that cause environmental problems such as climate change, acidification and the formation of ground-level ozone, and also includes a number of hazardous substances. The inventory covers only anthropogenic emissions, not natural emissions for example from oceans and forests. The Norwegian Pollution Control Authority and the Ministry of the Environment are responsible for reporting Norway's figures for emissions to air under multilateral environmental agreements such as the Kyoto Protocol. Figures from the emission inventory produced by Statistics Norway and the Norwegian Pollution Control Authority are used in such reports.

Emission figures are compiled partly from data reported by industrial plants, based on measurements or calculations at these plants, and partly from calculations using activity data and emission factors (see Appendix tables F8 and F9). Activity data may include consumption of energy commodities (e.g. fuel oil consumption by manufacturing industries and households) or other data such as the number of sheep put out to pasture, the quantity of waste landfilled, the quantity of ferro-alloys manufactured, etc.

In 2005, national emission figures for 2004 are being published. These are preliminary figures based on last year's calculations, in addition to emission figures reported by large enterprises and the activity data available now. Experience shows that these emission figures are good estimates for most pollutants at national level.

The 2003 figures are also considered to be preliminary figures. This is because auditing of the energy accounts, which are a very important source of data for the emission inventory, takes about eighteen months to complete. However, we would normally only expect minor adjustments between the preliminary figures for 2003, which are being published now, and the final figures, which will be published in 2006.

Emission figures are presented in a series of tables, for example showing emissions by source (see appendix, table F5) or by sector (see appendix, table F4). Most of the figures in this chapter are based on aggregated figures for emissions by source. Time series for the national emission figures and emissions split by source, sector, county and municipality are also available on Statistics Norway's website at: http://www.ssb.no/english/subjects/01/04/10/

For documentation of the emission inventory, see Hoem, B.: *The Norwegian Emission Inventory*. Documentation of methodologies for estimating emissions of greenhouse gases and long-range transboundary air pollutants. Reports 2005/28, Statistics Norway.

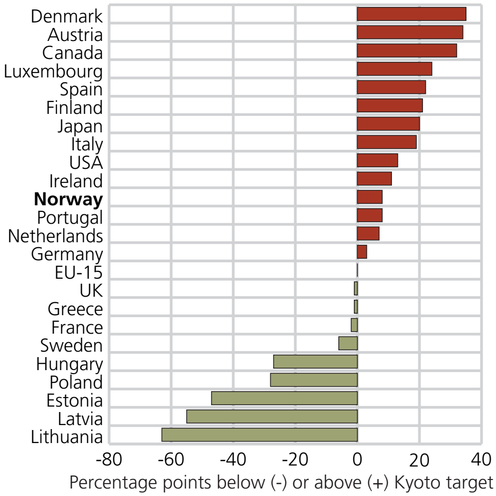
Box 6.2. Environmental problems caused by air pollution

Enhanced greenhouse effect	As a result of the natural greenhouse effect, the global mean temperature is about 15 °C instead of -18 °C. But anthropogenic emissions of gases such as CO_2, CH_4, N_2O and fluorinated gases can cause further warming. Since 1750, concentrations of the three most important greenhouse gases, CO_2, CH_4 and N_2O, have risen by 31, 151 and 17 per cent respectively (IPCC 2001). Norway's total greenhouse gas emissions are shown in figure 6.2.
Climate change	Anthropogenic emissions of greenhouse gases, SO_2 and particulate matter can alter the natural chemical composition of the atmosphere. This in turn may accelerate changes in the global climate system. It is difficult to quantify what proportion of climate fluctuations is a result of human activity. However, the evidence that most of the global warming that has been observed in the last 50 years is anthropogenic has become stronger (IPCC 2001). Variations in global mean temperature are shown in Chapter 1.
Ozone depletion	The atmospheric ozone layer is found in the stratosphere, 10-40 km above the earth, and prevents harmful ultra-violet (UV) radiation from the sun from reaching the surface of the earth. Episodes when the ozone content of the stratosphere is very low and the levels of UV radiation reaching the earth are high have been observed above Antarctica. Observations have also shown that the ozone content of the stratosphere above middle and northern latitudes has dropped. The causes of ozone depletion include anthropogenic emissions of CFCs, HCFCs, halons and other gases containing chlorine and bromine, all of which can break down ozone in the presence of sunlight. Depletion of the ozone layer increases the amount of UV radiation reaching the earth, and may result in a higher incidence of skin cancer, eye injury and damage to the immune system. In addition, plant growth both on land and in the sea (algae) may be reduced (SSB/SFT/DN 1994). For imports of ozone-depleting substances to Norway, see figure 6.14.
Ground-level ozone	Ozone in the lower atmosphere is a pollution problem because it has adverse effects on health, vegetation and materials. Ground-level ozone is formed by oxidation of CH_4, CO, NO_x and NMVOCs in the presence of sunlight. It may also be transported to Norway from other parts of Europe. In Scandinavia the background level varies between 40 and 80 µg/m^3 and is generally highest in spring. The number of pollution episodes[1] was higher in 2004 (15) than in 2003 (13). The highest hourly mean concentration in 2004 was 150 µg/m^3 (Norwegian Institute for Air Research 2005). The Norwegian Pollution Control Authority's air quality criterion for health (80 µg/m^3, 8-hour mean) was frequently exceeded at all measuring stations, but WHO's air quality criterion of 120 µg/m^3 was only occasionally exceeded.
Acidification	Total emissions of SO_2 and NO_x are lower in Norway than in most other European countries. Sulphur and nitrogen compounds acidify soils and water, and are also transported for considerable distances with air currents. The extent of the damage depends on the type of soil and vegetation. Lime-rich soil can for example withstand acidification better than other soil types because it weathers to release calcium. Many parts of Norway have lime-poor soils and sensitive vegetation, and the impact of acid rain is greater than in many other areas where deposition of acid components is higher. Fresh-water organisms have suffered the most serious damage, and the effects have been observed particularly in Southern Norway, the southern parts of Western Norway, and Eastern Norway. Sør-Varanger municipality in Finnmark suffers the effects of acid rain from sources in Russia. Acid rain increases leaching of nutrients and metals (especially aluminium) from soils and can cause corrosion damage to buildings. For deposition of sulphur and nitrogen compounds in Norway, see section 6.2.

[1] Number of days when one measuring station records a maximum hourly mean concentration of 200 µg per m^3 or several measuring stations record an hourly mean concentration of more than 120 µg per m^3 .

6.1. Greenhouse gases

Figure 6.1. "Distance-to-target" for greenhouse gas[1] emissions in 2003 (deviation of actual emissions from Kyoto[2,3] targets)

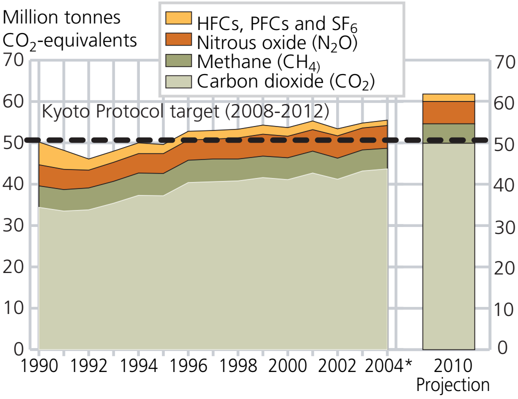


[1] Under the Kyoto Protocol, the base year for emissions of CO_2, N_2O and CH_4 is 1990. Some countries have chosen to use 1995 as the base year for fluorinated gases.
[2] The USA has not ratified the Kyoto Protocol.
[3] The figure is based on data from autumn 2005. More recent data are now available (January 2006).
Source: UNFCCC and EEA (2005).

Greenhouse gas emissions in other countries

- Aggregate greenhouse gas emissions from the 15 "old" EU states increased by 1.3 per cent from 2002 to 2003 (EEA 2005). The EU member states must reduce their overall emissions by 8 per cent by 2008-2012 compared with the 1990 level to meet their Kyoto commitments. The EU has adopted a burden-sharing agreement to divide this overall reduction among the member states.
- Germany is the EU state with the highest greenhouse gas emissions. In 2003, its emissions totalled 1 018 million tonnes CO_2 equivalents, a reduction of 19 per cent since 1990. Under the EU burden-sharing agreement, Germany has undertaken to reduce its greenhouse gas emissions by 21 per cent compared with the 1990 level.
- Greenhouse gas emissions in Spain, Ireland and the USA have risen by 41, 25 and 13 per cent respectively in the period 1990-2003. According to the EU burden-sharing agreement, emissions in Spain and Ireland may rise by 15 and 13 per cent respectively compared with the 1990 level.

Figure 6.2. Total emissions of greenhouse gases in Norway. 1990-2004*. Projected emissions in 2010.



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority and Report No. 21 (2004-2005) to the Storting.

Aggregate greenhouse gas emissions in Norway

- Greenhouse gas emissions in Norway rose by 1 per cent from 2003 to 2004. The overall rise since 1990, the base year for the Kyoto Protocol, is almost 11 per cent. Emissions totalled 55.5 million tonnes CO_2 equivalents in 2004.
- The increase in emissions from 1990 to 2004 is mainly due to the growth in emissions from oil- and gas-related activities, which rose by 77 per cent in the same period. There was also a 34 per cent increase in emissions from road traffic, which is related to a rise in the level of economic activity.
- In 2004, CO_2 accounted for almost 80 per cent of Norway's greenhouse gas emissions. The rise in emissions has also been greater for CO_2 than for other greenhouse gases. Emissions of fluorinated gases have dropped sharply since 1990.
- It is estimated that emissions will continue to rise and reach 61.8 million tonnes CO_2 equivalents in 2010 unless new climate-related measures are introduced. Projections indicate that the petroleum and transport sectors will account for a substantial proportion of the rise in emissions up to 2010 (Report No. 21 (2004-2005) to the Storting).

Box 6.3. Greenhouse gases. Sources and harmful effects

Substance	Important sources[1]	Effects
Carbon dioxide (CO_2)	Combustion of fossil fuels, changes in land use and deforestation	Enhances the greenhouse effect.
Chlorofluorocarbons (CFCs)	Cooling fluids	Enhance the greenhouse effect and deplete the ozone layer.
Hydrofluorocarbons (HFCs)	Cooling fluids	Enhance the greenhouse effect.
Hydrochlorofluorocarbons (HCFCs)[2]	Cooling fluids	Enhance the greenhouse effect and deplete the ozone layer.
Methane (CH_4)	Agriculture, landfills, production, transport and use of fossil fuels	Enhances the greenhouse effect and contributes to formation of ground-level ozone.
Nitrous oxide (N_2O)	Agriculture, fertiliser production	Enhances the greenhouse effect.
Perfluorocarbons (PFCs; CF_4 and C_2F_6)	Aluminium production	Enhance the greenhouse effect.
Sulphur hexafluoride (SF_6)	Magnesium production	Enhances the greenhouse effect.

[1] The table indicates important anthropogenic sources. There are also important natural sources for several of these substances.
[2] Not included in the national greenhouse gas inventory or in the Kyoto Protocol.

Box 6.4. Greenhouse gases and global warming potential

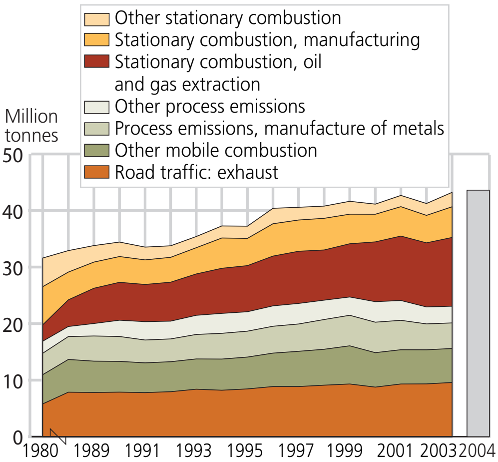
The three most important greenhouse gases are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Anthropogenic emissions of CO_2 are mainly associated with the combustion of fossil fuels, but are also generated by various chemical processes in manufacturing industries. Methane is formed mainly by decomposition of biological waste in landfills and by livestock (agriculture). Manure and the use and production of commercial fertilisers are the main sources of N_2O emissions in Norway.

The GWP value (Global Warming Potential) of a gas is defined as the cumulative impact on the greenhouse effect of 1 tonne of the gas compared with that of 1 tonne of CO_2 over a specified period of time. GWP values are used to convert emissions of greenhouse gases to CO_2 equivalents. The list below shows GWP values for the greenhouse gases to which the Kyoto Protocol applies. The time horizon used here is 100 years.

Substance:	**GWP value:**
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
Hydrofluorocarbons (HFCs)	
HFC-23	11 700
HFC-32	650
HFC-125	2 800
HFC-134a	1 300
HFC-143a	3 800
HFC-152a	140
HFC-227	2 900
Perfluorocarbons (PFCs)	
CF_4 (PFC-14)	6 500
C_2F_6 (PFC-116)	9 200
C_3F_8 (PFC-218)	7 000
Sulphur hexafluoride (SF_6)	23 900

The Kyoto Protocol sets out binding targets for greenhouse gas emissions by industrialised countries. The Protocol applies to the greenhouse gases CO_2, CH_4 and N_2O, sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Figure 6.3. Emissions of CO_2 by source. 1980-2004*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Carbon dioxide (CO_2)

- In 2004, CO_2 emissions totalled 43.6 million tonnes: this is a rise of 1 per cent from the year before. The overall rise since 1990 is 27 per cent.
- The most important sources of CO_2 emissions are oil and gas extraction and road traffic, which accounted for 28 and 22 per cent respectively of the total. Process emissions from metal production accounted for 11 per cent of emissions in 2003.
- In 2004, CO_2 accounted for almost 80 per cent of Norway's aggregate greenhouse gas emissions.

Box 6.5. The Kyoto Protocol and the Kyoto mechanisms

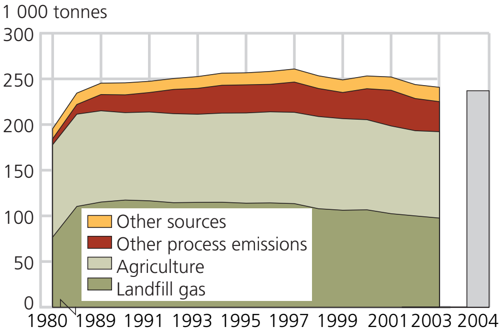
The Kyoto Protocol sets a ceiling for greenhouse gas emissions from industrialised countries for the period 2008-2012. Emissions from developing countries are not limited in this period, but negotiations on commitments for the period after 2012 are to start by 2005 at the latest. The protocol entered into force on 16 February 2005.

Emissions trading
Countries that have undertaken commitments under the Protocol may trade emission units among themselves. A country that can reduce emissions to below the target set out in the Protocol at relatively low cost may sell units to countries where the cost of achieving the target is relatively high. Countries that sell units must reduce their emissions *more* than the Protocol requires, and purchasing countries can reduce them *less*.

Joint implementation
Two countries that have undertaken commitments to reduce emissions may agree that reductions financed by one country and carried out in the other are to be credited to the investor's emission inventory. Since the cost of reducing emissions varies widely between countries, this is a more cost-effective solution than requiring all countries to carry out emission reductions within their own borders.

The clean development mechanism (CDM)
Similar to joint implementation, but CDM is applicable in cases where one party has undertaken a commitment to reduce emissions and the other has not.

Figure 6.4. Emissions of CH_4 by source. 1980-2004*

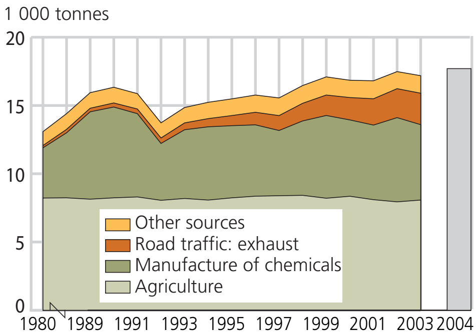


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Methane (CH_4)

- In 2004, CH_4 emissions totalled 237 000 tonnes, which is the same level as the year before. There has been a 3.5 per cent decrease in emissions since 1990.
- The most important sources of CH_4 emissions are landfills and agriculture (livestock and manure), which account for 41 and 39 per cent of Norwegian emissions, respectively.
- The model used to calculate emissions of methane from landfills was improved in 2004. As a result, the estimated level of emissions from this source has been cut by almost 50 per cent (see box 6.6).
- In 2004, CH_4 accounted for 9 per cent of Norway's aggregate greenhouse gas emissions.

Figure 6.5. Emissions of N_2O by source. 1980-2004*

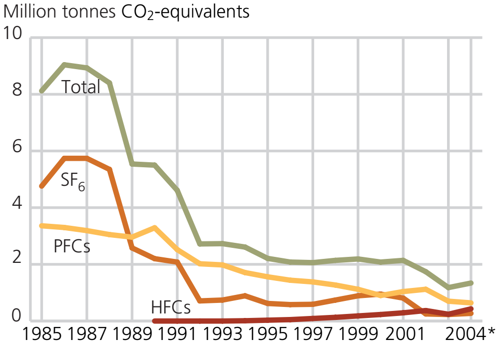


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Nitrous oxide (N_2O)

- In 2004, N_2O emissions totalled 17 700 tonnes, which is an increase of 3 per cent from 2003.
- The most important sources of N_2O emissions are agriculture, the manufacture of commercial fertiliser and road traffic. The marked drop in emissions from 1991 to 1992 reflects a cut in emissions from fertiliser manufacturing as a result of technological improvements.
- Emissions from road traffic continued to rise in 2004 because nitrous oxide emissions are higher from cars with catalytic converters than from those without, and because of the growing volume of traffic, particularly diesel vehicles.
- In 2004, N_2O accounted for 10 per cent of Norway's aggregate greenhouse gas emissions.

Figure 6.6. Total emissions of other greenhouse gases (HFCs, PFCs and SF_6). 1985-2004*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Other greenhouse gases

- The most important sources of SF_6 and PFC emissions are the process industry (magnesium and aluminium production). The most important source of HFC emissions is leakages from cooling equipment.
- In 2004, emissions of sulphur hexafluoride (SF_6) totalled 11 tonnes, which is a rise of 16 per cent from the year before. In 2002, emissions of SF_6 were reduced by two thirds as a result of discontinuation of primary production of magnesium.
- Emissions of perfluorocarbons (PFCs) dropped by 9 per cent from 2003 to 2004, to 97 tonnes. Emissions of hydrofluorocarbons (HFCs) increased by over 60 per cent in the same period and totalled 206 tonnes in 2004. However, it should be noted that the low level of emissions in 2003 may be the result of a deliberate increase in stocks before the introduction of a tax on PFCs in 2003.
- Measured in CO_2 equivalents, these pollutants together accounted for 2 per cent of Norway's aggregate greenhouse gas emissions in 2004.

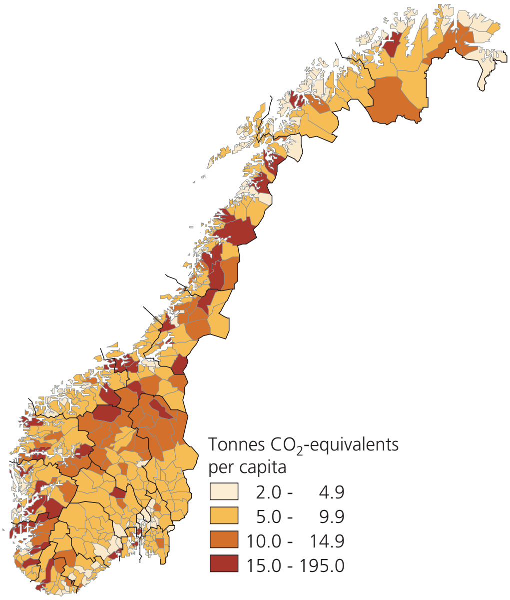
Box 6.6. Methane emissions from landfills

In 2004, the Norwegian Pollution Control Authority and Statistics Norway reviewed the calculations of greenhouse gas emissions from Norwegian landfills. The figures are calculated using a satellite model that forms part of the national emission model used to produce figures for reporting to the UN Framework Convention on Climate Change and the Kyoto Protocol.

The satellite model has been improved in a number of ways, including changes in the underlying assumptions on the composition of the landfill gas formed and the proportion of the waste that is biodegradable. The estimate for methane emissions from landfills in 2002 using the new model was 46 per cent lower than that previously calculated.

The new model is documented in the report *«Methane emissions from solid waste disposal sites»* (Norwegian Pollution Control Authority 2005).

Figure 6.7. Per capita emissions of CO_2 equivalents by municipality. 2003

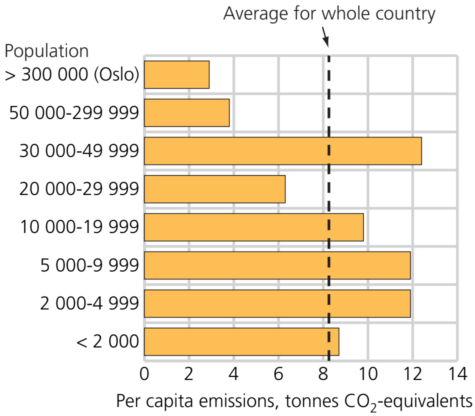


Map data: Norwegian Mapping Authority.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Greenhouse gas emissions at local level

- CO_2 is the most important greenhouse gas in all counties.
- Manufacturing, road traffic, agriculture and landfills are the largest sources of greenhouse gas emissions in most municipalities.
- Total emissions of the three most important greenhouse gases, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), have risen by on average 4 per cent in Norwegian municipalities from 2002 to 2003. Most of the overall rise in emissions is explained by increased use of oil products for heating and other purposes.
- About 40 per cent of Norway's CO_2 emissions take place at sea and in Norwegian airspace, and are generated mainly by the oil and gas industry, shipping and air traffic.

Figure 6.8. Average per capita greenhouse gas emissions in Norway, from municipalities grouped by population size. 2003. Tonnes CO_2 equivalents

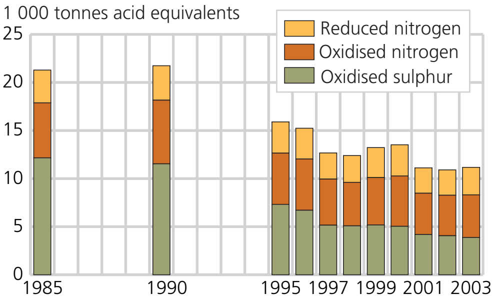


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

- Per capita greenhouse gas emissions average 3.5 tonnes in the 12 municipalities with a population of more than 50 000 (including Oslo), and 12.4 tonnes CO_2 equivalents in municipalities with a population of 30 000-50 000. Per capita emissions for mainland Norway as a whole average 8.1 tonnes CO_2 equivalents.
- There are several reasons why per capita emissions are below average in the municipalities with the highest population. CO_2 emissions from the process industry are high in Norway, and most plants in this sector are located outside the largest towns. There is little room for agriculture in the largest urban areas, so that major sources of methane and nitrous oxide emissions are more or less absent.
- Landfills generate substantial emissions in many municipalities. In several of the largest towns, however, most waste is incinerated, thus generating considerably lower greenhouse gas emissions. In a city like Oslo, car use is much lower than the average for Norway. This is partly because distances are shorter and public transport is better than in municipalities with a smaller population. In addition, there is less need for heating in densely built-up areas, which results in lower emissions.

6.2. Acidification

Figure 6.9. Deposition of acidifying substances in Norway. 1985-2003



Source: Norwegian Meteorological Institute and EMEP.

Deposition of acidifying substances in Norway

- Acidification of the Norwegian environment is being reduced. Sulphur emissions have been cut elsewhere in Europe, thus reducing the deposition of pollutants over Norway. Reductions in nitrogen emissions have been much smaller, so that the relative importance of nitrogen deposition is increasing.
- Although total deposition has been reduced, critical loads are still being exceeded in large parts of the southern half of Norway.
- Emissions from Norway are largely deposited in Norway or over the sea (EMEP/MSC-W 2005). A certain proportion of the Norwegian emissions is also deposited in Sweden.
- The UK and Germany are the countries outside Norway that make the largest contributions to the total deposition of acidifying substances in Norway.

Table 6.1. Emissions and emission targets under the Gothenburg Protocol for SO_2 and NO_x. 1000 tonnes

	SO_2			NO_X		
	Emissions		Target	Emissions		Target
Country:	1990	2003	2010	1990	2003	2010
UK	3 711	979	625	2 828	1 578	1 181
Germany	5 326	616	550	2 845	1 428	1 081
Russia[1]	4 671	2 130[2]	2 343	3 600	2 566[2]	2 653
Sweden	112	52	67	315	206	148
Denmark	177	31	50	283	209	127
Norway	52	23	22	224	220	156

[1] The figures apply to the European part, within the EMEP area.
[2] Emissions in 2002.
Source: EMEP (2005) and UN/ECE (1999).

Box 6.7. Acidifying substances. Sources and harmful effects

Substance	Important sources[1]	Effects
Ammonia (NH_3)	Agriculture	Contributes to acidification of water and soils.
Nitrogen oxides (NO_x)	Combustion (industry, road traffic)	Increase the risk of respiratory disease (particularly NO_2). Contribute to acidification, corrosion and formation of ground-level ozone.
Sulphur dioxide (SO_2)	Combustion, metal production	Increases the risk of respiratory complaints. Acidifies soil and water and causes corrosion.

[1] The table indicates important anthropogenic sources.

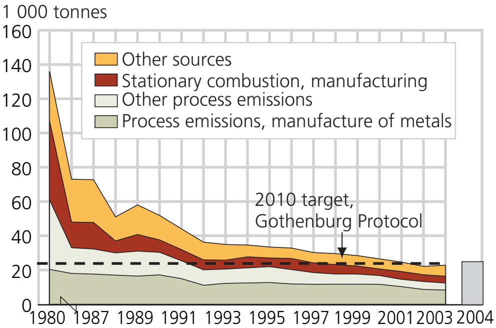
Box 6.8. Acidification: a brief explanation of causes and effects

The term acid rain means inputs of pollutants that have acidifying effects in the environment with rain and snow. Such pollutants can also be deposited directly in the form of gases or particles (dry deposition), and direct deposition is normally also included in the definition of acid rain. Acid rain is caused mainly by emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x) from the combustion of fossil fuels. In addition, ammonia and ammonium ions (NH_x) contribute to acidification through various chemical processes that take place in soil and water. Air pollutants are often transported for long distances, for example from central Europe or Britain, before ending up as acid rain in Norway. Most of the deposition of acidifying substances in Norway originates from emissions in other countries.

Acid rain has had serious impacts on life in rivers and lakes: for example, formerly abundant fish stocks have been lost from river systems across large parts of the southern half of Norway. Acidification of soils results in leaching of nutrients and metals. In addition to its impact on the flora and fauna, acid rain results in corrosion damage to buildings and cultural monuments.

There has been little change in emissions of nitrogen compounds. The problems related to emissions of these compounds are more complicated than for sulphur, because nitrogen has a fertilising effect and can therefore result in changes in the species composition of the vegetation. Species that can make use of an extra nitrogen supply benefit at the expense of other species. Nitrogen has an acidifying effect if inputs are larger than the amount the vegetation can absorb.

Figure 6.10. Emissions of SO_2 by source. 1980-2004*

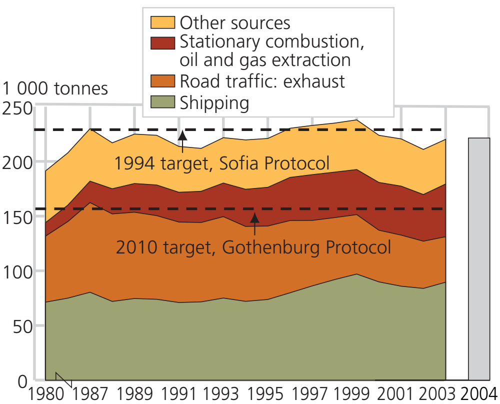


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Sulphur dioxide (SO_2)

- After decreasing steadily for almost 20 years, SO_2 emissions are now rising again, and increased by 10 per cent in 2004 to 25 190 tonnes. Nevertheless, SO_2 emissions have been reduced by 52 per cent since 1990.
- The rise in 2004 is mainly explained by higher emissions from iron, steel and ferro-alloy manufacturing and carbide manufacturing. Industrial emissions account for the largest proportion of Norway's SO_2 emissions, with shipping in second place. Domestic shipping and fishing vessels accounted for 16 per cent of total emissions in 2004.
- The Gothenburg Protocol entered into force on 17 May 2005. Under this agreement, Norway has undertaken to reduce its annual SO_2 emissions to 22 000 tonnes by 2010, about 13 per cent below the current level.

Figure 6.11. Emissions of NO_x by source. 1980-2004*

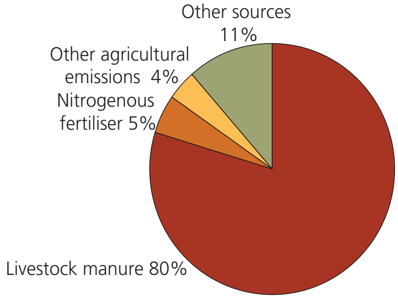


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Nitrogen oxides (NO_x)

- In 2004, NO_x emissions totalled 221 400 tonnes, which is about the same level as the year before.
- The largest sources of NO_x emissions are shipping (41 per cent), road traffic (19 per cent) and stationary combustion in the oil and gas industry (22 per cent).
- Total emissions must be reduced to 156 000 tonnes if Norway is to meet its commitment under the Gothenburg Protocol. This means a reduction of 30 per cent by 2010.

Figure 6.12. Emissions of ammonia by source. 2003*. Per cent

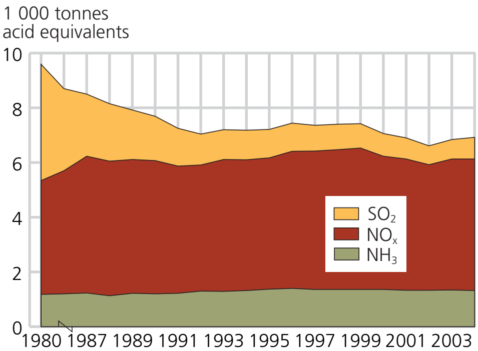


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Ammonia (NH_3)

- In 2004, NH_3 emissions were almost unchanged from the year before at 22 500 tonnes. Under the Gothenburg Protocol, Norway has undertaken to meet an emission ceiling of 23 000 tonnes NH_3 in 2010.
- Agriculture generated 89 per cent of Norwegian emissions of ammonia in 2003. The main sources of ammonia emissions are livestock, the use of commercial fertiliser and treatment of straw with ammonia. The distribution of emissions by source has remained largely unchanged since the 1980s.

Figure 6.13. Emissions of acidifying substances in Norway. 1980-2004*



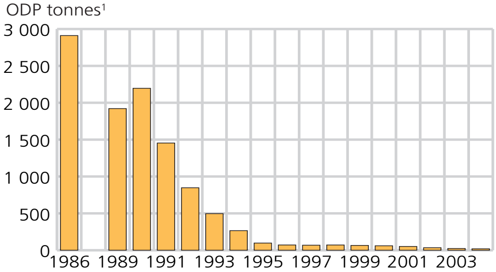
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Aggregate emissions of acidifying substances

- In 2004, Norway's aggregate emissions of acidifying substances, expressed as acid equivalents, amounted to 6 920 tonnes. NO_X accounts for 70 per cent of the total.
- The level of emissions expressed as acid equivalents has increased by just over 1 per cent since 2003.
- The dispersal potential of SO_2 and NO_X emissions is greater than that of NH_3 emissions.

6.3. Depletion of the ozone layer

Figure 6.14. Imports of ozone-depleting substances to Norway. 1986-2004



[1] The ozone-depleting potential (ODP) varies from one substance to another, and the figures are totals weighted according to the ODP of each substance (ODP factors).
Source: Norwegian Pollution Control Authority.

- Norway imported a total of 19 ODP tonnes ozone-depleting substances in 2004. This is a drop of 17 per cent since 2003.
- Various HCFCs still dominate imports of ozone-depleting substances to Norway, and accounted for 92 per cent of the total (expressed as ODP tonnes) in 2004.
- It has been calculated that the thickness of the ozone layer above Oslo has been reduced by an average of 0.21 per cent per year since 1979 (Norwegian Institute for Air Research 2004).

Box 6.9. The ozone layer and ozone-depleting substances

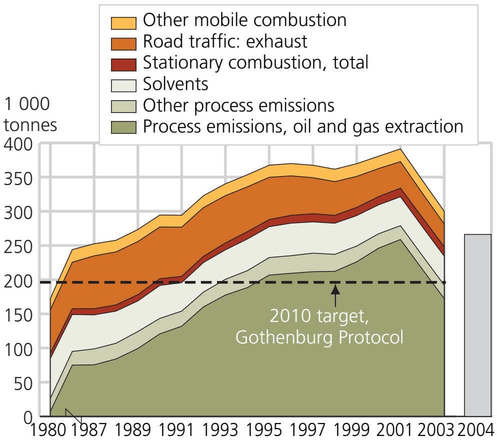
Substances that deplete the ozone layer include hydrochlorofluorocarbons (HCFCs), chlorofluorocarbons (CFCs) and other gases containing chlorine and bromine. Such gases have been used as cooling agents, propellants in aerosols and in the production of foam plastic. In new products, they are being replaced with hydrofluorocarbons (HFCs), which are greenhouse gases, but not ozone-depleting.

In accordance with the Montreal Protocol, the consumption of ozone-depleting substances in Norway has dropped steeply since the mid-1980s. Emissions take place largely during use of equipment containing these gases, not during production, and only small amounts are collected and destroyed. In accordance with the revised Montreal Protocol, Norway has eliminated imports of newly-produced halons, and there is a general prohibition against imports of CFCs (small quantities of CFCs are imported for necessary purposes such as laboratory analyses). In addition, Norway has undertaken to keep to a timetable for reductions in consumption or prohibitions against the use of several other substances that deplete the ozone layer.

The largest decreases in ozone concentrations have been observed over Antarctica. An annual cycle of significant ozone reduction occurs from September to November. In this so-called ozone hole, up to 60 per cent of the total ozone is lost. After a couple of months, new ozone is produced from oxygen under the influence of solar UV radiation, and the ozone layer regenerates until the next cycle starts. This phenomenon was first registered in the 1980s (Norwegian Pollution Control Authority 2004).

6.4. Formation of ground-level ozone

Figure 6.15. Emissions of NMVOCs by source. 1980-2004*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

NMVOCs

- In 2004, Norway's NMVOC emissions totalled 266 200 tonnes, which corresponds to a reduction of 11 per cent from 2003 and more than 30 per cent from 2001, when these emissions were at their highest level.
- This reduction is mainly a result of measures to reduce emissions during loading and storage of crude oil offshore. Emissions in 2004 were also reduced by recovery of oil vapour at onshore loading facilities, lower sales of petrol and an increase in the number of cars fitted with catalytic converters.
- Under the Gothenburg Protocol, Norway has undertaken to meet an emission ceiling of 195 000 tonnes NMVOCs in 2010, which corresponds to a reduction of about 27 per cent from the current level.

Box 6.10. Ground-level ozone and emissions that contribute to its formation. Sources and harmful effects

Substance	Important sources[1]	Effects
Carbon monoxide (CO)	Combustion (fuelwood, road traffic)	Increases risk of heart problems in people with cardiovascular diseases and contributes to formation of ground-level ozone.
Ground-level ozone (O_3)	Formed by oxidation of CH_4, CO, NO_x and NMVOCs (in sunlight)	Increases the risk of respiratory complaints and damages vegetation.
Methane (CH_4)	Agriculture, landfills, production, transport and use of fossil fuels	Enhances the greenhouse effect and contributes to formation of ground-level ozone.
Nitrogen oxides (NO_x)	Combustion (industry, road traffic)	Increase the risk of respiratory disease (particularly NO_2). Contribute to acidification, corrosion and formation of ground-level ozone.
Non-methane volatile organic compounds (NMVOCs)	Oil and gas industry, road traffic, solvents	May include carcinogenic substances. Contribute to formation of ground-level ozone.

[1] The table indicates important anthropogenic sources.

Box 6.11. Ozone precursors

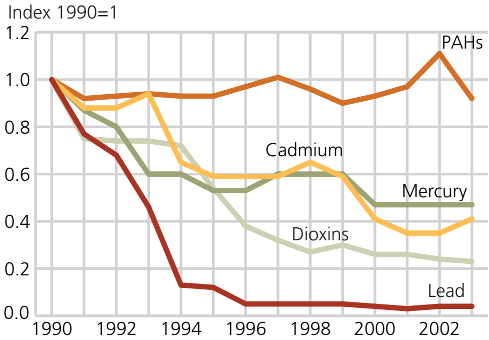
Ground-level or tropospheric ozone is formed by the oxidation of CH_4, CO, NO_X and NMVOCs in the presence of sunlight. A weighting factor is defined for each of these precursors according to how much ground-level ozone it forms during a specific period of time. These are known as TOFP (Tropospheric Ozone-Forming Potential) factors, and NMVOCs are used as the reference component.

Substance:	TOFP factor (de Leeuw 2002):
NO_X	1.22
NMVOCs	1
CO	0.11
CH_4	0.014

Aggregating Norwegian emissions of these gases, weighted with the appropriate factors, we find that total TOFP emissions have dropped by 11 per cent in the period 1990-2004.

6.5. Hazardous substances

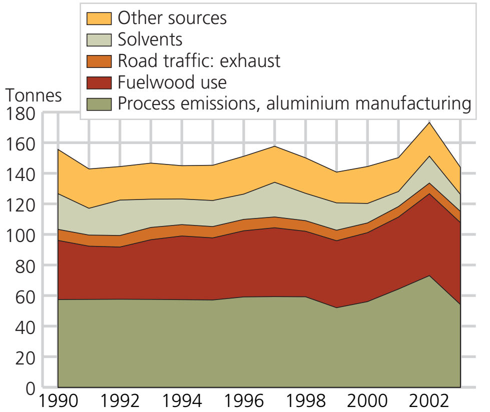
Figure 6.16. Changes in emissions of lead, cadmium, mercury, total PAH and dioxins in Norway. Index 1990=1. 1990-2003*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

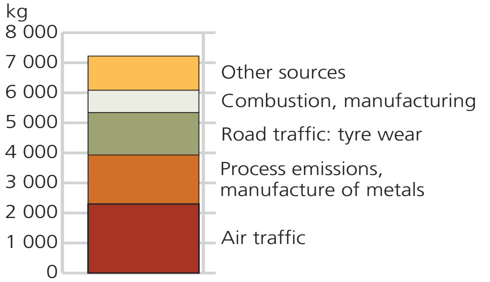
- Emissions of hazardous substances (heavy metals and several persistent organic pollutants) to air were substantially lower in 2003 than in 1990. The main reasons for this are the installation of equipment to control emissions and improvements in its operation, and the closure of plants in the chemical and metallurgical industry. Emissions from waste incineration have also been greatly reduced as a result of stricter emissions standards and the installation of equipment to control emissions.

Figure 6.17. Emissions of total PAH to air by source. 1990-2003*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Figure 6.18. Emissions of lead to air by source. 2003*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

PAHs

- In 2003, Norway's emissions of "total PAH" were 144 tonnes (PAH-4, which is the component regulated by the POPs Protocol under the LRTAP Convention, accounted for 13.8 tonnes of this). PAH emissions have decreased by 17 per cent from 2002 to 2003.
- The largest sources of PAH emissions are fuelwood use in households and process emissions from aluminium production. These two sources accounted for 37 and 38 per cent respectively of the total in 2003. Process emissions accounted for 59 per cent of total PAH-4 emissions.
- In 2002, there was an accidental release of PAHs in connection with upgrading to a cleaner process at one aluminium plant, which resulted in unusually high emissions. This is the main explanation for the drop in PAH emissions from 2002 to 2003.

Lead (Pb)

- Lead emissions were reduced by 96 per cent in the period 1990 to 2003. This was mainly a result of the changeover to unleaded petrol. Emissions in 2003 totalled 7.2 tonnes.
- Leaded petrol is still used in light aircraft, which are now the most important source of emissions. A reduction in sales of aviation fuel is the main explanation for the 5 per cent reduction in total emissions from 2002 to 2003.
- Domestic air transport generates 32 per cent of total lead emissions.
- Tyre wear was included in the emission inventory for the first time in 2003 (see box 6.13). This source accounted for 20 per cent of lead emissions, so that the level of lead emissions has been adjusted upwards from previous estimates.

Box 6.12. Harmful effects and sources of emissions for heavy metals, particulate matter, benzene and PAHs

Substance	Important sources[1]	Effects
Arsenic (As)	Chemical industry, pulp and paper industry, metal production and road traffic	Inorganic arsenic compounds (arsenates) very toxic to most organisms (acute and chronic effects), carcinogenic even at low concentrations. Organic compounds are much less toxic.
Benzene (C_6H_6)	Combustion and evaporation of petrol and diesel, fuelwood use	Carcinogenic, toxic effects on acute exposure to high concentrations.
Cadmium (Cd)	Pulp and paper industry, mineral production, metal production, fuelwood use	Liable to bioaccumulate. Delayed effects such as pulmonary emphysema, cancer, reduced fertility in men and kidney damage.
Copper (Cu)	Road traffic and process industry	Liable to bioaccumulate. Some copper compounds are acutely toxic or irritant in mammals.
Chromium (Cr)	Ferro-alloy industry and combustion in industry	Liable to bioaccumulate. Hexavalent compounds (Cr^{6+}) are carcinogenic and sensitising. May cause kidney and liver damage
Dioxins	Metal production, pulp and paper industry, fuelwood use, shipping and waste incineration	Become concentrated in organisms and food chains. Carcinogenic.
Lead (Pb)	Air traffic, waste incineration, mineral production	Environmentally hazardous. No damage to health at concentrations currently found in air in Norway, but because lead accumulates in living organisms, formerly high emissions still constitute a health hazard.
Mercury (Hg)	Pulp and paper industry, mineral production, metal production, fuelwood use, crematoria	Becomes concentrated in organisms and food chains Causes kidney damage and harms nervous system. May cause cellular changes.
Particulate matter ($PM_{2,5}$ and PM_{10})[2]	Road traffic and fuelwood use	Increase the risk of respiratory complaints.
Polycyclic aromatic hydrocarbons (PAHs)	All incomplete combustion of organic material and fossil fuels, solvents, aluminium production	Several are carcinogenic

[1] The table indicates important anthropogenic sources.
[2] $PM_{2,5}$; particles measuring less than 2.5 µm in diameter: PM_{10}; particles measuring less than 10 µm in diameter.

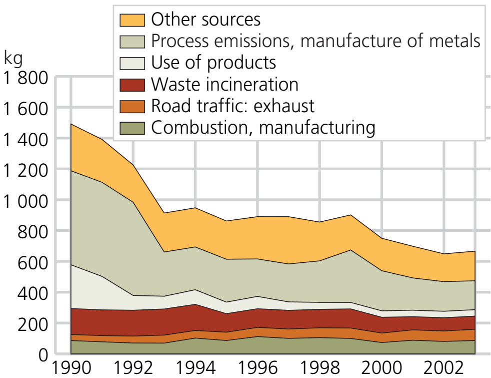
Box 6.13. New information on emission sources

According to the international guidelines for emissions reporting, emissions must be recalculated if new information is obtained on emission factors or if calculation methods are improved, for example if new emission sources are included in the inventory. If recalculations are made, this must be done consistently for the whole time series. Because improvements are made in calculation methods every year, Statistics Norway and the Norwegian Pollution Control Authority also publish new figures back to 1990 every year. This means that the figures will differ somewhat from those in earlier publications.

There has been a large change in the emission factor for mercury from combustion of wood and wood waste, and as a result, the emission figures published in 2005 are lower than previous estimates. According to the new method, the pulp and paper industry and fuelwood use by households accounted for just under 10 per cent of total emissions in 2003. Before the methodology for this emission source was improved, the contribution from these two sectors was estimated at about 30 per cent of total emissions.

A new source of emissions of lead has been included in the calculations: wear of tyres and brakes. As a result, estimated total emissions of lead in recent years are about 20 per cent higher than previously calculated. Small changes have also been made for emissions of other pollutants, but they are of less significance for estimates of total emissions.

Figure 6.19. Emissions of mercury to air by source. 1990-2003*

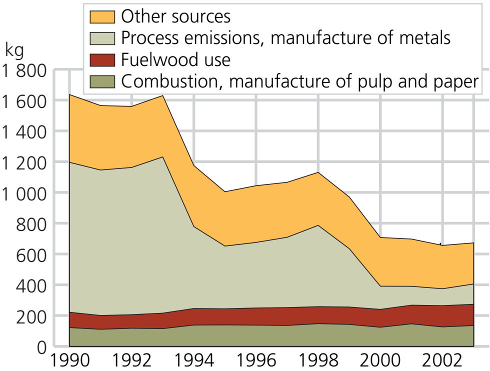


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Mercury (Hg)

- In 2003, mercury emissions totalled 660 kg, an increase of 3 per cent from the year before (see box 6.13).
- The main explanation for this is a marked rise in fuel consumption by coastal shipping and thus an increase in emissions from this source. Emissions from road traffic also rose considerably, mainly as a result of greater use of diesel vehicles.
- The drop in emissions since 1990 is mainly explained by a reduction in emissions from the manufacture of ferro-alloys, but emissions from the use of products (e.g. mercury thermometers) have also been substantially reduced.

Figure 6.20. Emissions of cadmium to air by source. 1990-2003*

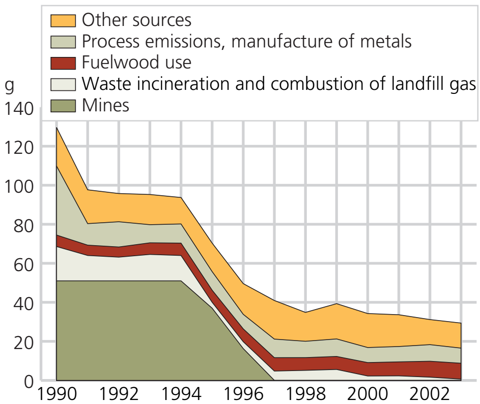


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Cadmium (Cd)

- In 2003, cadmium emissions totalled 672 kg, a drop of 2.5 per cent from the year before.
- The most important sources of cadmium emissions today are fuelwood use by households, process emissions from metal production and combustion of wood waste in manufacturing industries.

Figure 6.21. Emissions of dioxins to air by source. 1990-2003*

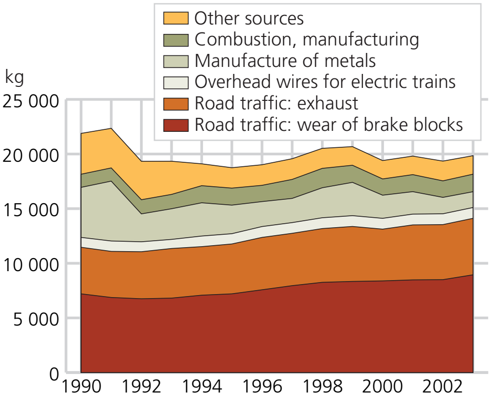


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Dioxins

- In 2003, emissions of dioxins totalled 29 g, a drop of 6 per cent since 2002. Most of the reduction is explained by the improvement of flue gas treatment at one waste incineration plant. The large reduction since 1990 is mainly explained by the closure of an ore production plant in Syd-Varanger in Finnmark and the reduction of emissions from magnesium production.
- Dioxin emissions from fuelwood use by households accounted for about one fourth of total emissions in 2003, and was the most important source, followed by emissions from metal production.

Figure 6.22. Emissions of copper to air by source. 1990-2003*

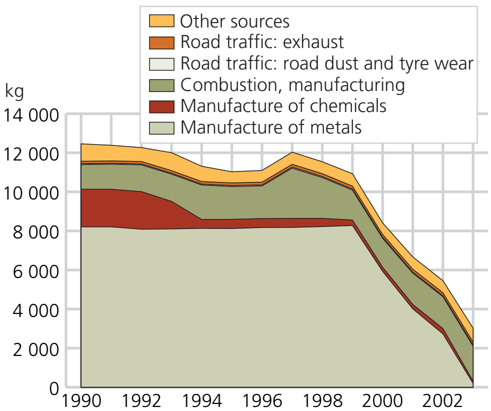


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Copper (Cu)

- In 2003, emissions of copper to air totalled 20 tonnes. Road traffic is by far the largest source of emissions. Wear of brake blocks accounted for more than 45 per cent of copper emissions in 2003, and exhaust emissions from petrol and diesel vehicles for 26 per cent. Emissions of copper from road traffic (exhaust) have risen by 21 per cent from 1990 to 2003.
- Process emissions from manufacturing and mining accounted for 8 per cent of the total in 2003. These emissions have been reduced by 75 per cent since 1990. Total copper emissions have been reduced by 9 per cent since 1990. The largest cuts have been in process industries, particularly the chemical and metallurgical industry, as a result of the reorganisation of production processes and the installation of equipment to control emissions.

Figure 6.23. Emissions of chromium to air by source. 1990-2003*

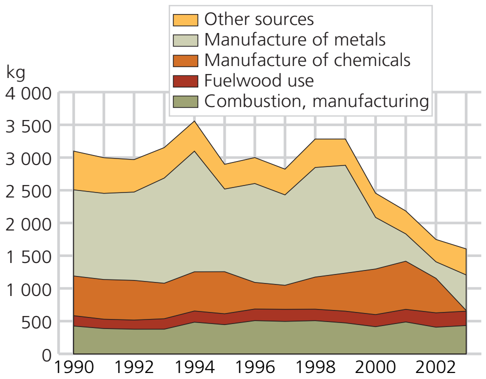


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Chromium (Cr)

- In 2003, emissions of chromium to air totalled 3 tonnes. These emissions have been reduced by 76 per cent since 1990 and 45 per cent since 2002. Cuts in emissions have been largest in the metallurgical industry, as a result of the installation of equipment to control emissions and the closure of a ferrochromium plant.
- In 2002, metal production was the most important source of chromium emissions, accounting for 50 per cent of the total. In 2003, combustion in manufacturing industries was the most important source, since emissions from metal production have been greatly reduced.

Figure 6.24. Emissions of arsenic to air by source. 1990-2003*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

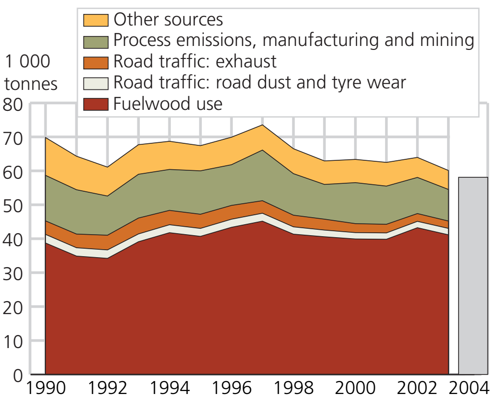
Arsenic (As)

- In 2003, arsenic emissions totalled 1.6 tonnes, which is a drop of 48 per cent since 1990.
- As a result of plant closures, carbide production is no longer the most important source of arsenic emissions in Norway. In 2002, this source accounted for 30 per cent of total emissions, but this dropped to only 1 per cent in 2003. Before 2000, the ferro-alloy industry was the dominant source of emissions. Emissions from this source dropped by 85 per cent from 1999 to 2002 because one sintering plant was closed for most of this period.
- Other important sources of arsenic emissions are combustion in the pulp and paper industry and fuelwood use by households.

6.6. Emissions of substances that particularly affect local air quality

Particulate matter, carbon monoxide (CO) and nitrogen oxides (NO_x) are the pollutants that are most important for local air quality in towns and urban settlements.

Figure 6.25. Emissions of particulate matter (PM_{10}) to air by source in Norway. 1990-2004*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Particulate matter

- Three different fractions of particulate matter are distinguished: TSP (total suspended particles), PM_{10}, with a diameter of less than 10 µm and $PM_{2.5}$, with a diameter of less than 2.5 µm. Total emissions of the three fractions in 2002 were 74 000 tonnes, 58 100 tonnes and 52 000 tonnes respectively.
- Emissions from fuelwood use are the largest source of particulate matter, and accounted for 69 and 76 per cent respectively of emissions of PM_{10} and $PM_{2.5}$ in 2003. For these two fractions, the next most important source of emissions is metal production.

Box 6.14. Emissions to air from fuelwood use

Emissions from fuelwood use are an important source of Norwegian emissions of pollutants including particulate matter, heavy metals, PAHs and dioxins. Statistics Norway's figures for emissions to air show that fuelwood use accounts for about 70 per cent of all emissions of particulate matter (PM_{10}) in Norway. Fuelwood use accounts for such a large proportion of these emissions because most of the wood is still burned in old wood-burning stoves, which are estimated to emit five times as much particulate matter as new stoves.

The level of emissions is high, but the figures are uncertain. Figures for fuelwood use are derived from the comprehensive survey of consumer expenditure, and there is a long delay before the figures are ready for use in the emission model.

Figures for energy use by households are of key importance for the energy accounts, the emission inventory and analyses carried out by Statistics Norway's Research Department. Until now, ad hoc questionnaire-based surveys have been used to survey fuelwood use and heating habits for use in the emission inventory.

In the last six months of 2005, two surveys of fuelwood use were carried out, including questions on fuelwood consumption, the type of stove or fireplace used and its age. From 2006 onwards, the plan is to carry out a survey every three months, and to include questions on the consumption of other energy commodities such as heating kerosene and fuel oil. The purpose of this project is to:

- reduce uncertainties relating to the figures for fuelwood, heating kerosene and fuel oil in the energy accounts, and make it possible to publish more up-to-date figures for fuelwood consumption.
- register the effects of measures that are introduced to reduce emissions. These include the replacement of old wood-burning stoves and the installation of chimney cowls.
- measure consumption of fuelwood rather than purchases, which is the parameter previously measured by the survey of consumer expenditure.
- facilitate analyses to estimate fuelwood consumption in a particular year or from day to day on the basis of data on temperature, prices, etc. This involves combining emission figures with meteorological data from external air quality models.

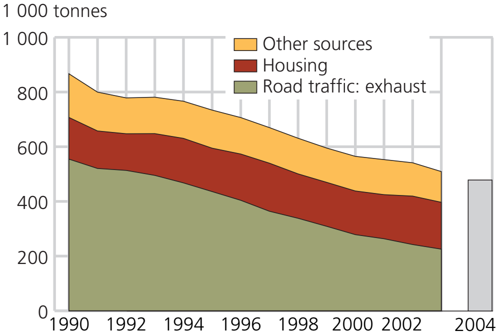
Fuelwood use is split between the different types of stoves and fireplaces on the basis of the answers to the surveys. The calculations combine figures for fuelwood consumption with emission factors for Norwegian wood-burning stoves and open fireplaces.

Read more in: Haakonsen, G. and E. Kvingedal (2001): *Utslipp til luft fra vedfyring i Norge. Utslippsfaktorer, ildstedsbestand og fyringsvaner.* (Emissions to air from fuelwood use in Norway. Emission factors, numbers of wood-burning stoves and open fireplaces, and heating habits). Reports 2001/36, Statistics Norway.

Finstad, A. et al. (2004): *Vedforbruk, fyringsvaner og svevestøv. Resultater fra Folke- og boligtellingen 2001, Levekårsundersøkelsen 2002 og Undersøkelse om vedforbruk og fyringsvaner i Oslo 2002.* (Fuelwood consumption, heating habits and particulate matter. Results of the Population and Housing Census 2001, Survey of Living Conditions 2002 and the 2002 survey of fuelwood consumption and heating habits in Oslo). Reports 2004/5, Statistics Norway.

Finstad, A. et al. (2004): *Vedforbruk, fyringsvaner og svevestøv. Undersøkelse om vedforbruk og fyringsvaner i Trondheim og Bergen 2003*. (Fuelwood consumption, heating habits and particulate matter. Survey of fuelwood consumption and heating habits in Trondheim and Bergen 2003). Reports 2004/27, Statistics Norway.

Figure 6.26. Emissions of carbon monoxide in Norway. 1990-2004*



Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Carbon monoxide (CO)

- In 2004, emissions of carbon monoxide to air totalled 479 100 tonnes.
- The largest sources of CO emissions are road traffic and heating of housing, especially with fuelwood, and these accounted for 44 and 34 per cent respectively of the total in 2003.
- Since 1990, emissions of CO have been reduced by 45 per cent. The main reason is reduced emissions from road traffic because more cars are equipped with catalytic converters.

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Useful websites

Statistics Norway - Greenhouse gas emissions: http://www.ssb.no/english/subjects/01/02/
Statistics Norway - Emissions to air: http://www.ssb.no/english/subjects/01/04/10/
Center for International Climate and Environmental Research: http://www.cicero.uio.no/index_e.asp
Norwegian Meteorological Institute: http://met.no/english/index.html
State of the Environment Norway: http://environment.no/
Norwegian Institute for Air Research: http://www.nilu.no/
Norwegian Pollution Control Authority: http://www.sft.no/english/

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Finstad, A., K. Flugsrud, G. Haakonsen and K. Aasestad (2004): *Vedforbruk, fyringsvaner og svevestøv. Resultater fra Folke- og boligtellingen 2001, Levekårsundersøkelsen 2002 og Undersøkelse om vedforbruk og fyringsvaner i Oslo 2002.* (Fuelwood consumption, heating habits and particulate matter. Results of the Population and Housing Census 2001, Survey of Living Conditions 2002 and the 2002 survey of fuelwood consumption and heating habits in Oslo). Reports 2004/5, Statistics Norway.

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Haakonsen, G. and E. Kvingedal (2001): *Utslipp til luft fra vedfyring i Norge. Utslippsfaktorer, ildstedsbestand og fyringsvaner.* (Emissions to air from fuelwood use in Norway. Emission factors, numbers of wood-burning stoves and open fireplaces, and heating habits). Reports 2001/36, Statistics Norway.

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7. Waste

The total quantities of waste generated in Norway are rising, but strict emission standards and new technology have resulted in large reductions in many of the emissions associated with waste management. The environmental and social impacts of waste depend partly on how it is managed. Waste can cause health and environmental problems, but sound management can both provide useful resources and reduce the environmental problems. There are still problems associated with hazardous waste that is not dealt with appropriately.

Waste consists of anything that is discarded after production and consumption. Various problems arise if waste is not managed appropriately, including pollution of soil and water (mainly caused by leachate from landfills), greenhouse gas emissions, health problems, littering and locally, unpleasant smells. One of the objectives of Norway's legislation on waste management is to prevent such problems from arising. The authorities also set standards for waste management facilities through regulations and the mandatory licensing system. Licences include requirements to collect and control leachate from new landfills and upper limits for permitted emissions from incineration plants. A general prohibition against landfilling of wet organic waste (food waste, slaughterhouse waste, etc.) has been introduced. A series of voluntary agreements have also been established between various sectors of industry and the authorities to ensure the collection and sound management of selected waste types.

Certain types of waste are particularly dangerous to human health and the environment, and special legislation applies to these waste fractions to ensure that they are managed properly and in a way that can be controlled. With few exceptions, the authorities require hazardous waste to be treated at separate, specially designed treatment facilities. Detailed reports on such waste are also required to ensure control of the waste stream. Nevertheless, in 2003 almost 13 per cent of the hazardous waste generated was dealt with without being reported to the authorities, and some of this may in the worst case have been dumped in the environment.

Preliminary figures from the waste accounts show that about 8.6 million tonnes of waste was generated in Norway in 2004, including 820 000 tonnes of hazardous waste. Investigations also show that in 2002, the overall waste recovery rate was 70 per cent. The government's target is to reach a recovery rate of 75 per cent by 2010 (see the targets for waste management and recovery in Chapter 1) and subsequently to raise this to 80 per cent. The percentage rise in waste generation was larger for households than for other sectors that generate large quantities of waste. Every Norwegian generated an average of 378 kg waste in 2004. This is 13 kg more than the year before, but nevertheless lower than in many comparable countries. A large proportion of what is discarded can be re-used, or can be processed to manufacture new products (material recovery) or used as a source of energy.

7.1. Some environmental problems related to waste management

Table 7.1. Emissions from waste incineration and landfills. Percentages of total Norwegian emissions in 2003 and change since 1990

	Percentage of total Norwegian emissions	Percentage change since1990
Incineration plants:		
Quantity of waste incinerated	.	+ 64
Sulphur dioxide	1.2	- 26
Nitrogen dioxide	0.6	+ 21
Carbon dioxide[1]	0.3	+ 82
Particulate matter, PM_{10}	0.0	- 99
Lead	1.8	- 93
Cadmium	1.2	- 91
Mercury	12.8	- 49
Arsenic	0.8	- 91
Chromium	1.0	- 90
Copper	0.3	- 74
Total PAH	0.7	- 33
Dioxins	2.1	- 96
NMVOCs	0.2	+ 80
Landfills:		
Methane (greenhouse gas)[1]	4	-17
Leachate: heavy metals[2]	1	..
Leachate: nitrogen[2]	2	..
Leachate: phosphorus[2]	1	..

[1] Calculated as a percentage of total greenhouse gas emissions in CO_2 equivalents.
[2] Figures from 1996.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority (emissions to air) and Report No. 8 (1999-2000) to the Storting (leachate).

Emissions to air and leachate

- Emissions of particulate matter, heavy metals and organic compounds (PAHs and dioxins) from waste incineration have dropped steeply since 1990, even though significantly more waste is being incinerated.
- Emissions from waste incineration plants account for only a small proportion of national emissions. For example, emissions of cadmium, mercury and dioxins from fuelwood use are 3-4 times higher than those from waste incineration (see Chapter 6 Air pollution and climate change).
- Emissions of methane (a greenhouse gas) from rotting waste in landfills make a substantial contribution to Norway's total emissions. In 2003, methane emissions totalled 240 800 tonnes, and landfills accounted for 41 per cent of this, or just under 4 per cent of Norway's aggregate greenhouse gas emissions. The model used to calculate methane emissions from landfills has recently been revised, and the estimated level of emissions has been substantially reduced.
- Leachate from landfills may contain heavy metals, organic material and plant nutrients such as nitrates and phosphates. These discharges may cause local pollution, but are often small compared with those from other sources. The figures for leachate are uncertain, and recent surveys indicate that discharges of leachate from landfills contain only moderate amounts of hazardous inorganic and organic substances (Norwegian Pollution Control Authority 2005). However, it is difficult to draw firm conclusions, since the statistical basis in this field is still rather weak.

Box 7.1. The impacts of waste and waste management on the environment and natural resources

Waste has a variety of impacts on the environment. Waste generation, management and transport, as well as litter, have direct impacts in the form of pollution released to the air, water and soil. However, waste is also a resource that can be used to provide new products through material recovery or heating through energy recovery. This means that poor management of waste streams can result in environmental damage that in some cases is both serious and long-lasting, whereas good management helps to optimise the supply of resources and at the same time reduce extraction of virgin raw materials.

If organic waste is landfilled, it generates emissions of the greenhouse gas methane. Methane emissions from landfills account for 4 per cent of Norway's greenhouse gas emissions (measured as CO_2 equivalents) and contribute to global warming (see table 7.1). Old landfills generate leachate that contains hazardous substances and nutrients and pollutes the environment (Norwegian Pollution Control Authority 1992). Even though substantial amounts of environmentally hazardous waste are still being landfilled, newer landfills are less of a problem because they are required to meet higher standards for the collection of leachate. Locally, landfills can give rise to problems related to unpleasant smells and vermin.

Successful composting is an environmentally sound method of treatment for wet organic waste, including park and garden waste, and generates no harmful emissions (water vapour is not a pollutant, and the carbon dioxide generated is "climate-neutral"). If the process is unsuccessful, on the other hand, it may generate methane emissions, give rise to unpleasant smells (for example from hydrogen sulphide) and produce leachate. Such problems may arise when a new composting system is being started up and before it is operating properly. They are not considered to be a serious health threat (Lystad and Vethe 2002). The content of hazardous substances in Norwegian compost has been investigated and found to be low enough to be safe (Norwegian Pollution Control Authority 1997).

On average, 70 per cent of the heat generated by Norwegian incineration plants was utilised in 2003. This reduces the need for extraction and use of other energy resources. On the other hand, waste incineration generates emissions to air. Emissions of hazardous substances and acidifying substances from this source are small compared with those from other sources (see Chapter 6). New technology has reduced these emissions, and they will probably be reduced even further as a result of further technological advances and the stricter standards set out in new regulations on waste incineration and landfills.

A marginal but highly visible fraction of our waste ends up as litter in streets and our surroundings otherwise. This is mainly an aesthetic problem rather than a threat to the environment, and generally involves disposable packaging and food waste.

Hazardous waste that is not dealt with appropriately is a serious environmental problem. Some of the more common types of hazardous waste are *PCBs (polychlorinated biphenyls), waste oil, solvents* and *brominated flame retardants*.

The acute toxicity of PCBs is not very high, but chronic exposure, even at relatively low concentrations, can impair reproduction, disturb behavioural patterns, weaken the immune system and cause cancer (Thorsen 2000). PCBs provide very good heat and electrical insulation, are flame-retardant, and improve the resistance of certain materials to wear. They were therefore used in a wide variety of products, particularly in the 1960s and 1970s, but their use was prohibited from 1980 onwards. Today, PCBs can still be found in insulating windows, in capacitors (especially ballasts in light fixtures), in concrete and filling compounds, and in smaller amounts in ships' paints and electricity lead-ins. PCBs break down very slowly in the environment and can be transported over long distances. PCBs are readily absorbed by living organisms and stored in fatty tissue, and thus become concentrated in food chains. In Norway, the authorities have advised people not to eat fish and shellfish from a number of fjords and restricted commercial fishing in certain areas because of the presence of PCBs. PCBs spread through the environment by evaporation and with runoff. Once PCBs have entered the environment, their removal is a very costly process.

Cont.

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Waste oil contains carcinogenic tars (PAHs) and small quantities of heavy metals. Degradation of waste oil in the environment is fairly rapid if the oil is finely divided, but after major oil spills, it may take many years before the process is completed. Some harbour basins in Norway have become polluted as a result of discharges of oil-contaminated waste over long periods of time.

Organic solvents are highly flammable and it is therefore dangerous to mix them with ordinary waste. In most cases, their acute toxicity is not very high and they are easily broken down in the environment. This means that they are not generally very harmful to the environment. Waste containing solvents also includes paints, and may also contain both heavy metals and persistent organic pollutants. Chlorinated solvents are particularly hazardous to health and the environment. They break down slowly in the environment, become concentrated in food chains and have a variety of toxic effects. For example, they may be endocrine disruptors, carcinogenic or impair reproduction (Norwegian Labour Inspection Authority 2002).

Brominated flame retardants are a group of substances that are used, for example in electronic circuit boards, textiles and fittings for vehicles, to prevent fire. Some of them are chemically similar to PCBs, but we still have only limited knowledge of the health risks associated with them and the extent to which they become dispersed in the environment. The concentrations of some of them in human breast milk have risen by a factor of 50 in the last 25 years. Some of them are suspected to be endocrine disruptors and to impair reproduction. The annual global consumption of brominated flame retardants is estimated at 150 000 tonnes (National Institute of Public Health 2003). The brominated flame retardants that are believed to be most dangerous have been included in the new regulations on hazardous waste, which entered into force on 1 January 2004.

Box 7.2. Waste - definition and classification

According to the Pollution Control Act, waste is defined as discarded objects of personal property or substances. Waste water and waste gases are not defined as waste.

Waste can be classified in many ways, for instance according to its origin, composition or environmental impact. The result is a wide variety of terms, some of which have overlapping meanings. Standards Norway has drawn up a new standard for waste classification, NS 9431 (NAS 2000), that classifies the waste by material, sector of origin, method of treatment/disposal and place of origin. The objective is to encourage uniform use of categories when registering and reporting waste quantities. The European List of Wastes is the most commonly used waste classification system in Europe. This system classifies waste into about 850 categories according to material characteristics, sector of origin, the pollutants it contains and in some cases the type of product. In addition, the OECD (the Y-list) and the Basel Convention have their own waste classification systems.

In the Pollution Control Act, waste was previously divided into three categories: consumer waste, production waste and special waste (including hazardous waste). In 2003, the Act was amended and the terms production waste and consumer waste were replaced by industrial waste and household waste. These amendments entered into force on 1 July 2004. According to the Pollution Control Act, the municipalities are responsible for collection and management of household waste, but are no longer responsible for industrial waste. The term municipal waste has been used for waste actually treated or administered in the municipal system. Industrial waste has made up a little over half of all municipal waste. Now that the Pollution Control Act has been amended, it is likely that more of this waste will be dealt with by non-municipal actors. The term municipal waste is now in limited use in Norway, but is still used internationally, for example in various sets of environmental indicators including the EU structural indicators.

Often, *waste fractions* consisting of particular materials are discussed separately (paper, glass, metal, etc.). Waste may also be classified according to product type (packaging, electrical and electronic equipment, etc.). Both material fractions and product types may belong to any of the above-mentioned categories.

Box 7.3. Waste and waste statistics - terminology

Biogas treatment: Degradation of organic waste by living organisms without access to oxygen (anaerobic biological treatment). Methane gas is formed in the process.

Composting: Controlled degradation of waste by living organisms with access to oxygen (aerobic biological treatment). Often considered to be a form of recovery.

Consumer waste: All waste that is not production waste. Includes both non-hazardous and hazardous waste, and also large items such as fittings and furnishings from private households and commercial undertakings.

EEE waste, or WEEE (waste electrical and electronic equipment): EEE items require an electric current or electromagnetic field to function, and need batteries, transformers, wires, etc. to generate, transmit, distribute and measure the current or field, and parts to cool, warm, protect, etc. the electric and/or electronic components. Means of transport are not included in this definition, and cooling equipment containing CFCs is generally also excluded since a separate waste collection and recovery scheme has been established for such equipment.

Energy recovery: Use of the energy released by waste incineration, for example to heat buildings.

Final disposal: Means that the resources in the waste are not utilised: either landfilling or incineration without energy recovery.

Hazardous waste: Waste which cannot appropriately be treated together with municipal waste because it may cause serious pollution or a risk of injury to people and animals. Hazardous waste is governed by separate regulations under the Pollution Control Act. The list of hazardous waste in Norway was expanded from 1 January 2003.

Household waste: Defined in the Pollution Control Act as waste from private households, including large objects such as furniture, etc.

Industrial waste: Defined in the Pollution Control Act as waste from public and private enterprises and institutions. This includes both consumer waste and production waste. In its waste statistics, Statistics Norway further subdivides industrial waste according to the branch of industry from which it originates. The degree of aggregation in the classification varies. Includes all waste that is not defined as household waste.

Landfilling: Final disposal of waste at an approved landfill.

Material recovery (or recycling): Use of the waste in a way that wholly or partly retains the materials of which it consists. One example is the production of writing paper from recycled paper.

Municipal waste: All waste treated or administered in the municipal system, in practice the same as consumer waste. Municipal waste includes all household waste and a large proportion of industrial waste. However, the amendments to the Pollution Control Act (see Box 7.2) mean that the municipalities are now only responsible for household waste. Municipal waste is therefore a little-used term in Norwegian waste statistics, but is used a good deal internationally.

Production waste: Waste from production of goods and services which is significantly different in type or amount from consumer waste. Includes all waste that is not classified as consumer waste.

Re-use: Use of the waste in its original form. For example, discarded clothing may be sold in second-hand shops or sent abroad as emergency relief.

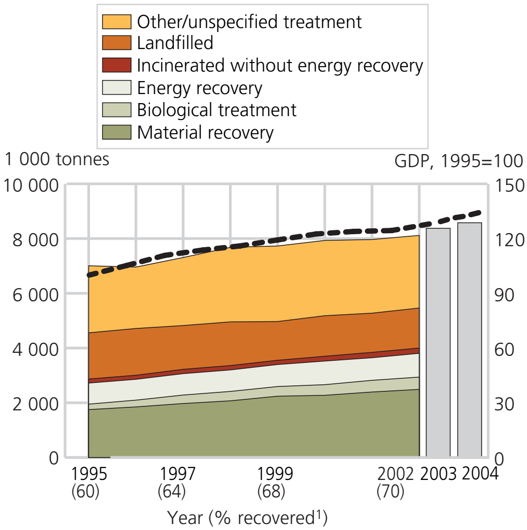
Waste management: Usually defined to include all operations from the moment when an object or substance is discarded until all treatment, recovery and disposal operations are completed.

Waste recovery: Includes re-use, material recovery, incineration combined with energy use and composting.

Wet organic waste (biodegradable waste): Readily degradable organic waste, e.g. food waste and slaughterhouse waste. Park and garden waste is included in this category in the waste accounts unless otherwise specified.

7.2. Waste accounts for Norway

Figure 7.1. Waste quantities in Norway 1995-2004* according to method of recovery or disposal (1 000 tonnes) and GDP 1995-2004 (percentage change, 1995=100)



[1] The figures in brackets below the years on the x axis indicate the overall recovery percentage (excluding waste for which the treatment/disposal method is unknown or unspecified).
Source: Waste accounts and national accounts, Statistics Norway.

Waste quantities and form of treatment/disposal

- The waste accounts have been revised and back-calculated since *Natural Resources and the Environment 2004* was published, and this has resulted in some changes in the figures presented this year. In figure 7.1, final figures are shown only for the period 1995-2002. Preliminary figures for 2003-2004 for waste quantities split by method of treatment or disposal have not yet been published, and only figures for total waste quantity, waste split by material type (see figure 7.2) and waste split by source (see figure 7.3) are available at present.
- Preliminary figures show that from 1995 to 2004, total annual waste generation rose from 7.0 to about 8.6 million tonnes, a rise of 22 per cent. In the same period, GDP grew by 24 per cent. The rise in waste generation was considerably larger than population growth, which was 6 per cent in the same period.
- In 2002, treatment/disposal was unknown for 26 per cent of the total quantity of waste generated. A large proportion of this consists of discarded products that are left where they were used, for example oil and other pipelines and underground cables.

Box 7.4. Waste accounts and projections of waste quantities

Waste accounts

The waste accounts are based on traditional principles for natural resource accounting and organised as a material balance between annual waste generation and the quantities treated or disposed of each year. In practice, the accounts are a multidimensional matrix, where the dimensions are represented by four selected characteristics of the waste. These are:

- material type (e.g. paper, glass, metals)
- product type (e.g. food waste, park and garden waste, packaging, EEE waste)
- source (e.g. agriculture, manufacturing industries)
- form of treatment/disposal (e.g. material recovery, incineration)

As a general principle, existing data sources such as statistics on external trade, production and waste have been used wherever possible, and new costly investigations have thus been avoided so far.

Two different methods have been used to estimate waste quantities. One is called the "supply of goods method", and is a theoretical method of estimating waste quantities. It is based on the assumption that waste quantities are equal to the supply of goods after correction for the lifetime of the products. The supply of goods is calculated from statistics on import, export and production of goods. The second method is called the "waste statistics method": existing waste statistics are collected and harmonised, and waste quantities are estimated in cases where the existing statistics are inadequate.

The two methods give an estimate of waste quantities at different points in the waste stream. The supply of goods method estimates the quantities of waste that are generated, while the waste statistics method shows the quantities delivered for various types of treatment. There may be a real difference between these quantities, for example if not all the waste generated is registered as delivered for treatment or disposal.

Projections of waste quantities

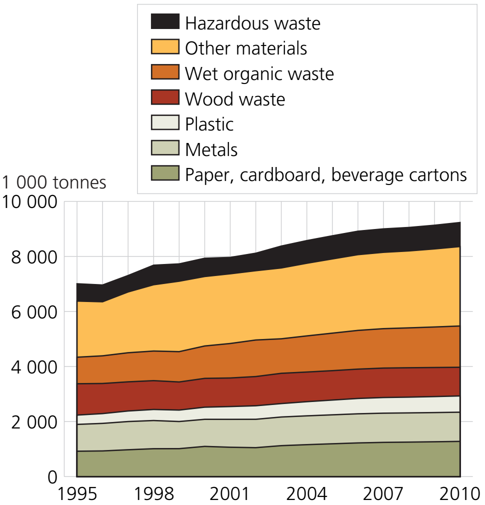
Statistics Norway has made projections of waste quantities in Norway several times previously, on the basis of waste statistics and economic projections in the macroeconomic model MSG (see Bruvoll and Spurkland 1995, Bruvoll and Ibenholt 1999, and Ibenholt 1999). In winter 2002-2003, Statistics Norway was commissioned by the Norwegian Pollution Control Authority to calculate projections of quantities of organic waste up to 2020 on the basis of projections of gross production and consumption in various sectors (Bruvoll and Skullerud 2004), using the macroeconomic model MODAG (Statistics Norway 2002) and waste statistics from the waste accounts. These projections have since been expanded to include all types of waste. The calculation method used was described in *Natural Resources and the Environment 2003. Norway*.

The results show that we can expect waste quantities to grow by about 14 per cent from 2002 to 2010. It is estimated that a rise in household waste generation will account for about half of the overall increase (47 per cent). Other sectors that will account for a significant proportion of the increase are manufacturing industries (15 per cent) and the construction industry (14 per cent). These results are based on the assumption that the relationship between production and waste quantities will remain unchanged in the next ten years.

In other words, expected or possible changes in definitions or the introduction of policy instruments that will influence the relationship between production and waste quantities have not been taken into account in the calculations.

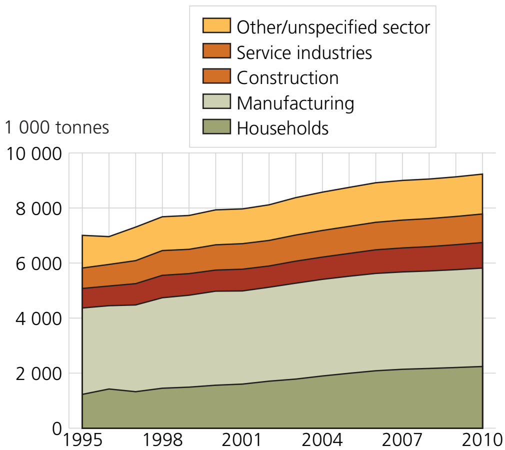
For more information, see: http://www.ssb.no/english/subjects/01/05/40/avfregno_en/

Figure 7.2. Waste quantities in Norway, 1995-2004*. Projections for 2005-2010. By material. 1 000 tonnes



Source: Waste statistics, Statistics Norway.

Figure 7.3. Waste quantities in Norway, 1995-2004*. Projections 2005-2010. By source. 1 000 tonnes



Source: Waste statistics, Statistics Norway.

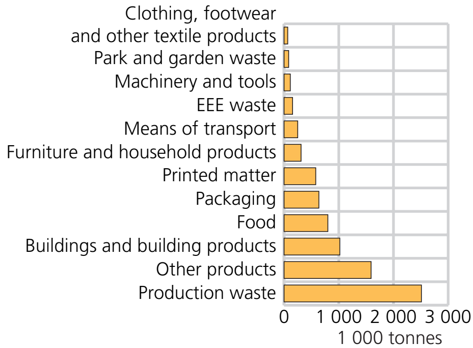
Materials in waste

- Waste quantities are rising each year. The most rapidly-growing fractions are plastics, wet organic waste and textiles, which are largely found in household waste.
- Projections indicate that total waste generation will reach 9 million tonnes in 2007, but waste generation will grow less than Statistics Norway's prognoses for GDP growth in the same period.
- Only wood waste and inorganic sludge of the waste fractions specified in the waste accounts are expected to show a drop in the period up to 2010. For wood waste, this is because a lower level of activity is expected in the wood and wood products industry.
- The category "other materials" includes organic and inorganic sludge, slag, rubber, glass, china and ceramics, and dust. Unpolluted stone, gravel, etc. are not included in the statistics.

Sources of waste

- In the period 1995-2004, the quantity of household waste rose more rapidly than household consumption, and today this category accounts for about 22 per cent of the total quantity of waste. If this trend continues, the percentage will rise to over 24 per cent in 2010.
- For waste from other sectors, the relationship between economic developments (measured as GDP) and waste generation is less clear or uncertain.
- Manufacturing waste accounted for 41 per cent of the total in 2004. Of this, about 75 per cent was production waste. Service industries account for 11 per cent of total waste generation, and the construction industry for 9 per cent.

Figure 7.4. Waste by product type[1]. 2002



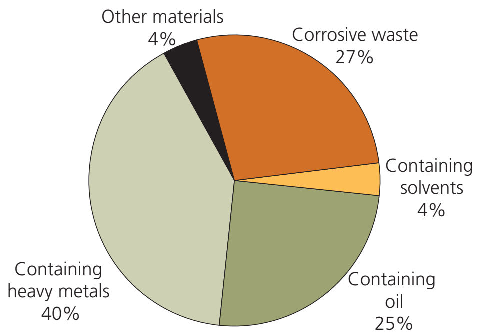
[1] Ships over 100 gross tonnage and large constructions are not included in the statistics.
Source: Waste statistics, Statistics Norway.

Product types

- The quantities of most fractions of waste by product type rose from 2000 to 2002.
- The product types *food waste, production waste* and *packaging waste* rose most steeply from 1995 to 2002. For park and garden waste, only the proportion delivered is included.
- The category *other products* includes large quantities of hazardous waste, metal piping that has been used as oil and gas pipelines, etc.
- *WEEE* (waste electrical and electronic equipment) makes up only 2 per cent of the total, but often contains substances that are classified as hazardous waste.

7.3. Hazardous waste

Figure 7.5. Hazardous waste handled at approved facilities, by material. 2003*. Per cent

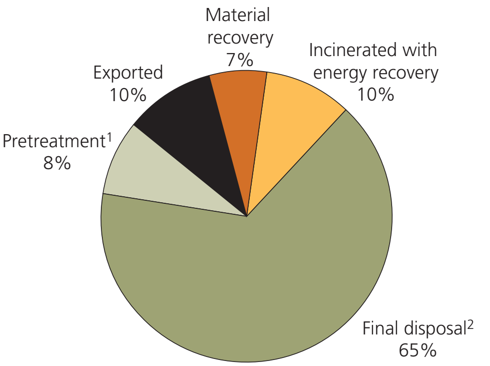


Source: Waste statistics, Statistics Norway.

Origin and materials

- In 2003, a total quantity of 782 000 tonnes of hazardous waste was handled at approved facilities. Of this, 693 000 tonnes was registered with the authorities.
- About two-thirds of all hazardous waste is generated by manufacturing industries. This includes almost all corrosive waste, most waste containing heavy metals and substantial proportions of other types of hazardous waste.
- Oil-contaminated waste is generated mainly by petroleum extraction, but manufacturing and service industries (especially wholesale and retail trade and transport) also account for substantial amounts.

Figure 7.6. Hazardous waste handled at approved facilities, by type of treatment. 2003*. Per cent



[1] Calculated as net reduction in weight. Includes all products of a pretreatment process that are no longer classified as hazardous waste
[2] Includes all types of landfilling, permanent storage, incineration without energy recovery and treatment that results only in non-hazardous products.
Source: Waste statistics, Statistics Norway.

Treatment/disposal of hazardous waste

- Most of the hazardous waste delivered for final disposal is deposited at special landfills for hazardous waste, generally after being stabilised by means of chemical reactions. A large proportion of hazardous waste, such as slag, blasting agents and acid sludge, is not suitable for material recovery.
- Hazardous waste is exported either for final disposal or for material recovery. Exports for final disposal are only permitted if the waste cannot be properly dealt with in Norway.
- Previous estimates from Statistics Norway show that in 2003, no information on disposal or treatment was available for about 100 000 tonnes of hazardous waste, or 13 per cent of the total. A large proportion of this was probably dealt with at approved facilities but not reported to the authorities, or stored until it could be treated or disposed of properly. However, some hazardous waste will have been treated or disposed of illegally and may have been dumped in the environment.

Box 7.5. Hazardous waste management in Norway

Normally, anyone who has hazardous waste is required to deliver it to an approved municipal facility. Waste is collected from such facilities, and transferred to a firm that specialises in preliminary treatment, or directly to a firm that can carry out final treatment. On the other hand, companies that generate large amounts of hazardous waste often have special agreements with transport firms that collect the waste directly from the site.

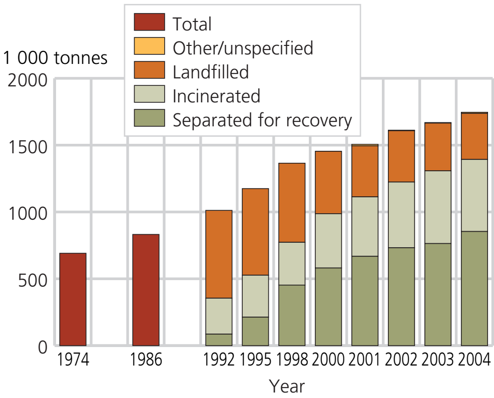
Some industrial plants that generate large quantities of hazardous waste can document sound management of the waste on site. They may be granted permits to dispose of their own hazardous waste. This applies mainly to landfilling of slag containing heavy metals.

Some companies, especially in the petroleum extraction and manufacturing sectors, hold permits to export hazardous waste.

If hazardous waste is not reported to the authorities or to Statistics Norway, it is included in the category "no information available on disposal or treatment". A good deal of this is probably treated at approved facilities but not reported, or stored until better treatment methods are available or in anticipation of changes in the legislation. However, a proportion of this waste may be disposed of in ways that cause environmental damage.

7.4. Household waste

Figure 7.7. Household waste by method of recovery or disposal. 1974-2004



Source: Waste statistics, Statistics Norway.

Quantities and methods of disposal

- In 2004, per capita generation of household waste was 378 kg, 143 kg more than in 1992 and 13 kg more than in 2003.
- In 2004, 854 000 tonnes of household waste, or 49 per cent of the total, was separated for recovery.
- A 3 per cent decrease in the quantity of household waste landfilled was registered from 2003 to 2004. In 2004, 345 000 tonnes of household waste was landfilled.
- In 2004, 539 000 tonnes (31 per cent) of household waste was incinerated.

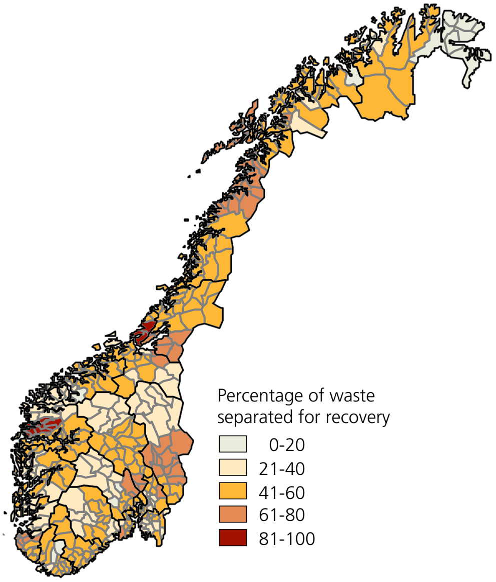
Box 7.6 Legislation relating to waste management in Norway

Act of 13 March 1981 No. 6 relating to protection against pollution and to waste (Pollution Control Act).

Regulations of 1 June 2004 No. 930 relating to the recovery and treatment of waste.

Regulations of 1 June 2004 No. 931 relating to pollution control.

Figure 7.8. Percentage of household waste separated for recovery, by municipality. 2004



Source: Waste statistics, Statistics Norway.

Waste recovery

- In 2004, each person in Norway separated 185 kg of household waste for recovery, 18 kg more than in 2003. The proportion of household waste delivered for final disposal (incineration without energy recovery and landfilling) in 2004 was 30 per cent.
- The highest proportions of household waste were separated in Hedmark and Nord-Trøndelag counties, 68 and 62 per cent respectively. The percentage increase in household waste separation was highest in Sogn og Fjordane, where it rose from 38 per cent in 2003 to 54 per cent in 2004.
- In 2004, the largest fractions of separated waste were paper and board and wet organic waste (food waste, etc.). These materials accounted for 32 and 18 per cent respectively of the total separated. Plastic accounted for only 1 per cent of the total. However, new technology has made it possible to separate different types of plastic automatically.
- From 2003 to 2004, there was a slight drop in the proportion of households served by collection schemes for about half the waste material types. This drop was largest for plastics, metal and wet organic waste. For hazardous waste, the reverse is true: hazardous waste was collected from 22 per cent of households in 2004, as compared with 19 per cent in 2003.

7.5. Fees in the municipal waste management system

Table 7.2. Average annual fee for waste management services. County. 2005. NOK

County	Average annual fee
Country average	1 833
Østfold	1 330
Akershus	1 671
Oslo	1 462
Hedmark	1 532
Oppland	1 611
Buskerud	1 710
Vestfold	1 896
Telemark	1 684
Aust-Agder	1 800
Vest-Agder	1 926
Rogaland	1 970
Hordaland	1 765
Sogn og Fjordane	1 892
Møre og Romsdal	1 887
Sør-Trøndelag	1 881
Nord-Trøndelag	2 046
Nordland	1 969
Troms	1 999
Finnmark Finnmárku	2 281

Source: KOSTRA, Statistics Norway.

- A large proportion of waste management services at municipal level in Norway are provided by entities other than the municipalities themselves: intermunicipal companies, municipal limited companies or private companies.
- Waste management fees have risen by 2.7 per cent from 2004 to 2005. One reason for this is that the VAT rate was raised from 24 to 25 per cent from 1 January 2005.
- The average annual fee per subscriber for household waste was NOK 1 833 in 2005. The annual fee varies from one county to another. The highest average annual fee, NOK 2 281, was registered in Finnmark and the lowest, NOK 1 330, in Østfold.

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Useful websites

Norwegian Pollution Control Authority: http://www.sft.no/english/
Norwegian Resource Centre for Waste Management and Recycling: http://www.norsas.no/norsas/main.nsf
State of the Environment Norway: http://www.environment.no/
Statistics Norway - waste statistics: http://www.ssb.no/english/subjects/01/05/

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8. Water resources and water pollution

As water resources are used in almost all forms of economic activity and are vulnerable to exploitation and pollution, it is important to monitor their state and environmental trends. In many parts of the world, there is a growing shortage of clean water supplies, due to the increasing withdrawal of water for industrial, household, agricultural and mining and quarrying purposes, and discharges of waste water and environmentally hazardous substances. Although the overall situation in Norway is good as regards both quantity and quality, there can be substantial problems at the local level.

Drinking water is of vital importance to life and health and to society as a whole. Good water and sufficient water is therefore a primary objective in the supply of water. The drinking water regulations of 4 December 2001 (Ministry of Health 2001) require all water works supplying more than 50 persons or 20 households or holiday homes, or supplying water to food manufacturers, health institutions, etc., to be approved by the authorities.

Figures from the Norwegian Institute of Public Health's water works register show that of a total of 1 727 water works subject to reporting requirements (municipal and private) in 2003, 340 recorded unsatisfactory results for pH, 204 recorded unsatisfactory results for water colour and thermo-tolerant intestinal bacteria in the water were found at 83 water works. The quality of drinking water supplied by some private and small municipal water works is still unsatisfactory. There are many reasons for this. Even though the regulations require that all water from surface water sources shall be disinfected, many small water works still do not do this adequately. The microbiological quality of drinking water may be unsatisfactory in periods as a result and may, at worst, cause illness. Warnings that water must be boiled before use must therefore sometimes be issued in areas supplied by smaller water works. However, the quality of drinking water for most users in Norway is good (Norwegian Food Control Authority 2003).

About 90 per cent of the population in Norway receive their water supplies from surface sources. These water sources are vulnerable to acid rain, which for a long time has been regarded as one of the major environmental problems in Norway. However, a substantial reduction in sulphur and nitrogen discharges in Europe has reduced the acidification load in Norwegian inland waters. Nonetheless, there is still a long way to go before the natural ecosystems in the most vulnerable areas have recovered, and new international agreements, such as the Gothenburg Protocol, have already been concluded to reduce discharges of harmful substances even further.

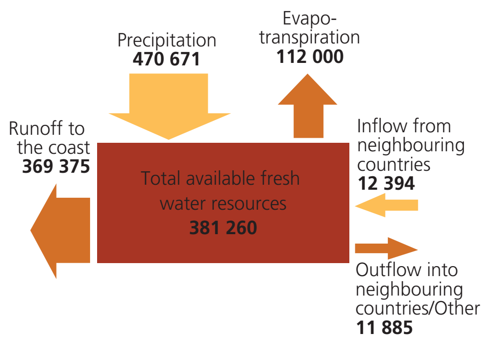
Discharges of phosphorus and nitrogen from the waste water treatment sector have been a matter of concern for many years, because these plant nutrients play an important role in the eutrophication of rivers, lakes and coastal areas. Eutrophication causes excessive growth of algae and oxygen depletion. Agriculture, aquaculture and manufacturing industry are also important sources of large nutrient inputs to inland waters and coastal areas.

In recent years, both Norway and other countries that drain to the Skagerrak and the North Sea basin have invested substantial resources in waste water treatment. The main reason has been that the pollution load in these waters has resulted in eutrophication and periodical algal blooms. In addition, Norway has signed the North Sea Agreements and the OSPAR Convention, thereby undertaking to halve inputs of phosphorus and nitrogen compared with the 1985 levels.

During the past 20 years, Norway has achieved a satisfactory level of treatment efficiency for phosphorus, mainly by building waste water treatment plants providing chemical or chemical-biological treatment. Nitrogen removal measures have been given priority over the last few years in areas where discharges from Norway have a major impact on eutrophication (as defined in the EU directive concerning urban waste water treatment and the directive concerning protection against pollution caused by nitrate from agricultural sources), i.e. areas from the border with Sweden to Strømtangen lighthouse near Fredrikstad (Hvaler/Singlefjorden in Eastern Norway) and in the Inner Oslofjord. Discharges of nitrogen and phosphorus from Norway are relatively modest in comparison with discharges from the other countries bordering the North Sea and the Baltic Sea. As is the case in many other contexts, cooperation across national borders is important to achieve the objective of reducing pollution in these marine areas.

8.1. Availability and consumption of water

Figure 8.1. Annual available water resources in Norway. Average 1961-1990. Million m³

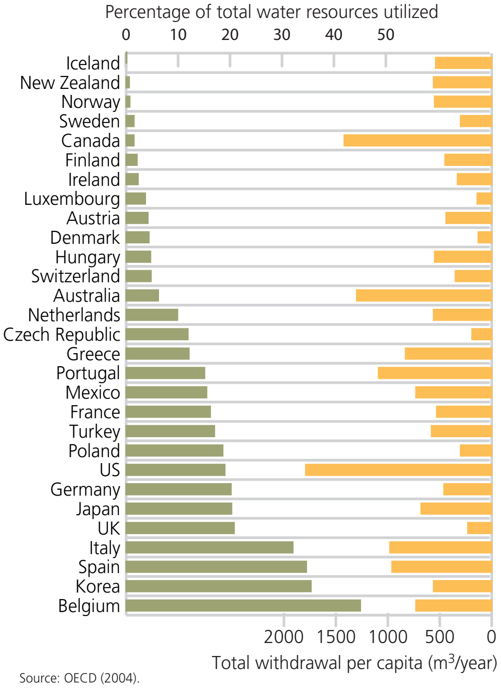


Source: Based on data from the Norwegian Water Resources and Energy Directorate and the Norwegian Meteorological Institute.

Available water resources

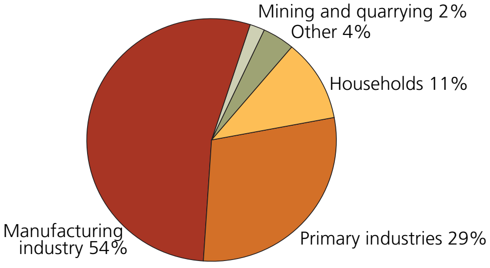
- Renewable water resources in Norway in a normal year total about 381 billion m^3.
- 97 per cent of the annual input of water resources is in the form of precipitation, while the remainder is in the form of incoming water flows via rivers from our three neighbouring countries.
- About 79 per cent of the annual input of water drains to the sea and to neighbouring countries through watercourses and run-off. The rest evaporates.

Figure 8.2. Percentage of total water resources utilized and withdrawal per inhabitant in OECD countries at the turn of the century



Source: OECD (2004).

Figure 8.3. Total water consumption by sector. 1999 or latest year for which figures are available



Source: Provisional figures from Statistics Norway.

Water withdrawal and consumption

- Only 0.7 per cent of the water resources available each year in Norway is utilized (water used in hydropower production is not included) before draining to the coast (97 per cent) or via rivers to neighbouring countries (3 per cent).
- The only OECD countries that utilize a smaller percentage of their total available water resources than Norway are Iceland (0.1 per cent) and New Zealand (0.6 per cent).
- About 550 m^3 of water is withdrawn annually per inhabitant in Norway. This is well below the average for the OECD countries (910 m^3). The average American uses 1 790 m^3, while an inhabitant of Denmark uses 130 m^3.
- A total of about 3 130 million m^3 of water is used annually in Norway. The largest share, just under 1 700 million m^3, is used in manufacturing. The sectors that utilize most are the wood processing industry, the food processing industry and the petrochemical industry.
- Over 340 million m^3 is used by households. Approximately 95 per cent of this amount is supplied by public water works. Manufacturing industry and the primary industries (agriculture, forestry and fish farming) largely meet their water needs from their own sources.

Box 8.1. The EU Water Framework Directive

As a party to the EEA Agreement, Norway is required to implement the Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000). The Directive, which entered into force in 2003, provides a framework for other EU directives of importance to water resource management, including the Urban Waste Water Treatment Directive (see box 8.3). The main objective of the Directive is to protect and, if necessary, improve the quality of inland waters, estuaries, coastal waters and groundwater. Other objectives include promoting sustainable water resource use, and protecting terrestrial ecosystems that directly depend on water, such as wetlands.

The main principle in the framework directive is that inland waters, coastal waters and groundwater should have "good status" with regard to water quality. This means that by 2015 the volume and quality of bodies of water should not deviate substantially from the "natural" conditions that would have existed without the impact of human activity.

The new key elements in the directive in relation to current Norwegian water resource management are as follows:
- coordination of administrative arrangements
  - administrative arrangements based on river basin districts
  - programmes and measures based on river basins and river basin districts
  - clear assignment of responsibilities and coordination between authorities (cross-sectoral management)
- specified evironmental objectives for all water and a stronger focus on ecological conditions
- greater need for investigation and monitoring.

A management regime based on river basins means that all water within a river basin district and all activities that may affect the quality or amount of water are viewed as a whole, irrespective of administrative boundaries such as municipal, county or national borders. Each river basin district shall also have a management plan, which shall include the following:
- environmental objectives
- action plans (programmes of measures) for the bodies of water
- description of the river basin
- impact of human activity
- protected areas (e.g. designated protected areas, recreation areas, areas defined as a result of other directives)
- the results of the monitoring of water bodies required by the directive

These management plans shall be produced for all river basin districts by 2009. With regard to Norway, the progress of the various processes and developments in relation to water bodies shall be reported to the EFTA Surveillance Authority (ESA). The requirements and objectives of the directive shall be achieved by 2015.

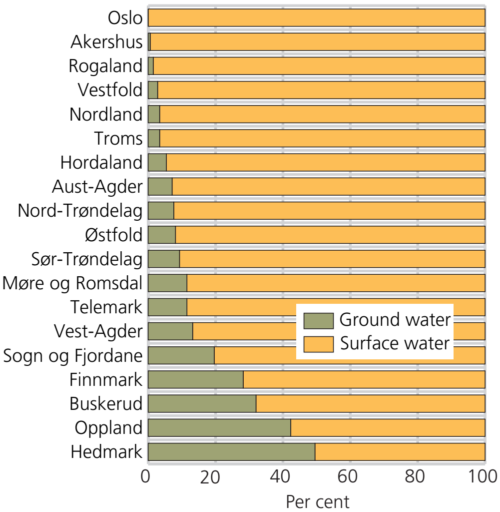
The Ministry of the Environment has coordinating responsibility for the Directive, with the County Governors responsible at the regional level. A reference group was established in 2005 comprising representatives from a range of national interest organisations (various business interests, public institutions, conservation organisations, etc.) The group's main task is to offer suggestions and comments to facilitate the implementation of the Water Framework Directive.

See also the indicators for ecological status in aquatic ecosystems in the indicator set for sustainable development presented in Chapter 1.6.

Sources: The Norwegian Pollution Control Authority (*www.sft.no/arbeidsomr/vann/vanndirektiv/*), the Norwegian Institute for Water Research (*www.vanndirektivet.no*)) and the Water Framework Directive (*europa.eu.int/comm/environment/water/water-framework/index_en.html*).

8.2. Public water supplies

Figure 8.4. Percentage of population connected to municipal water works using various sources of drinking water. By county. 2003

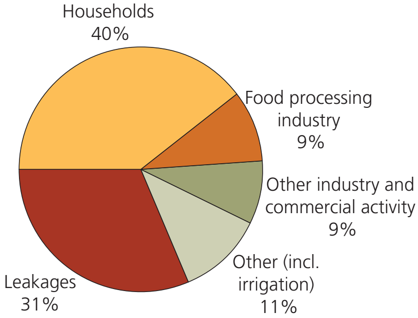


Source: National Institute of Public Health, water works register.

Water sources

- In 2003, about 90 per cent of Norway's population was served by public water supplies from 1 727 water works. These water works, which include municipal, intermunicipal and privately-owned water works, are subject to reporting requirements and registered in the Water Works Register of the National Institute of Public Health. The remaining 10 per cent of the population was supplied by smaller water works or from their own water sources.
- In 2003, 64 per cent of Norway's public water works used surface water as their source of water, while the remainder used groundwater, and in a few cases sea water.
- The counties that in 2003 had the highest percentage of the population connected to water works using groundwater as their source were Hedmark, Oppland and Buskerud.

Figure 8.5. Percentage of public water supplies used by various sectors[1]. 2003

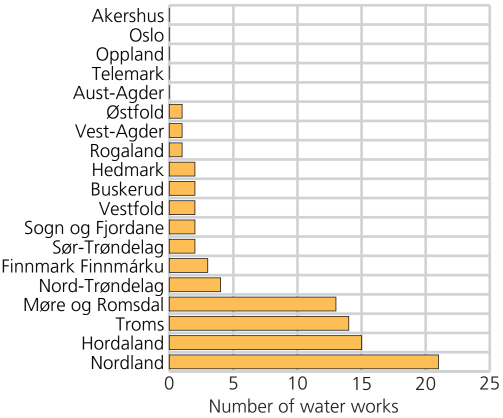


[1] The figure is based on data for 1 627 water works.
Source: National Institute of Public Health, water works register.

Production and consumption of water

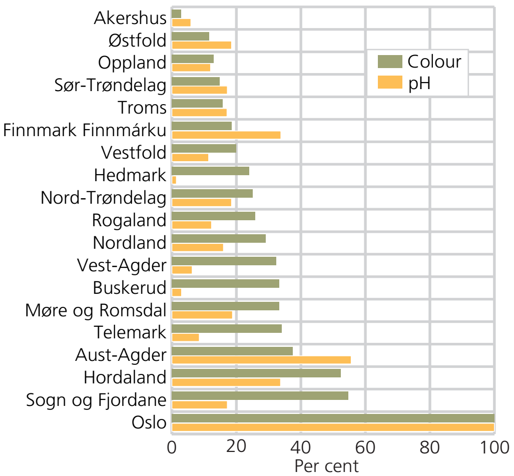
- In 2003, water production at Norwegian water works was calculated to be 815 million m^3, with households using 40 per cent of this total.
- About a third of the water produced was lost due to leakages from pipelines and joints.
- Average household consumption is estimated at 216 litres per person per day.
- There is substantial uncertainty associated with these figures as they are largely based on estimates from the water works.

Figure 8.6. Number of water works that do not satisfy the requirements with respect to content of thermo-tolerant pathogenic bacteria. By county. 2003



Source: National Institute of Public Health, water works register.

Figure 8.7. Percentage of public water works that do not satisfy the requirements with respect to pH and colour. By county. 2003[1]



[1] The figure is based on information from 1 198 water works that report having conducted pH tests and 1 206 water works that have conducted colour tests. In 2003, 1 727 water works were subject to the reporting requirement. In Oslo, the information refers to one water works comprising several treatment plants. The main treatment plant is currently not satisfactory, but a new plant has been planned/is under construction.
Source: National Institute of Public Health, water works register.

Water quality

- It is important to ensure that drinking water does not contain pathogenic bacteria. The drinking water regulations contain an absolute requirement for all water to be disinfected or treated to prevent the spread of infection. The treatment of drinking water involves adding chemicals (primarily chlorine), the use of UV radiation or membrane filtration.
- A number of water works using surface water as their source are finding it hard to comply with the requirements with respect to thermo-tolerant pathogenic bacteria in water. In 2003, the highest percentages of unsatisfactory samples were recorded in the counties of Nordland, Hordaland, Troms and Møre og Romsdal.
- Figures from 2003 show that of a selected 4.1 million people in Norway, 1.3 per cent are supplied with drinking water that does not satisfy water quality with regard to *E.coli*. The *E. coli* bacteria is a common indicator of the presence of intestinal bacteria in drinking water.
- A number of water works are finding it difficult to meet the acidity and colour requirements. Acidic water corrodes pipelines and can result in high metal content levels in drinking water. High humus content colours the water brown and may cause sludge and unwanted bacterial growth in water pipeline systems. Chlorination of water containing humus may result in the formation of organochlorine compounds, with potential effects on odour, taste and health.
- A pH level that is too low is mainly due to acid rain and runoff from acidic rock such as granite and gneiss. The problem of coloured water is mainly due to humus and organic material deposited in water sources during rainfall and minor flooding.

Box 8.2. International agreements and concepts related to nutrient inputs to coastal areas and inland waters

North Sea Agreements and the OSPAR Convention

- The North Sea Agreements refer to the joint declarations made by the countries round the North Sea to reduce inputs of nutrients to the North Sea. One of the targets was to halve the total inputs of nitrogen and phosphorus during the period 1985 to 1995. Since Norway had not reached the nitrogen target by the end of 1995, the national time limit was extended to 2005.

- One of the key agreements is the OSPAR Convention for the protection of the marine environment of the North-East Atlantic. The Convention was opened for signature at the Ministerial Meeting of the Oslo and Paris Commissions in Paris on 22 September 1992. The following countries have ratified the Convention: Belgium, Denmark, Finland, France, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, UK, Sweden, Switzerland and Germany. The Convention entered into force on 25 March 1998.

Source: *http://www.ospar.org/eng/html/welcome.html*

The North Sea counties or North Sea region

In principle, the North Sea Agreements apply to the areas south of 62° N. In Norway, the targets for reducing inputs of nutrients apply to the counties from the border with Sweden to Lindesnes. Thus, the North Sea counties or North Sea region means the following counties: Østfold, Akershus, Oslo, Hedmark, Oppland, Buskerud, Vestfold, Telemark, Aust-Agder and Vest-Agder. Virtually all land in these counties drains into the Skagerrak or the North Sea.

Trophic status and eutrophication

The trophic status describes the plant nutrient and biological production conditions in water bodies. Water that is rich in nutrients and very productive biologically is called eutrophic, while water that is poor in nutrients and unproductive is termed oligotrophic. In fresh water, eutrophication is usually caused primarily by phosphorus inputs, although nitrogen and other substances also play a role. Eutrophication is a natural process in which inputs of organic matter containing plant nutrients alter biological production conditions in water bodies towards an environment rich in nutrients and high plant production. Excessive inputs of phosphorus, nitrogen and organic matter, often anthropogenic, cause increased eutrophication of inland waters and coastal areas. Important anthropogenic sources include agriculture, waste water from households, industry, fish farms and nitrous gases in air pollution. The effects of eutrophication include cloudy, discoloured water, overgrown bottom and shore and vigorous vegetation. Excessive algal production may lead to anaerobic decomposition. This may cause fish mortality, the destruction of spawning areas, a sludge layer on the bottom and toxic, sulphuric bottom water.

The sensitive area for phosphorus

The area that drains to the coast from the border with Sweden to Lindesnes is particularly sensitive to phosphorus inputs.

The sensitive area for nitrogen

The inner Oslofjord, the area Hvaler-Singlefjorden (around the estuary of the river Glomma) and the catchment areas of the Glomma and Halden watercourses are regarded as particularly sensitive to nitrogen inputs. In these areas, the authorities have issued instructions for nitrogen removal at six waste water treatment plants.

Box 8.3. The Urban Waste Water Treatment Directive

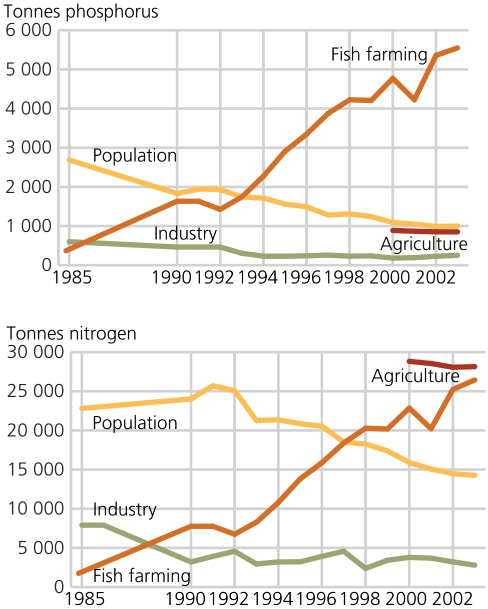
The objective of the Urban Waste Water Treatment Directive (EU Council Directive of 21 May 1991 concerning urban waste water treatment, 91/271/EEC, amended by Directive 98/15/EEC) is to protect people and the environment from the adverse effects of waste water discharges. Waste water from human activities contains nitrogen, phosphorus, organic substances, micro-organisms and small amounts of hazardous substances. If waste water treatment is inadequate, this may result in various kinds of pollution in Norwegian coastal areas and watercourses.

The directive therefore focuses on the collection, treatment and discharge of urban waste water, and treatment and discharges of biodegradable waste water from the food industry. Specific time limits and treatment requirements for urban waste water in agglomerations with a population equivalent (p.e.) of more than 2 000 for discharges to inland water bodies and river estuaries and more than 10 000 p.e. for discharges to coastal waters. The requirements shall be met at the latest by 31 December 2005. The Urban Waste Water Treatment Directive sets out a general requirement for secondary treatment, but it is assumed that many treatment plants along the coast between Lindesnes and Grense-Jakobselv on the Russian border only need to carry out primary treatment (see box 8.4) under an exception provision in the directive. This presupposes, however, that municipalities carry out thorough investigations to document that the discharges will not adversely affect the environment.

The treatment requirements will, however, depend somewhat on the area to which waste water is discharged. Particularly stringent treatment is required before waste water is discharged to "sensitive areas" with respect to pollution. The identification of "sensitive areas" will be reviewed every four years.

8.3. Inputs of nutrients to coastal areas

Figure 8.8. Inputs[1] of phosphorus and nitrogen to the Norwegian coast, by sector. 1985-2003

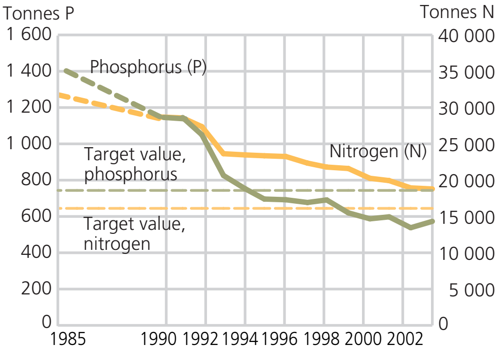


[1] Inputs from agriculture have not been modelled for data sets prior to 2000.
Source: Norwegian Institute for Water Research (2004).

The Norwegian coast

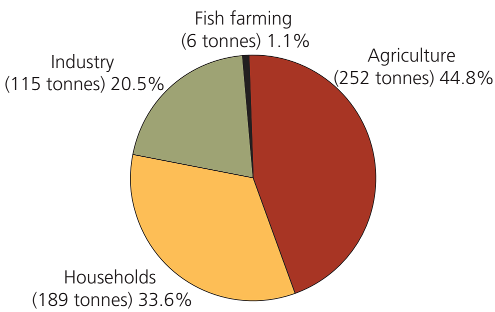
- In the period from 2000 to 2003, the total anthropogenic inputs of phosphorus and nitrogen to the coast increased by an estimated 10 and 25 per cent respectively.
- Due to the development of the fish farming industry along the coast from the county of Rogaland and northwards, the discharges from this industry have increased substantially since 1985. In 2003, phosphorus discharges were 5 200 tonnes higher and nitrogen discharges 24 700 tonnes higher than in 1985. Today, this industry accounts for 73 per cent of phosphorus inputs and 37 per cent of nitrogen inputs to coastal areas.
- In 2003, agriculture was the largest source of nitrogen run-off to the Norwegian coast, and accounted for 39 per cent of the anthropogenic inputs.

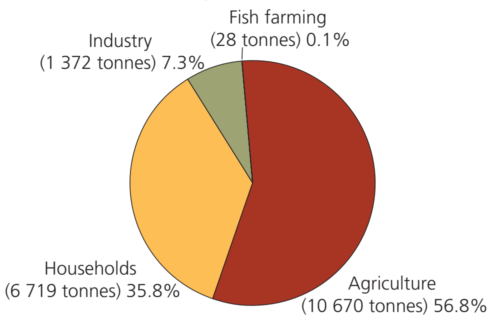
Figure 8.9. Inputs of phosphorus and nitrogen to the North Sea region. 1985-2003



Source: Norwegian Institute for Water Research (2004).

Figure 8.10. Inputs of phosphorus and nitrogen to the North Sea region, by sector. 2003





Source: Norwegian Institute for Water Research (2004).

The North Sea area

- In order to achieve the targets of the North Sea Agreements, substantial sums have been invested in new high-grade waste water treatment plants and upgrading of older plants in the North Sea region. Measures have also been implemented in fish farming and the agricultural sector.
- Phosphorus and nitrogen inputs to the sensitive North Sea region (from the border with Sweden to Lindesnes) have been reduced by 62 and 42 per cent respectively from 1985 to 2003.
- This means that the target set for phosphorus in the North Sea Agreements has already been achieved, but that the nitrogen target has not yet been reached (see box 8.2).
- Phosphorus inputs from municipal waste water treatment plants (mainly from households) have been reduced by 739 tonnes (80 per cent) since 1985 and nitrogen inputs by 5 210 tonnes (44 per cent).
- Phosphorus inputs from agriculture have been reduced by around 37 per cent and nitrogen inputs by 27 per cent since 1985.
- Phosphorus and nitrogen inputs from manufacturing industry have been reduced by 14 and 76 per cent respectively.
- In 1997, open fish farming facilities were prohibited in the North Sea region, and inputs from this industry have thus been considerably reduced.

Box 8.4. Terms, municipal waste water treatment

Waste water means domestic and industrial waste water and run-off rain water (storm water).

Municipal waste water means domestic waste water and waste water consisting of a mixture of domestic waste water and industrial waste water and/or run-off rain water. Waste water consisting of less than 5 per cent domestic waste water is not regarded as municipal waste water.

Domestic waste water is waste water that predominantly originates from the human metabolism and household activities, including waste water from toilets, kitchens, bathrooms, utility rooms and the like.

Storm water is water at surface level. It is mainly a result of precipitation (see also the definition of overflow).

An overflow (weir) is a technical device to conduct water out of the sewerage system in the event of an overload in the system. The water is diverted away via other systems (ditches, etc.), bypassing any treatment devices.

A waste water treatment plant is any plant for the treatment of waste water consisting of one or more of the following components: sewerage system, treatment plant and discharge facility.

A sewerage system is a system of conduits that collects and conducts waste water from houses or other buildings with indoor plumbing.

The public sewerage system is a sewerage system to which connection is permitted for the general public.

A private sewerage system is a sewerage system to which connection is not permitted for the general public.

Waste water treatment plants are generally divided into three main groups according to the type of treatment they provide: mechanical, biological or chemical. Some plants operate combinations of these basic types.

Mechanical waste water treatment plants include sludge separators, screens, strainers, sand traps and sedimentation plants. They remove only the largest particles from the waste water.

High-grade waste water treatment plants are those that provide a biological and/or chemical treatment phase. Biological treatment mainly removes readily degradable organic material using microorganisms. The chemical phase involves the addition of various chemicals to remove phosphorus. High-grade plants reduce the amounts of phosphorus and other pollutants in the effluent more effectively than mechanical plants.

Natural purification processes include facilities where the waste water is treated for example using wetland filters (constructed wetlands). In these and other facilities using a similar system, micro-organisms decompose the organic material in the waste water and plants utilise the nutrients.

Primary treatment means treatment of waste water by a physical and/or chemical process involving settlement of suspended solids, or other processes in which the BOD5 of the incoming waste water is reduced by at least 20 per cent before discharge and the total suspended solids of the incoming waste water are reduced by at least 50 per cent.

Secondary treatment means further reduction of organic material in relation to primary treatment requirements (see above). The requirements may be met by means of a treatment efficiency requirement (minimum percentage reduction) or a concentration requirement (maximum concentration of organic material).

Tertiary treatment means the strictest requirements as to treatment methods and the reduction of phosphorus and nitrogen in the waste water before discharge to the recipient.

The number of population equivalents (p.e.) in an area is given by the sum of the number of permanent residents and all waste water from industry, institutions, etc. converted to the number of people who would produce the same amount of waste water.

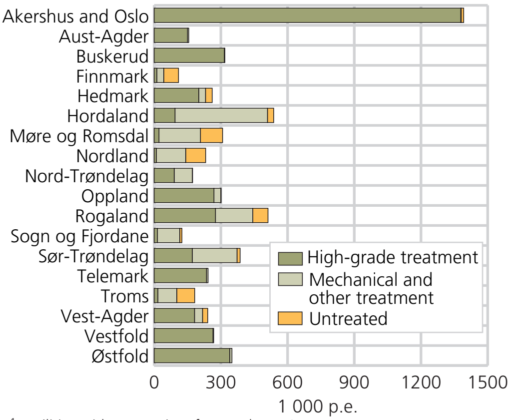
The hydraulic capacity (treatment capacity) of a treatment plant is the amount of waste water it is designed to treat.

Individual waste water treatment facilities are designed to receive waste water equivalent in amount or composition up to 50 p.e. (generally, private plants in areas with scattered settlement).

Source: Norwegian Pollution Control Authority (www.sft.no)

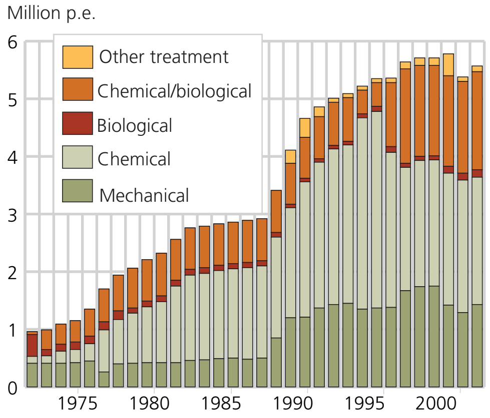
8.4. Municipal waste water treatment

Figure 8.11. Hydraulic capacity of waste water treatment plants[1], by treatment method. By county. 2003



[1] Facilities with a capacity of more than 50 p.e.
Source: Waste water treatment statistics, Statistics Norway.

Figure 8.12. Trend in treatment capacity[1]. Whole country. 1972-2003

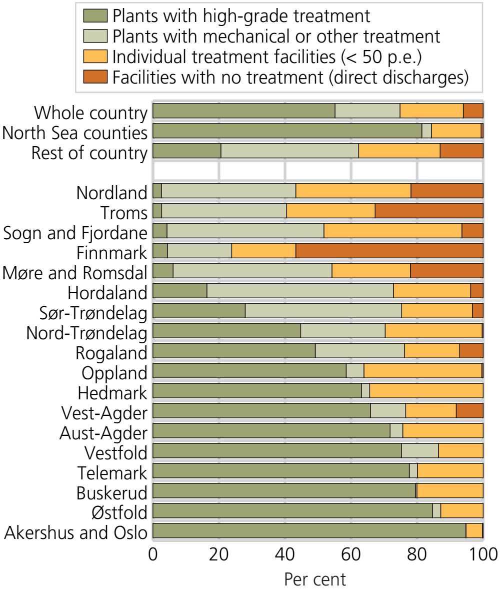


[1] Facilities with a capacity of more than 50 p.e.
Source: Waste water treatment statistics, Statistics Norway.

Treatment capacity at waste water treatment facilities

- In 2003, total waste water treatment capacity in Norway was 5.57 million population equivalents (p.e.), 73 per cent of which was high-grade treatment. In addition, systems with direct discharges of untreated sewage had a total capacity of 0.52 million p.e.
- High-grade treatment methods account for over 96 per cent of treatment capacity in the North Sea counties, but only 34 per cent of the total in the rest of the country.
- High-grade treatment capacity in the North Sea region totals 1.32 p.e. per inhabitant, while the equivalent figure for the rest of the country is 0.34 p.e. This is about the same level as in 2002.
- The developments in treatment capacity reflect investments made in the 1970s in chemical treatment processes for the removal of phosphorus and the upgrading of some large treatment facilities in the inner Oslofjord to chemical-biological treatment facilities since the mid-1990s.
- The substantial increase in mechanical treatment capacity, particularly since 1988, is largely because this is when registration of strainers and sludge separators in mechanical treatment facilities was introduced.
- The category "other treatment" includes natural purification processes. In 2001, the capacity of this category increased substantially, but has since then been reduced. The changes in this category are probably to a large degree attributable to modified reporting routines, rather than real changes in the number of plants.

Figure 8.13. Percentage of population connected to various types of treatment plants. By county. 2003



Source: Waste water treatment statistics, Statistics Norway

Connection to waste water treatment plants

- In 2003, 81 per cent of the population of Norway were connected to waste water treatment plants with a capacity greater than 50 p.e. and to municipal sewerage systems. The remaining 20 per cent were connected to smaller, individual treatment facilities.
- Over 55 per cent of the population were connected to high-grade treatment plants in 2003. In the North Sea counties, this proportion was over 81 per cent, while the figure for the rest of the country was 21 per cent.

Discharges of plant nutrients from waste water treatment plants

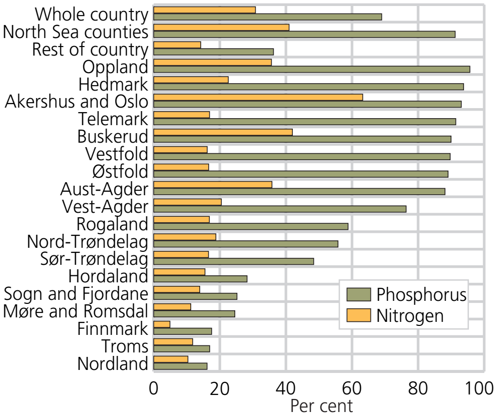
- Discharges of phosphorus and nitrogen from the waste water treatment sector in 2003 totalled 1 228 and 15 599 tonnes respectively. This includes leakages from sewers and discharges from individual treatment facilities (< 50 p.e.).
- Plants in the North Sea counties accounted for 27 per cent of the phosphorus discharges and 50 per cent of the nitrogen discharges. This corresponds to a discharge of 0.13 kg phosphorus and 3.07 kg nitrogen per capita per year. Compared with 2002, the per capita phosphorus discharges are almost unchanged, while there has been a small decrease for nitrogen. The equivalent figures for the rest of the country were 0.44 kg phosphorus and 3.83 kg nitrogen. For both phosphorus and nitrogen there has been a slight increase in per capita discharges.

Table 8.1. Total discharges of phosphorus and nitrogen from sewerage systems 2000-2003. By county. 2003

	Phosphorus					Nitrogen				
	Total	Discharges from municipal treatment plants	Leakages from sewers[1]	Discharges from individual treatment facilities	Discharges per inhabitant	Total	Discharges from municipal treatment plants	Leakages from sewers[1]	Discharges from individual treatment facilities	Discharges per inhabitant
	Tonnes				kg	Tonnes				kg
Total 2000	**1 296**	**825**	**124**	**346**	**0.29**	**17 374**	**13 191**	**912**	**3 270**	**3.88**
Total 2001	**1 280**	**795**	**123**	**362**	**0.28**	**16 723**	**12 303**	**860**	**3 560**	**3.71**
Total 2002	**1 186**	**725**	**120**	**347**	**0.26**	**15 802**	**11 785**	**830**	**3 246**	**3.49**
Total 2003	**1 228**	**756**	**121**	**351**	**0.27**	**15 599**	**11 426**	**835**	**3 338**	**3.41**
North Sea counties (01-10)	3 331	134	72	125	0.13	7 764	5 866	507	1 391	3.07
Other counties (11-20)	897	622	49	226	0.44	7 835	5 559	329	1 947	3.83
01 Østfold	40	19	7	14	0.15	977	818	49	111	3.81
02-03 Akershus and Oslo	95	44	32	19	0.09	2 032	1 629	222	181	2.01
04 Hedmark	34	11	6	18	0.18	810	528	36	246	4.30
05 Oppland	24	4	4	16	0.13	692	415	35	243	3.77
06 Buskerud	31	11	6	15	0.13	635	442	37	156	2.62
07 Vestfold	40	14	7	19	0.18	960	765	46	150	4.37
08 Telemark	25	8	5	12	0.15	700	541	33	127	4.22
09 Aust-Agder	14	5	2	7	0.14	333	228	18	88	3.23
10 Vest-Agder	28	17	4	6	0.17	623	502	32	90	3.89
11 Rogaland	126	93	10	24	0.32	1 480	1 199	68	214	3.81
12 Hordaland	170	123	9	38	0.38	1 530	1 125	71	334	3.44
14 Sogn and Fjordane	60	41	2	17	0.56	415	240	14	161	3.87
15 Møre and Romsdal	130	94	6	30	0.53	1 058	762	44	252	4.33
16 Sør-Trøndelag	127	89	9	29	0.47	990	697	42	251	3.66
17 Nord-Trøndelag	42	23	3	17	0.33	449	299	19	131	3.51
18 Nordland	124	71	4	49	0.52	937	521	31	386	3.95
19 Troms	76	56	3	17	0.50	632	465	26	141	4.14
20 Finnmark Finnmárku	41	32	2	7	0.56	344	253	14	77	4.69

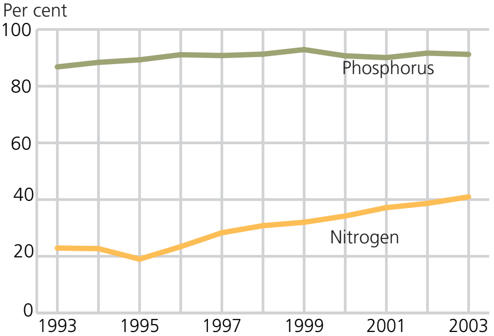
[1] Estimated at 5 per cent of the content of phosphorus and nitrogen in waste water before treatment.
Source: Waste water treatment statistics, Statistics Norway.

Figure 8.14. Estimated treatment effect for phosphorus and nitrogen. By county. 2003



Source: Waste water treatment statistics, Statistics Norway.

Figure 8.15. Trend in treatment effect for phosphorus and nitrogen in the North Sea region. 1993-2002. Per cent

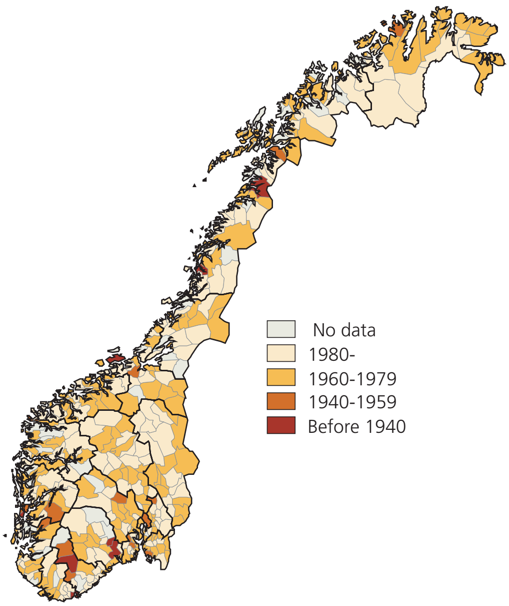


Source: Waste water treatment statistics, Statistics Norway.

Treatment efficiency

- In 2003, waste water treatment plants in the North Sea counties removed on average 91 per cent of the phosphorus and 41 per cent of the nitrogen load processed by the plants. In the rest of the country, treatment efficiency for these nutrients was 36 and 14 per cent respectively.
- In the North Sea region, a 2 per cent increase in treatment efficiency for nitrogen was registered from 2002 to 2003. Treatment efficiency for phosphorus has stood at over 90 per cent since 1996. Actual efficiency will vary somewhat from year to year, partly because unusual incidents (operational failure, overload, etc.) at the larger plants can have a substantial effect on the figures.
- Since 1995, treatment efficiency for nitrogen has been improved from about 20 per cent to over 40 per cent due to the construction of nitrogen removal plants in the Oslofjord area.

Figure 8.16. Average age of municipal sewerage systems. 2004

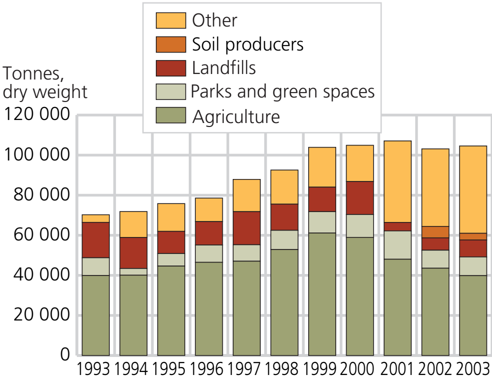


Source: KOSTRA, Statistics Norway.

Sewerage systems

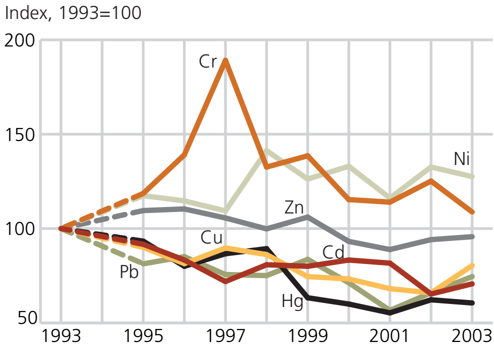
- There is a total of 33 200 km of municipal sewage pipelines in Norway. This corresponds to 4/5 of the earth's circumference at the equator.
- Renewal of the sewerage system is essential to prevent damage to buildings and inadvertent environmental pollution as a result of damaged pipes or leaks. Damaged pipes can also contribute to higher treatment costs due to surface water and groundwater draining into the sewerage system.
- The average rate of renewal for sewerage systems in Norwegian municipalities for the period 2002-2004 is estimated at 0.56 per cent per year. This corresponds to a pipeline life of about 180 years, given that the rate of renewal remains the same.
- The average regional rate of renewal is 0.51 per cent for the counties in the North Sea region (from Østfold to Vest-Agder) and 0.62 per cent for the rest of the country.
- The sewerage system, however, is larger in the southeastern part of the country, so that the length of pipeline renewed in the North Sea region is nevertheless greater (about 95 kilometres) than in the rest of the country (about 90 kilometres).
- These figures show that for the country as a whole, about 12 per cent of the sewerage system was laid in the period prior to 1940 and about 9 per cent in the period 1940-1959. The remainder of the sewerage system was laid after this date.

Figure 8.17. Quantities of sewage sludge used for different purposes. Whole country. 1993-2003



Source: Waste water treatment statistics, Statistics Norway.

Figure 8.18. Trends for contents of heavy metals in sludge. 1990-2003[1]. Whole country. Index, 1993=100



[1] Figures for 1994 are not available.
Source: Norwegian Pollution Control Authority (SESAM) and Waste water treatment statistics, Statistics Norway.

Sewage sludge

- Sludge is a residual product of the waste water treatment process, but also a potential resource in integrated plant nutrient management in agricultural areas and parks and other green spaces. Nutrients and organic matter are separated from the waste water, and the sludge is stabilized and hygienized to remove odours and harmful bacteria before utilization or disposal in landfills.
- In 2003, 104 600 tonnes of sludge, expressed as dry weight, was used for various purposes, an increase of 1 per cent compared with 2002. The amount of sludge that has been reported used for various purposes since 1993 seems to be stabilising. Since 2002, the municipalities have reported the amount of sludge used by soil producers. It is assumed that this was previously included in existing categories.

- If the content of heavy metals exceeds the limit values, the sludge cannot be used in integrated plant nutrient management.
- The concentration of heavy metals varies over time. However, the main trend i Norway has been a decrease in the content of heavy metals in sludge. Nickel and chromium are exceptions, however, maintaining a persistently high level since 1993.
- The content of heavy metals varies, sometimes substantially, from one plant to another. This is because the composition of waste water varies (depending on, for example, the amount of waste water from households, and the proportion of industrial waste water and of rain/melt water).

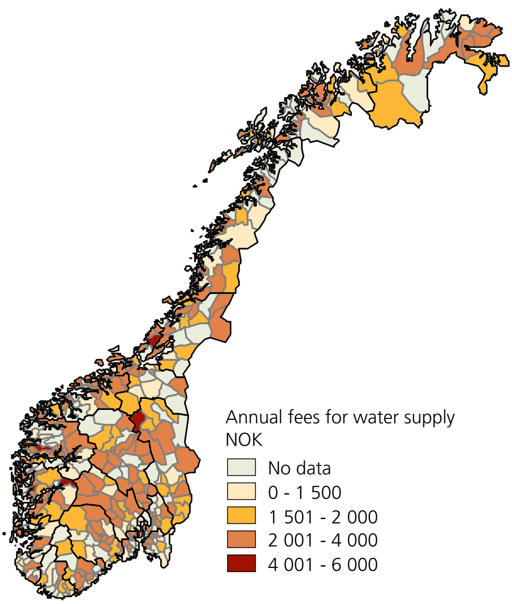
Table 8.2. Content of heavy metals in sludge. 2003

Heavy metals	Mean value	Maximum value	Limit value agriculture	Limit value parks, etc.	Change in mean value 2002-2003
	Milligrams per kg expressed as dry weight				Per cent
Cadmium (Cd)	0.9	1.2	2	5	9.6
Chromium (Cr)	23.4	48.1	100	150	-13.0
Copper (Cu)	267.6	363.2	650	1 000	21.9
Mercury (Hg)	0.9	1.7	3	5	1.8
Nickel (Ni)	13.9	23.7	50	80	-3.5
Lead (Pb)	21.6	33.8	80	200	13.0
Zinc (Zn)	326.0	421.7	800	1 500	1.7

Source: Waste water treatment statistics, Statistics Norway.

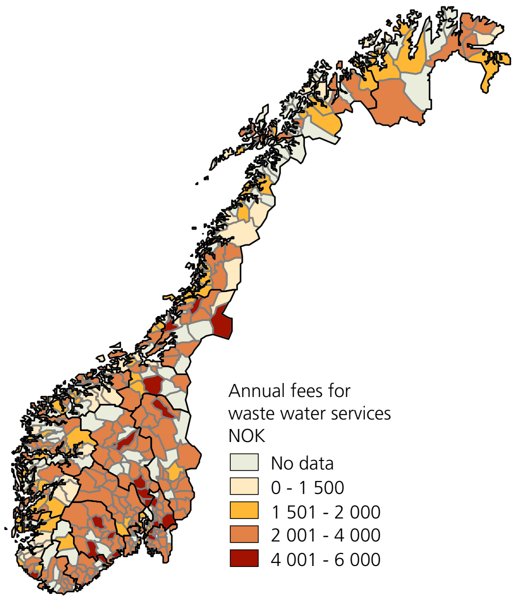
8.5. Fees in the municipal water and waste water sectors

Figure 8.19. Annual fees for water supply, by municipality. 2005. NOK



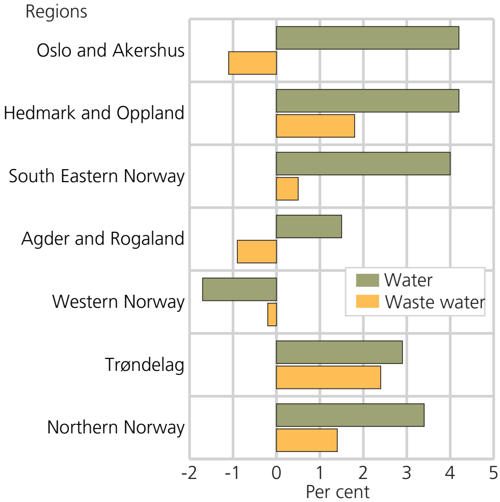
Source: KOSTRA, Statistics Norway.

Figure 8.20. Annual fees for waste water services, by municipality. 2005. NOK



Source: KOSTRA, Statistics Norway.

Figure 8.21. Municipal fees for residential water and waste water services. Percentage change, January 2004-January 2005



Source: Dwelling and housing conditions statistics, Statistics Norway.

Water supply

- From January 2004 to January 2005, water fees rose by 2.6 per cent, including 1 per cent in increased VAT.
- Water fees rose most in the counties of Oslo, Akershus, Hedmark and Oppland, which all had an increase of 4.2 per cent. Fees decreased most in Western Norway, falling by 1.7 per cent.
- The level of water fees vary widely among municipalities. The reasons for this have not yet been investigated.

Waste water services

- For the country as a whole, waste water fees showed only a slight increase of 0.2 per cent. Since VAT, paid to the state, rose by 1 per cent in January 2005, this means that municipal fees declined somewhat in real terms.
- Oslo and Akershus showed the sharpest decline, 1.1 per cent, while in Trøndelag waste water fees rose by 2.4 per cent.
- To obtain comparable figures, the fees for water and waste water are based on estimated or actual water consumption for a standard dwelling with an area of 120 square metres. Water and waste water fees have been calculated as an average of estimated and actual consumption. In municipalities where consumers are charged according to actual consumption as measured by a water meter, the price per cubic metre is multiplied by a standard consumption volume of 175 cubic metres. In municipalities with a two-part tariff structure, a standard charge is made in addition to the variable rates.
- One reason for the relatively high waste water fees in many municipalities in Eastern Norway may be that stricter requirements for waste water treatment in this region (for example compared with the North Sea Agreements) result in higher costs and thus a need to increase financing in the form of waste water fees in these areas. These relationships have not been systematically examined, however.

More information: Julie L. Hass (julie.hass@ssb.no) (financial data) and Jørn Kristian Undelstvedt (jku@ssb.no).

Useful websites

Statistics Norway - Water and waste water statistics:
http://www.ssb.no/english/subjects/01/04/20/
Statistics Norway - Environmental protection expenditure statistics:
http://www.ssb.no/english/subjects/01/06/20/
Norwegian Institute of Public Health: http://www.fhi.no/english/
Norwegian Institute for Water Research: http://www.niva.no/engelsk/welcome.htm
State of the Environment Norway: http://www.environment.no/

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Norwegian Institute for Water Research (2004): Government programme for pollution monitoring – input of nutrients to Norwegian coastal areas in 2003, calculated using the input model TEOTIL. NIVA report nr. 4895-2004. Norwegian Institute for Water Research (NIVA).

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9. Land use

With a land area of 304 280 km² and 4.6 million inhabitants, Norway has the second lowest population density in Europe after Iceland with 15 inhabitants per km². Because of Norway's climate, geology and topography, a large proportion of the country has not been developed for settlement and agriculture. Nearly 80 per cent of the population lives in urban settlements, where population density is over 100 times the national average. These densely built-up areas, and the productive agricultural and forest areas surrounding them, are therefore under considerable pressure. But land use has increased in many sparsely settled areas too, as a result of road construction, the building of holiday cabins, the construction of power lines, and so on.

How the land is used is of great importance in terms of economics and the environment, and it affects people's lives. Changes in land use result in changes in the cultural landscape and the local environment. This may have considerable impact on human health and quality of life, and on the productivity and ecological qualities of the natural environment.

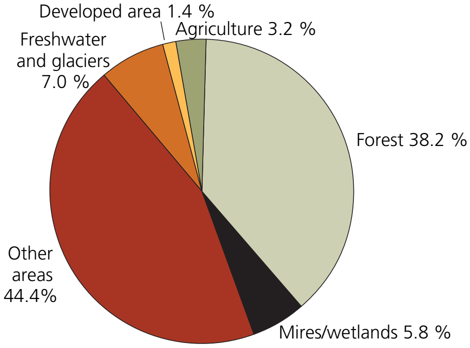
Resource and environmental conflicts often result as settlement patterns become increasingly concentrated along the coast and in the most productive agricultural areas. These can include the conversion of the most valuable agricultural areas for other purposes, pressure on recreational areas in and around urban settlements, conflicts about whether to demolish or restore old buildings, and more concentrated pollution. On the other hand, population concentrations provide opportunities for environmental gains such as reduced energy use for transport and residential areas, a greater range of play and recreational areas and more efficient water, sewage and waste disposal schemes.

Sustainable urban settlement development is one of the main issues in Report No. 29 (1996-1997) to the Storting on regional planning and land use policy. The objective of planning is to focus on strengthening economic activity and promoting settlement in urban settlement centres, reducing the need for transport, generally making more efficient use of the land and ensuring green spaces are protected for recreational purposes and to maintain biological diversity. Efforts to develop a national environmental and land use policy have been followed up in the Reports to the Storting on the Government's environmental policy and the state of the environment in Norway, which set strategic and national targets for biological diversity, outdoor recreation and the cultural heritage.

In Report No. 21 (2004-2005) to the Storting, regional planning and land use policy was established as a new priority area for environmental policy, and strategic objectives and national targets were defined. The white paper highlights the fundamental importance of a national land use policy in order to achieve sustainable management of Norway's total land resources and to create a healthy physical environment. The policy focuses on land as a basis for settlement and commercial development, for experiencing the natural surroundings and for recreational purposes, and on safeguarding the values inherent in the landscape and biological and cultural diversity. The objective of sustainable land use management should not only be to avoid environmental conflict as a result of the conversion or degradation of environmental assets, but also to make a contribution towards long-term solutions and enhance the environment.

9.1. Land use in Norway

Figure 9.1. Proportion of different types of land cover. Mainland Norway. 2005



Source: Norwegian Mapping Authority and Statistics Norway.

The most common types of land use

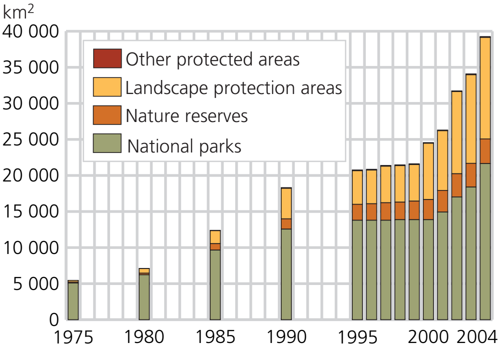
- In 2005, developed land contained a total of 4.2 million buildings, 4 100 km of rail track and 93 000 km of public roads, in addition to about 73 000 km of forest roads and other roads (Norwegian Mapping Authority 2005, and Norwegian National Rail Administration 2005).
- Agricultural area in use covers about 10 400 km^2 and productive forest about 75 000 km^2 (Norwegian Institute for Land Inventory 2005).
- The remaining land area comprises other cultivated land, non-developed coastal areas, scrub and heaths, marginal forest, and mountains. About 2 600 km^2 of the mainland is under permanent ice and snow (Wold 1992).

Box 9.1. Norway's main geographical features

The geographical location of the country and its elongated form with variations in climate, quaternary geology and topography mean that the conditions for land use vary widely. The mainland is 323 802 km^2 in total (304 280 km^2 land and 19 522 km^2 fresh water) and 1 752 km in length. It stretches from Lindesnes in the south (57° 58' N) to Kinnarodden in the north (71° 7' N). The mainland is bounded to the south, west and north by a 2 650 km long coastline, not including fjords, bays and islands. In terms of altitude, 31.7 per cent of the land area lies 0-299 metres above sea level. As much as 20.1 per cent of the land area lies at least 900 metres above sea level and productivity (in terms of vegetation) is therefore low (see also Statistical Yearbook of Norway 2005, pp. 15-23 and 43- http://www.ssb.no/english/yearbook/).

9.2. Protection and development

Figure 9.2. Areas protected under the Nature Conservation Act. Whole country. 1975-2005. km²



Source: Directorate for Nature Management.

Areas protected under the Nature Conservation Act

- The total area protected under the Nature Conservation Act has expanded considerably since 1975. At 1 January 2005, protected areas included 24 national parks, 1 701 nature reserves, 153 protected landscapes and 98 other types of protected area. See also Appendix, table I5.
- Protected areas account for 39 266 km^2 or 12.1 per cent of Norway's total area, an increase over the year of 15 per cent.
- At the end of 2004, a total of 914 km^2 of productive forest had been protected. This is equivalent to 1.2 per cent of the total area of productive forest, and includes protected forest in the national parks (Directorate for Nature Management 2005).

Box 9.2. Protected areas. Overview of legislation

Most of the protected areas in Norway are protected under the Nature Conservation Act. Other legislation and treaties of importance in this connection include:

- Wildlife Act
- Planning and Building Act
- Act relating to salmonids and fresh-water fish
- Forestry Act
- Cultural Heritage Act
- Svalbard Environmental Protection Act
- Act relating to Jan Mayen
- Act relating to Bouvet Island, Peter I's Island and Queen Maud Land
- Antarctic Treaty

In addition there are so-called administratively protected areas. These are areas or individual trees or groups of trees on public ground.

Box 9.3. Building activity in the 100-metre belt along the coast

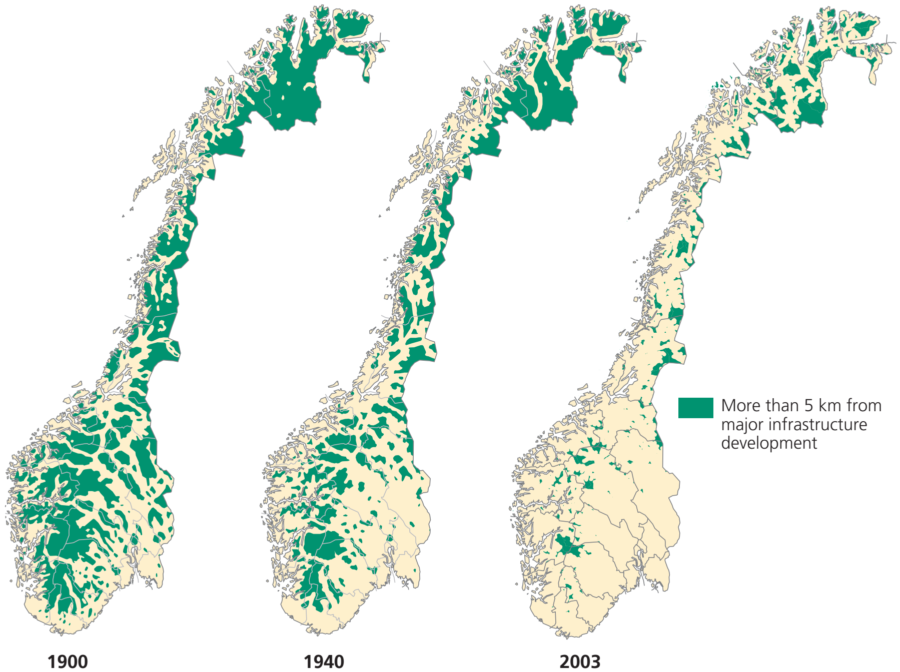
Protecting areas of recreational value is an expressed national target. Several specific key figures have been drawn up as operational tools to monitor developments in relation to the national targets for the priority area *Outdoor recreation* in environmental policy.

Access to the 100-metre belt along the coast is one such key figure. The mainland coastline is 83 300 km long, including islands, fjords and bays. This is equivalent to twice the circumference of the earth at the equator. Most of the urban settlements and a large proportion of other built-up areas, including holiday cabins, are concentrated along the coast. As much as 23.5 per cent of the total length of the coastline is less than 100 metres from the nearest building (registered in the GAB, the official Norwegian register for property, addresses and buildings, as of 1 January 2004). From Halden in the south-east to Hordaland in the west, a stretch of the coast specifically mentioned in the context of key figures, as much as 39.1 per cent of the coastline is less than 100 metres from a building. This indicates that public access to the 100-metre belt of the coastal zone is considerably restricted in some parts of this stretch of the coast (see Chapter 1, figure 1.2 and Appendix, table I4).
Read more in: http://www.ssb.no/english/subjects/01/01/20/strandsone_en

Wilderness-like area

- Wilderness-like areas, defined as areas more than 5 km from major infrastructure development, have been dramatically reduced from about 48 per cent of Norway's land area in 1900 to between 11 and 12 per cent today. See also figure 1.1 and text in Chapter 1.

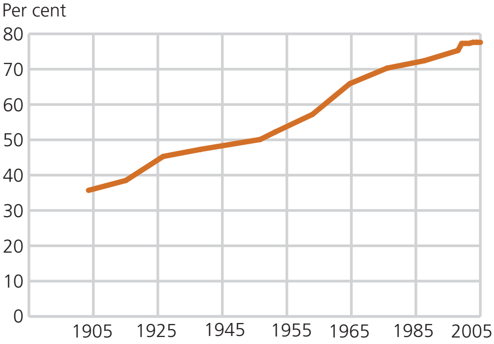
Figure 9.3. Wilderness-like areas. 1900, 1940 and 2003



Source: Brun, M. NOU-1986 / Geodatasenteret AS 2004. Directorate for Nature Management 2004/Editing and graphic production: Geodatasenteret AS 2004.

9.3. Area and population in urban settlements

Figure 9.4. Percentage of population resident in urban settlements/densely populated areas. 1900-2005



Source: Population statistics, Statistics Norway.

Population trends and area of urban settlements

- The percentage of the population living in urban settlements/built-up areas has increased considerably from 1900 to 2005. A total of 77.6 per cent of the Norwegian population lived in a total of 909 urban settlements at 1 January 2005.
- 63 per cent of the population growth in urban settlements in 2004 occurred in the four largest urban areas: Oslo, Bergen, Stavanger/Sandnes and Trondheim (see also Statistics Norway 2005a).

Table 9.1. Urban settlements, residents and area, by size of population. 1 January 2005. Change from 2004 to 2005

	2005			Change from 2004 to 2005		
Size groups of urban settlements, by number of residents	Population	Total area in km²	Number of areas	Population	Total area in km²	Number of areas
Total	**3 560 137**	**2 219.2**	**909**	**23 647**	**1.94**	**-2**
200-499	115 366	160.9	334	-85	1.18	-1
500-999	153 832	184.1	221	2 733	1.32	2
1 000-1 999	205 479	204.4	146	-428	-0.97	-2
2 000-19 999	1 008 340	745.5	189	2 435	-1.13	-1
2 000-99 999	731 576	426.8	15	4 135	0.40	0
100 000 eller flere	1 345 544	497.5	4	14 857	0.90	0

Source: Population statistics and land use statistics, Statistics Norway.

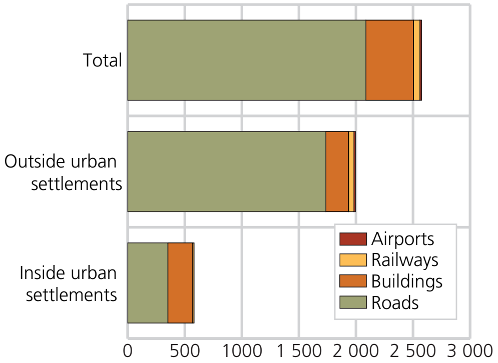
Box 9.4. Delimitation of urban settlements and background data

An urban settlement has been defined by Statistics Norway in simple terms as an area that has at least 200 residents and where the distance between buildings does not normally exceed 50 metres. Urban settlement boundaries are thus dynamic, changing in pace with building patterns and changes in the population.

In addition to the increasing expansion of the major urban settlements, general population growth has resulted in some small areas of scattered settlement developing into urban settlements. At the same time, in areas where the industrial structure is weak, a declining population has meant that some urban settlements are no longer classified as such. Changes in methods of operation in the primary industries and the evolution and concentration of the manufacturing industries and service sectors have resulted in major changes in settlement patterns over the last 100 years. Urban settlements vary widely in size, both measured by area and by population, but most of Norway's urban settlements are small.

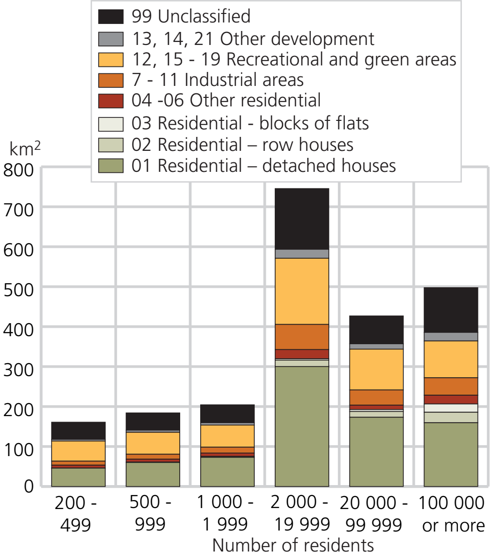
As of 1999, urban settlement statistics are based on correlation between the National Population Register and the GAB register, the official Norwegian register for property, addresses and buildings. With the help of numerical addresses, address or building coordinates and a geographical information system (GIS), buildings and the associated population are grouped together into urban settlements. The quality of the statistics will always depend on how complete and accurate the register data are.

Figure 9.5. Developed area in Norway, by type. km². 2005



Source: Land use statistics, Statistics Norway.

Figure 9.6. Land use in urban settlements, by size of population. km². 2005



Source: Statistics Norway
(2005c http://www.ssb.no/english/subjects/01/01/20/arealbruk_en/)

Physically developed area in urban settlements

- Urban settlements make up less than 1 per cent of Norway's total area, but about one fourth of the physically developed area.
- Infrastructure, buildings and roads make up about 30 per cent of the total area of urban settlements.
- In urban areas, buildings covered about 220 km². Buildings outside urban areas covered about 200 km².
- Roads account for about 2/3 of the physically developed area in urban settlements. Outside urban settlements, this share is 88 per cent (forest roads included).

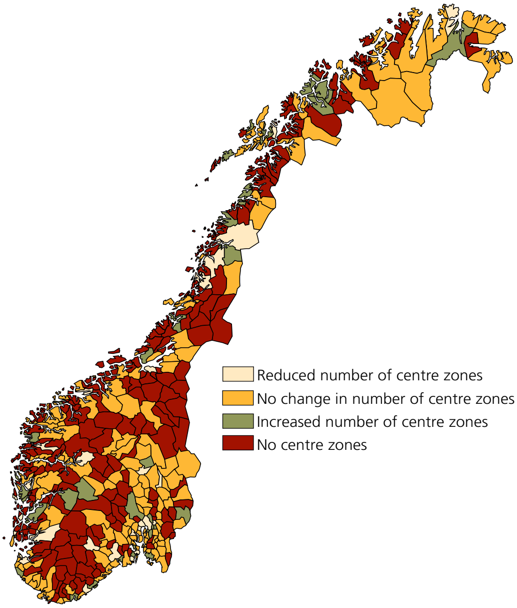
Land use in urban settlements

- Detached houses account for over one third of the total area of urban settlements.
- Small urban settlements take up a larger area in relation to housing density and land use efficiency than large urban settlements.
- Close to one million employees work on 8 per cent of the urban settlement area.
- There are considerable differences between the various urban settlements.

Box 9.5. Land use calculation, data sources and uncertainty

Land use statistics for urban settlements is calculated on the basis of building and property figures in the GAB register, the official Norwegian register for property, addresses and buildings, information on commercial activity in the form of a business code from the Register of Business Enterprises, and area calculated from the outline of buildings in cartographical series (mainly on a scale of 1:1 000). Land use is quantified at two geographical levels: physically developed areas and aggregated land use areas (functional areas). Land use in terms of *physical development* means roads, railways, buildings, etc. *Aggregated land use areas* refer to functional use (residential (gardens and smaller roads included), transport, industry, commercial, etc.).
Methods and uncertainty are described in technical documentation reports (Statistics Norway 2002b-f).

Figure 9.7. Change in number of centre zones by municipality. 2004-2005



Source: Statistics Norway
(2005b http://www.ssb.no/english/subjects/01/01/20/arealsentrum_en/).
Map data: Norwegian Mapping Authority.

Centre zones

- Centre zones (see box 9.6) only figured in 212 of Norway's 434 municipalities as of 1 January 2005, and tend not to be formed in the smallest municipalities (Statistics Norway 2005b).
- In 2004, there was a net increase of 4 centre zones, as against a net loss of 82 the year before.
- As of 1 January 2005 there were a total of 614 centre zones with a population of about 433 000 in Norway. This is equivalent to a 0.6 per cent increase in the number of centre zones, following a decline from 692 in 2003 to 610 in 2004.
- The number of employees in centre zones was 696 000, an increase of 3 000 on the year before, mainly as a result of the increase in the number of centre zones.

Box 9.6. Operationalisation of the concept of the centre zone

In January 1999, a national policy decision, applicable for up to five years, was adopted to call a temporary halt to the establishment of shopping centres outside central parts of towns and urban settlements (Ministry of the Environment 1999). One important reason for this decision was the desire to actively strengthen the development of urban settlement centres and to counteract the tendency towards a pattern of increased transport by private car to large shopping centres outside urban areas.

As a result of this national policy decision, there was a need for a clearer definition of the concept of the centre to ensure that the decision could be uniformly practised by central and local authorities. A pilot project was therefore launched by Statistics Norway in cooperation with the Oslo and Akershus county administration to operationalise the concept of *the centre core* based on criteria of physical concentration and diversity of activity:

- retail trade must take place
- there must be either a public administration centre, a health and social centre or other social/personal services
- at least three main industries must be represented
- the maximum distance between the buildings where these undertakings are located must not exceed 50 metres.

A 100-metre zone was added around the centre core to comprise the *centre zone*.

See map showing centre zones and urban settlements http://www.ssb.no/emner/01/01/20/tettstedskart (in Norwegian only).

Box 9.7. Indicators for sustainable urban development

The national programme for sustainable development in five towns (Ministry of the Environment 1995) resulted in the formulation of a number of general targets for sustainable urban development. Their objective was to reduce land use for development and transport purposes and to safeguard natural surroundings and local outdoor areas to maintain biological diversity and opportunities for recreation, and to improve access to inland water bodies and the sea. In connection with these goals, a number of indicators were formulated (Norwegian Pollution Control Authority 2000):

- Urban settlement area per resident
- Traffic area per resident
- Base area for residential buildings in urban settlements per resident
- Proportion of population resident in urban settlement centre
- Proportion of population within walking distance of various service functions
- Average distance from centre to new housing

These indicators have been described in more detail in *Natural Resources and the Environment 2002*. Norway (Statistics Norway 2002a).

Box 9.8. Targets and key figures for outdoor recreation

Under the strategic environmental policy objective for the priority area outdoor recreation, national target 4 reads as follows: "Near housing, schools and day care centres, there shall be adequate opportunities for safe access and play and other activities in a varied and continuous green structure and ready access to surrounding areas of countryside." On the basis of this target, two key figures to measure performance over time have been calculated:

- Percentage of dwellings, schools and day care centres with safe access to play and recreational areas (at least 0.5 hectares) within a distance of 200 metres.
- Percentage of dwellings, schools and day care centres with access to nearby outdoor recreation areas (larger than 20 hectares) within a distance of 500 metres.

These indicators were described in more detail in *Access to outdoor recreational areas - method and results 2004* (Engelien et al. 2005, in Norwegian only), and a county overview is presented in the Appendix, table I3.

9.4. Municipal land use management

The status of biological diversity, recreation and cultural heritage in municipal land-use planning

- A municipality uses the land-use part of the municipal master plan as the basis for safeguarding areas of special value. This can be done in various ways, for example by adopting plans with a special focus on environmental assets such as biological diversity, opportunities for outdoor recreation and cultural heritage.
- Of these environmental assets, the municipalities place greatest emphasis on outdoor recreation. Biological diversity has to a lesser degree been a priority area, but the share of municipalities with plans has increased substantially since 2001 (see table 9.2). This is probably related to the funds allocated to municipalities to register and assign a value to biological diversity.
- The decisive factor underlying these differences may be municipalities' perception of their areas of responsibility. Classic nature conservation and cultural heritage conservation has traditionally been regarded as a central government responsibility, while outdoor recreation has to a greater extent been delegated to local government.
- Densely populated municipalities incorporate these aspects in their municipal master plan to the greatest extent.
- The lower average age of plans indicates that they are renewed more frequently.
- See also Chapter 4.7 Management of uncultivated areas.

Table 9.2. Percentage of municipalities with an adopted plan with special focus on biological diversity, outdoor recreation and preservation of the cultural heritage. Average age of plans in the reporting year

	Biological diversity		Outdoor recreation		Cultural heritage	
	Percentage of municipalities with plan	Age. Years	Percentage of municipalities with plan	Age. Years	Percentage of municipalities with plan	Age. Years
Whole country						
2001	17	4.6	62	3.7	28	5.5
2002	20	4.2	57	3.4	..	5.3
2003	29	2.3	59	2.3	30	5.2
2004	32	2.7	61	2.6	30	4.8
By population in municipalities, 2004						
Over 300 000	100	2.0	100	3.0	100	3.0
50 000-300 000	91	2.5	91	1.4	73	3.3
30 000-50 000	62	4.3	92	2.5	62	1.8
20 000-30 000	65	5.1	90	2.8	70	6.3
10 000-20 000	40	1.8	62	3.6	38	4.6
5 000-10 000	30	3.1	59	2.4	19	5.7
2 000-5 000	19	2.4	52	2.4	23	4.4
Under 2 000	24	1.9	47	2.3	18	6.0

Source: Statistics Norway (2005d).

Administration of plans in areas of particular environmental value

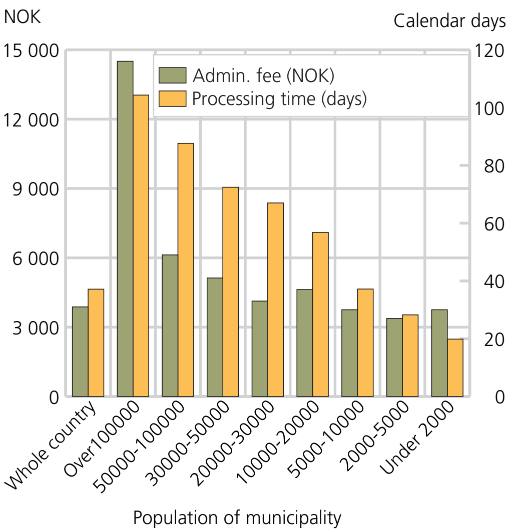
- Plans can be binding or in the form of guidelines indicating which projects can be implemented. Reports on projects in areas of particular environmental value (defined as agricultural areas, areas of natural environment and outdoor recreation areas, the 100-metre belt along the coast and special areas set aside for the preservation of the cultural heritage) show that most applications are in accordance with plans and are approved (see table 9.3).
- Applications for exemptions from adopted plans are granted more often than they are rejected. This applies to all types of area.
- The percentage of exemptions granted along the coastline and in areas along rivers and lakes where building is prohibited has increased from 69 per cent in 2001 to 73 per cent in 2004. The percentage increase is highest along the coast, while along rivers and lakes the percentage of exemptions granted has decreased.
- The case load in municipalities does not seem influence the percentage of exemptions granted.

Table 9.3. Building project applications in areas of particular environmental value. 2001-2004

Type of area	Year	No. of cases processed[2]	Applications consistent with plan, percentage approved	Applications that include exemptions, percentage approved	Rejected applications, percentage
Projects in agricultural areas, areas of natural environment and outdoor recreation areas[1]	2001	15 853	70	23	8
	2002	17 167	74	20	6
	2003	7 801	62	29	9
	2004	7 175	69	26	5
Projects in the coastal zone where building is prohibited[1]	2001	1 636	.	67	33
	2002	1 570	.	69	31
	2003	1 175	.	74	26
	2004	1 167	.	74	26
Projects along rivers and lakes where building is prohibited[1]	2001	336	.	80	20
	2002	410	.	80	20
	2003	325	.	74	26
	2004	295	.	68	32
Projects in areas set aside for preservation of the cultural heritage	2001	799	79	12	10
	2002	568	71	16	13
	2003	866	73	11	17
	2004	636	68	19	14

[1] As from 2003, exceptions apply exclusively to new buildings.
[2] The number applies to municipalities that have reported for the years 2001-2003. About 80 per cent of the municipalities have reported. In 2004 the figures apply to the whole country.
Source: Statistics Norway (2005d).

Figure 9.8. Administrative municipal fee for building of single-family dwelling and average case processing time for undertakings for which application is required, by size of population. 2004



Source: Statistics Norway (2005d).

Fees and case processing time in municipal land use management

- In 2004, net expenses for land use planning accounted for 0.7 per cent of total net municipal operating expenses.
- The size of fees increases with the size of the municipality, measured by population. This may be because more interests are affected by cases involving regulation or building in larger municipalities. There may be more objections, resulting in an increase in the administrative load. It is also likely that the initial processing of these cases must be conducted more thoroughly because there are more considerations to be taken into account, and in order to avoid or be better prepared for subsequent objections or other complaints.
- The low level of fees compared to expenses in small municipalities may, in addition to less complicated administration, be partly related to the use of low fees as an incentive to attract new businesses.
- Case processing time is longest in the largest municipalities. This may be due to higher case complexity. However, this has not been further analysed.

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Useful websites

Directorate for Nature Management: http://english.dirnat.no/
Ministry of the Environment: http://odin.dep.no/md/engelsk/
Geological Survey of Norway: http://www.ngu.no/
Norwegian Institute of Land Inventory: http://www.nijos.no/
Norwegian Institute for Air Research: http://www.nilu.no/
Norwegian Institute for Water Research: http://www.niva.no/engelsk/welcome.htm
Norwegian Mapping Authority: http://www.statkart.no/
Norwegian Pollution Control Authority: http://www.sft.no/english/
Norwegian Water Resources and Energy Directorate: http://www.nve.no/
Statistics Norway, land use statistics: http://www.ssb.no/english/subjects/01/01/20
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Notater 02/68.

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Status and important trends

Appendix A

Table A.1 Environmental protection expenditure in large companies, by type of transactions and environmental domain. Manufacturing and Mining and quarrying (NACE 10, 12-37). 2002

	Total	Air/climate	Waste-water	Solid waste	Soil and ground-water	Biodiversity and land-scape	Other
	NOK 1 000	Per cent					
2002, total	**2 185 031**	**24**	**29**	**26**	**1**	**1**	**18**
Current expenditure	1 321 656	20	37	35	2	1	5
Investments	863 375	31	17	13	1	0	38
End-of-pipe investments	425 715	45	26	25	0	1	4
Process-integrated investments	437 660	17	8	2	1	0	72

Source: Environmental protection expenditure statistics, Statistics Norway.

Energy

Appendix B

Table B.1 Reserve accounts for crude oil. Fields already developed or where development has been approved. Million Sm^3 o.e.

	1990	1997	1998	1999	2000	2001[1]	2002	2003	2004
Reserves as of 01.01	1 189	1 795	1 858	1 810	1 692	1 770	1 776	1 589	1 540
New fields	126	84	-	36	190	106	2	26	46
Re-evaluations	125	168	133	26	82	99	5	113	70
Extraction	-99	-189	-181	-181	-194	-198	-193	-189	-186
Reserves as of 31.12	1 340	1 858	1 810	1 692	1 770	1 776	1 589	1 540	1 470
R/P-ratio	13	10	10	9	9	9	8	8	8

[1]Break in homogeneity of time series between 2000 and 2001 due to changes in classification system.
Source: Norwegian Petroleum Directorate and Statistics Norway.

Table B.2 Reserve accounts for natural gas. Fields already developed or where development has been approved. Million Sm^3 o.e.

	1990	1997	1998	1999	2000	2001[1]	2002	2003	2004
Reserves as of 01.01	1 261	1 479	1 173	1 172	1 247	1 259	2 189	2 117	2 461
New fields	17	12	-	45	61	229	7	376	7
Re-evaluations	-20	-271	47	82	5	759	-9	46	3
Extraction	-28	-47	-48	-52	-54	-58	-70	-78	-83
Reserves as of 31.12	1 230	1 173	1 172	1 247	1 259	2 189	2 117	2 461	2 388
R/P-ratio	45	25	24	24	23	38	30	32	29

[1]Break in homogeneity of time series between 2000 and 2001 due to changes in classification system.
Source: Norwegian Petroleum Directorate and Statistics Norway.

Table B.3 Norway´s hydropower potential and developed and undeveloped hydropower[1]. GWh

Year	Hydro-power potential[2]	Developed as of 31 Dec.	Undeveloped						
			Under construc-tion[3]	Licence granted	Applied for licence	Licence denied[4]	Notifi-cation submitted	Perma-nently protected	Remainder
1973	149 594	76 250	..	..	..	..	..	6 900	..
1974	149 594	80 280	..	..	..	..	..	6 900	..
1975	152 390	81 161	..	..	..	..	..	6 900	..
1976	151 046	81 813	..	..	..	..	..	6 900	..
1977	151 214	83 145	..	..	..	..	..	6 900	..
1978	151 010	85 080	..	..	..	..	..	6 900	..
1979	151 639	87 072	..	..	..	..	..	6 900	..
1980	155 763	89 676	..	..	..	..	..	11 438	..
1981	170 135	94 661	9 545	..	..	..	..	11 464	..
1982	170 638	96 963	7 774	..	..	..	..	11 668	..
1983	174 599	99 208	5 847	..	16 755	..	7 297	11 685	33 807
1984	171 940	99 696	7 100	..	14 164	..	6 902	11 685	32 392
1985	170 207	101 894	5 412	..	12 855	..	6 503	11 679	31 864
1986	169 970	102 716	4 447	..	12 217	..	6 559	20 947	23 084
1987	170 084	105 108	3 800	..	10 783	..	6 047	20 947	23 399
1988	171 209	105 578	3 778	..	8 674	..	4 415	20 947	27 817
1989	171 475	107 816	3 055	..	7 298	..	4 557	20 947	27 802
1990	171 366	108 083	3 494	..	6 609	..	4 890	20 947	27 343
1991	171 382	108 083	3 605	..	6 631	..	5 900	20 947	26 215
1992	176 395	109 457	2 913	..	4 767	..	3 318	22 246	33 695
1993	175 387	109 635	1 232	1 430	3 223	..	4 202	34 854	20 811
1994	177 745	111 850	799	1 585	3 124	..	4 529	35 259	20 599
1995	178 116	112 348	502	1 488	3 233	..	4 559	35 259	20 728
1996	178 302	112 701	161	1 532	2 774	..	2 180	35 258	23 694
1997	178 335	112 938	292	1 471	2 912	..	2 641	35 258	22 824
1998	179 647	113 015	332	1 446	3 132	..	2 920	35 321	23 481
1999	180 199	113 442	53	1 446	2 654	..	2 893	35 321	24 389
2000	186 970	118 041	73	347	2 536	1 351	3 456	36 543	24 623
2001	186 947	118 154	349	1 036	3 765	1 344	1 576	36 543	24 179
2002	186 486	118 277	993	498	3 583	1 362	1 294	36 543	23 936
2003	186 544	118 415	1 174	1 416	2 002	1 435	893	36 543	24 667
2004[5]	205 067	118 993	1 157	1 594	1 809	1 456	818	36 543	42 697

[1]Mean annual production capability. [2]Plans for undeveloped hydropower are evaluated regularly, and this is why hydropower potential changes from year to year. [3]Includes the category 'Licence granted' for all years before 1993. [4]Included in 'Licence granted' and 'Applied for licence' before 2000. [5]The growth is due to the fact that small plants between 50 kW and 10 000 kW are included in the potential.
Source: Norwegian Water Resources and Energy Directorate.

Table B.4 Extraction, conversion and use[1] of energy commodities. 2003*

	Coal and coke	Wood, wood waste, black liquor, waste	Crude oil	Natural gas	Petroleum products[2]	Electricity	District heating	Total	Average annual change 1976-2003	Average annual change 2002-2003
	PJ								Per cent	
Extraction of energy commodities	83	-	5 927	3 120	[3] 607	382	-	10 118		
Energy use in extraction sectors	-	-	-	[4]-186	-14	-8	0	-207		
Imports and Norwegian purchases abroad	43	2	26	-	285	48	-	404		
Exports and foreign purchases in Norway	-79	0	-5 372	-2 853	-878	-20	-	-9 202		
Stocks (+decrease, -increase)	-4	..	-22	-	-7	.	.	-33		
Primary supplies	43	2	559	81	-7	402	0	1 080		
Oil refineries	8	-	-560	-	527	-2	-	-27		
Other energy sectors or supplies	-1	50	-	0	16	3	10	79		
Registered losses, statistical errors	-5	..	2	-49	-42	-31	-2	-128		
Registered use outside energy sectors	44	52	-	32	495	373	8	1 005	0.7	0.2
Domestic use	44	52	-	32	347	373	8	857	1.3	0.4
Agriculture and fisheries	-	0	-	-	27	8	0	35	0.6	-1.5
Energy-intensive manufacturing	31	1	-	31	75	120	0	259	1.8	8.9
Other manufacturing and mining	13	22	-	1	30	52	1	118	-0.2	-3.2
Other industries	-	0	-	0	139	81	5	226	1.9	-1.9
Private households	0	29	-	0	76	113	1	218	1.3	-3.9
International maritime transport	-	-	-	-	148	-	-	148	-1.4	-1.3

[1]Includes energy commodities used as raw materials. [2]Includes liquefied petroleum gas, refinery gas, fuel gas and methane. Petrol coke is included in coke. [3]Natural gas liquids and condensate from Kårstø. [4]Includes gas terminals.
Source: Energy statistics, Statistics Norway.

Table B.5 Use of energy commodities outside the energy sectors and international maritime transport[1]

Energy commodity	1976	1980	1985	1990	1995	1999	2000	2001	2002	2003*	2004*	Average annual change 1976-2003	Average annual change 2003-2004
	PJ											Per cent	
Total	**606**	**674**	**727**	**750**	**783**	**857**	**833**	**878**	**853**	**857**	**880**	**1.3**	**2.8**
Electricity	241	269	329	349	374	395	395	403	392	373	396	1.6	6.3
Priority power	232	265	312	324	348	371	359	377	369	362	...	1.7	...
Non-priority power	9	4	17	24	26	25	36	26	23	11	...	0.7	...
Oil, total	298	291	252	245	251	274	246	261	262	271	271	-0.3	-0.1
Oil other than transport	159	137	77	57	51	54	43	47	47	55	49	-3.9	-10.8
Petrol	9	3	0	0	0	0	0	0	-	-	-	-100.0	.
Kerosene	17	16	9	7	7	7	5	6	6	6	6	-3.5	-15.0
Middle distillates	66	62	43	35	30	33	27	27	30	36	31	-2.2	-12.7
Heavy fuel oil	66	56	25	15	14	15	11	13	12	12	12	-6.0	-3.1
Oil for transport	139	154	175	188	200	219	203	215	214	217	222	1.7	2.6
Petrol, aviation fuel, jet fuel	74	82	92	99	102	103	97	100	99	94	91	0.9	-3.8
Middle distillates	62	68	75	85	98	116	106	115	116	119	128	2.5	7.6
Heavy fuel oil	3	5	7	3	1	1	1	0	0	3	4	0.0	7.2
Gas[2]	1	41	52	63	54	76	81	102	95	108	104	17.2	-3.3
District heating	-	-	2	3	4	6	5	7	7	8	8	.	0.0
Solid fuel	65	73	93	90	100	106	106	105	97	97	101	1.5	4.0
Coal and coke	47	48	57	49	56	56	56	50	46	44	48	-0.2	7.8
Wood, wood waste, black liquor, waste	19	25	35	41	44	50	50	55	51	52	53	3.9	0.8

[1] Includes energy commodities used as raw materials. [2] Includes liquefied petroleum gas. From 1990 also fuel gas and landfill gas, and from 1995 natural gas.
Source: Energy statistics, Statistics Norway.

Table B.6 Net use[1] of energy in the energy sectors. PJ

	1976	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003*	2004*
Total	**54**	**90**	**99**	**154**	**183**	**195**	**204**	**194**	**195**	**215**	**220**	**219**	**234**	**227**
Of this:														
Electricity	4	6	8	7	10	7	11	8	9	8	9	8	10	10
Natural gas	30	52	61	116	141	151	153	147	145	167	175	176	186	194

[1] Does not include energy use for conversion purposes.
Source: Energy statistics, Statistics Norway.

Table B.7 Use of energy commodities ouside the energy sectors and international maritime transport, by sector[1]. 2002. PJ

	Coal and coke	Wood, wood waste, black liquor, waste	Crude oil	Natural gas	Petroleum products[2]	Electricity	District heating	Total
Total	**45.9**	**50.8**	**-**	**23.5**	**333.5**	**392.1**	**7.2**	**853.1**
Manufacturing and mining	**45.7**	**22.3**	**-**	**23.1**	**99.8**	**168.3**	**1.0**	**360.1**
Oil drilling	-	-	-	-	0.9	-	-	0.9
Manufacture of pulp and paper	-	16.9	-	0.3	6.3	23.0	0.0	46.4
Manufacture of basic chemicals	8.7	-	-	21.2	66.7	22.1	0.3	119.1
Manufacture of minerals[3] .	8.1	0.9	-	0.0	8.4	4.7	0.0	22.0
Manufacture of iron, steel and ferro-alloys.	19.2	0.2	-	-	0.9	22.7	0.0	43.1
Manufacture of other metals.	4.2	0.0	-	1.1	2.4	67.7	-	75.4
Manufacture of metal goods, boats, ships and oil platforms	5.5	0.2	-	0.1	4.0	10.4	0.2	20.4
Manufacture of wood, plastic, rubber and chemical goods, printing	-	4.1	-	-	2.0	6.6	0.1	12.8
Manufacture of consumer goods	-	0.0	-	0.3	8.2	11.2	0.3	20.1
Other industries, total . .	**0.1**	**28.6**	**-**	**0.5**	**233.7**	**223.8**	**6.3**	**493.0**
Construction.	-	0.1	-	-	8.5	2.8	-	11.5
Agriculture and forestry . .	-	0.1	-	-	6.2	7.1	0.0	13.4
Fishing, whaling and sealing	-	-	-	-	21.9	0.5	-	22.4
Land transport[4].	-	-	-	0.1	48.4	2.3	-	50.8
Sea transport, domestic . .	-	-	-	0.1	20.6	0.0	-	20.6
Air transport[4]	-	-	-	-	21.0	0.4	-	21.4
Other private services	-	-	-	0.0	24.4	60.2	2.7	87.3
Public sector, municipal . .	-	-	-	0.2	3.4	15.3	1.5	20.5
Public sector, state	-	-	-	-	6.7	10.5	0.8	18.0
Private households	0.1	28.4	-	0.1	72.7	124.7	1.2	227.2

[1]Includes energy commodities used as raw materials. See also tables F3 and F4, which give emission figures for the same sectors. [2] Includes liquefied petroleum gas, fuel gas and methane. Petrol coke is included under coke. [3]Includes mining. [4]Norwegian purchases in Norway + Norwegian purchases abroad.
Source: Energy statistics, Statistics Norway.

Table B.8 Electricity balance

	1975	1980	1985	1990	1995	2000	2001	2002	2003	2004*	Average annual change 1990-2004*	Average annual change 2003-2004*
	TWh										Per cent	
Production	77.5	84.1	103.3	121.8	123.0	142.8	121.6	130.5	107.2	110.4	-0.7	3.0
+ Imports	0.1	2.0	4.1	0.3	2.3	1.5	10.8	5.3	13.5	15.3	31.4	13.2
- Exports	5.7	2.5	4.6	16.2	9.0	20.5	7.2	15.0	5.6	3.8	-9.8	-31.5
= Gross domestic consumption	71.9	83.6	102.7	105.9	116.3	123.8	125.2	120.8	115.1	121.9	1.0	5.8
- Electric boilers	3.2	1.2	4.8	6.7	7.5	10.5	7.8	6.8	3.2	3.6	-4.3	12.3
- Consumption in pumped storage power plants	0.1	0.5	0.8	0.3	1.4	0.7	0.8	0.7	0.9	0.7	5.3	-18.8
- Consumption in power plants, losses and statistical differences	7.1	8.0	10.0	7.9	10.0	12.2	11.1	10.0	10.0	9.0	1.0	-9.5
= Net domestic consumption	61.4	73.9	87.1	91.0	97.5	100.4	105.5	103.2	101.1	108.5	1.3	7.4
- Energy-intensive manufacturing	26.2	27.9	30.0	29.6	28.4	30.5	32.1	29.6	31.7	33.4	0.9	5.5
= Net general consumption	35.2	46.0	57.1	61.5	69.1	69.9	73.4	73.6	69.4	75.1	1.4	8.2
Gross general consumption	..	..	..	..	..	76.9	80.7	81.0	76.3	82.6	.	8.2
Net general consumption corrected for temperature[1]	36.3	45.1	54.6	65.4	69.6	..	..	..	..	..	.	.
Gross general consumption corrected for temperature[1]	..	..	..	..	..	81.4	81.4	83.7	79.1	86.0	.	8.8

[1] Break in the series between 1995 and 2000. For the years prior to 2000, the temperature correction is made for the net general consumption. From 2000 onwards, it is the gross general consumption that is corrected for temperature.
Source: Electricity statistics, Statistics Norway and Norwegian Water Resources and Energy Directorate.

Table B.9 Average prices[1] for electricity[2] and some selected oil products. Energy supplied

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Price in øre/kWh[4]														
Electricity	**45.7**	**46.5**	**46.6**	**47.8**	**46.8**	**49.7**	**52.4**	**55.0**	**51.0**	**50.3**	**52.3**	**61.0**	**68.0**	**90.0**	**75.8**
Heating products	Price in øre/kWh[4]														
Heating kerosene	33.9	40.1	37.4	37.8	37.1	37.7	41.6	43.8	42.6	47.6	59.5	61.1	57.2	60.4	66.1
Fuel oil no.1/light fuel oils[3]	26.6	31.9	28.3	28.0	28.2	29.6	34.0	37.0	34.3	39.9	51.5	53.4	48.8	54.1	58.1
Fuel oil no.2	25.7	30.8	27.2	26.9	27.1	[3]..	..	..	..	..	..	..	..	..	..
Transport products	Price in øre/litre[4]														
Petrol, leaded, high oct.	643	741	795	836	851	889	.	.	.	.	.	.	.	.	.
Petrol, unl. 98 octane	622	705	747	787	791	838	880	909	904	948	1 087	976	931	963	1 031
Petrol, unl. 95 octane	594	677	717	757	761	807	849	888	873	919	1 052	944	901	929	996
Auto diesel	286	341	326	403	649	701	757	779	781	827	991	862	808	834	871

[1] Including all taxes. [2]Price for households and agriculture. The price includes energy price, grid rent and taxes. Until 1992, prices are for priority power only. From 1993, both priority power and non-priority power. [3]Fuel oil 1 and fuel oil 2 are so similar that they have been combined in the category light fuel oils after 1994. [4]100 øre = 1 NOK.

Source: Energy statistics, Statistics Norway, Norwegian Water Resources and Energy Directorate and Norwegian Petroleum Institute.

Table B.10 Total primary energy supply. World, total and selected countries

	1973	1980	1990	2000	2001	2002	Per unit GDP (2002)	Per unit GDP (2002)	Per capita (2002)
	Mtoe						toe/1 000 1995 USD	toe/1 000 1995 USD PPP[1]	toe/capita
World, total	**6 033.4**	**7 156.0**	**8 627.9**	**9 951.1**	**10 010.8**	**10 230.7**	**0.29**	**0.24**	**1.65**
OECD	3 762.6	4 081.7	4 527.1	5 313.1	5 296.3	5 345.7	0.19	0.21	4.67
Norway	14.6	18.7	21.5	25.8	26.5	26.5	0.15	0.21	5.84
Denmark	19.8	19.8	17.6	19.4	20.0	19.8	0.09	0.14	3.67
Finland	21.4	25.4	29.2	33.0	33.9	35.6	0.21	0.28	6.85
Iceland	1.2	1.5	2.2	3.2	3.4	3.4	0.38	0.44	11.82
Sweden	39.3	39.9	46.7	47.5	51.2	51.0	0.17	0.23	5.72
Belgium	46.3	46.1	48.7	59.3	59.0	56.9	0.18	0.22	5.51
France	184.7	193.6	227.3	257.6	266.4	265.9	0.15	0.18	4.34
Greece	12.4	15.7	22.2	27.8	28.7	29.0	0.19	0.16	2.65
Italy	128.9	139.0	152.6	171.7	172.6	172.7	0.14	0.13	2.98
Netherlands	62.4	65.0	66.5	75.5	77.3	77.9	0.15	0.19	4.83
Poland	93.1	123.0	99.9	89.6	90.0	89.2	0.51	0.24	2.33
Portugal	7.2	10.3	17.8	25.3	25.4	26.4	0.20	0.16	2.54
Spain	52.4	68.6	91.2	124.7	127.8	131.6	0.18	0.17	3.24
United Kingdom	220.7	201.3	212.2	231.1	234.4	226.5	0.16	0.16	3.83
Switzerland	19.7	20.9	25.1	26.5	28.0	27.1	0.08	0.14	3.72
Czech Republic	45.4	47.3	47.4	40.4	41.4	41.7	0.72	0.30	4.09
Turkey	24.4	31.5	53.0	77.5	71.6	75.4	0.37	0.18	1.08
Germany	337.9	360.4	356.2	343.6	353.4	346.4	0.13	0.18	4.20
Hungary	21.3	28.5	28.6	25.0	25.6	25.5	0.44	0.21	2.51
Austria	21.7	23.3	25.3	28.8	30.9	30.4	0.11	0.14	3.78
Canada	159.8	193.0	209.1	250.9	248.2	250.0	0.33	0.30	7.96
Mexico	53.2	97.3	124.1	150.6	152.1	157.3	0.42	0.19	1.57
United States	1 736.5	1 811.7	1 927.6	2 302.6	2 253.9	2 290.4	0.25	0.25	7.97
Japan	323.5	346.5	445.9	521.6	517.0	516.9	0.09	0.17	4.06
Republic of Korea	21.6	41.4	92.7	190.9	193.9	203.5	0.30	0.28	4.27
Australia	57.6	70.4	87.5	109.8	108.4	112.7	0.23	0.23	5.71
Non-OECD	2 270.8	3 074.3	4 100.8	4 638.0	4 714.5	4 885.0	0.71	0.27	0.97
Romania	47.8	65.1	62.4	36.3	36.9	37.0	1.03	0.29	1.66
Russia	..	..	..	614.0	621.3	617.8	1.32	0.59	4.29
Egypt	8.1	16.0	31.9	46.6	49.6	52.4	0.63	0.24	0.79
Ethiopia	9.4	11.1	15.2	18.7	19.5	19.9	2.39	0.43	0.79
Nigeria	39.0	52.9	70.9	90.5	92.8	95.7	2.90	0.94	0.72
South Africa	49.1	65.4	91.2	108.9	109.2	113.5	0.62	0.28	2.50
Argentina	35.6	41.8	46.1	62.1	58.7	56.3	0.23	0.16	1.54
Brazil	82.0	111.9	133.5	185.6	186.7	190.7	0.24	0.16	1.09
Guatemala	2.9	3.9	4.5	7.2	7.3	7.4	0.40	0.17	0.62
Venezuela	21.3	35.6	43.9	56.7	58.1	54.0	0.72	0.46	2.15
Bangladesh	6.4	8.5	12.8	18.7	20.4	21.0	0.39	0.10	0.15
India	191.2	243.0	365.4	516.9	524.2	538.3	1.04	0.22	0.51
Indonesia	37.7	56.0	94.8	142.8	149.6	156.1	0.70	0.26	0.74
China[2]	427.3	598.5	879.9	1 140.5	1 137.6	1 228.6	1.02	0.24	0.96
Thailand	16.4	22.8	43.9	74.6	78.2	83.3	0.45	0.22	1.35

[1]PPP (Purchasing power parity): GDP adjusted to local purchasing power. [2]Excluding Hong Kong.
Source: OECD/IEA: Energy Balances of OECD Countries 2001-2002 and OECD/IEA: Energy Balances of non-OECD Countries 2001-2002.
More information: http://www.iea.org/ .

Table B.11 Norway´s net exports of energy commodities. Selected countries and regions. 2004*. Million NOK

	Coal, coke and briquettes	Mineral oil and products	Gas, natural and manufactured	Electricity
Nordic countries	46	17 130	1 661	-2 681
EFTA	1	949	28	-
EU	446	206 830	79 650	-2 681
Developing countries	-157	3 315	812	-
Denmark	84	5 691	41	-556
Finland	-7	2 311	82	-14
Sweden	-32	7 705	1 534	-2 110
Belgium	-45	343	8 320	-
France	31	22 253	16 031	-
Ireland	-	4 345	-	-
Italy	-3	4 096	5 667	-
Netherlands	-71	37 162	7 105	-
Portugal	116	1 076	170	-
Spain	-26	6 824	2 500	-
UK	-123	92 066	11 263	-
Czech Republic	-	-31	2 018	-
Turkey	-	31	1 471	-
Germany	884	23 069	24 412	-
China	-78	1 188	0	-
Canada	-	19 903	0	-
USA	-67	26 922	1 359	-

Source: External trade statistics, Statistics Norway.

Agriculture

Appendix C

Table C.1 Agricultural area in use. km²

Year	Agricultural area in use, total	Cereals and oil seeds	Other field crops and horticultural crops	Meadows on arable land	Other meadows and pastures
1949	10 264	1 516	1 065	5 350	2 332
1959	9 845	2 178	1 089	4 814	1 765
1969	9 553	2 522	862	4 584	1 585
1979	9 535	3 252	895	4 157	1 232
1989	9 911	3 530	903	4 385	1 093
1999	10 382	3 345	649	4 877	1 511
2000	10 422	3 363	621	4 856	1 581
2001	10 467	3 390	607	4 865	1 605
2002	10 466	3 378	536	4 917	1 635
2003	10 404	3 342	512	4 905	1 644
2004*	10 362	3 330	490	4 887	1 656

Source: Agricultural statistics from Statistics Norway.

Table C.2 Sales of commercial fertilizer expressed as content of nitrogen and phosphorus

Year	Total, tonnes		Mean quantity (kg) applied per decare agricultural area in use	
	Nitrogen	Phosphorus	Nitrogen	Phosphorus
1980/81	102 513	26 980	10.9	2.9
1981/82	107 546	28 291	11.4	3.0
1982/83	109 120	27 638	11.5	2.9
1983/84	110 648	27 382	11.6	2.9
1984/85	110 803	24 828	11.6	2.6
1985/86	106 011	22 752	11.1	2.4
1986/87	109 807	21 953	11.5	2.3
1987/88	111 208	19 699	11.6	2.0
1988/89	110 138	17 376	11.1	1.8
1989/90	110 418	16 002	11.1	1.6
1990/91	110 790	15 190	11.0	1.5
1991/92	110 875	14 818	11.1	1.5
1992/93	109 299	13 722	10.8	1.4
1993/94	108 287	13 688	10.6	1.3
1994/95	110 851	13 291	10.8	1.3
1995/96	111 976	13 836	10.9	1.3
1996/97	112 879	13 522	10.9	1.3
1997/98	112 327	13 408	10.7	1.3
1998/99	106 017	13 092	10.2	1.3
1999/00	107 410	13 325	10.3	1.3
2000/01	100 592	12 399	9.6	1.2
2001/02	101 258	12 593	9.7	1.2
2002/03	104 162	12 643	10.0	1.2
2003/04	105 096	12 786	10.1	1.2

Source: Agricultural statistics from Statistics Norway and Norwegian Food Safety Authority.

Table C.3 Sales of pesticides. Environmental taxes on pesticides

Year	Sales of pesticides. Quantity of active substances					Taxes as per cent of purchase price[1]		Taxes		
	Total	Fungi-cides	Insecti-cides	Herbi-cides	Other sub-stances including additives	Environ-mental tax	Control fee	Total	Environ-mental tax	Control fee and registra-tion fee
	Tonnes					Per cent		NOK million		
1985	1 529.3	138.4	38.7	1 236.2	116.1	-	-	-	-	-
1986	1 513.9	144.3	47.3	1 188.2	134.1	-	-	-	-	-
1987	1 323.2	110.9	32.1	1 057.8	122.5	-	-	-	-	-
1988	1 193.6	107.8	37.9	919.2	128.7	2.0	5.5	..	1.5	..
1989	1 033.8	119.3	27.5	856.9	30.1	8.0	6.0	30.3	17.3	..
1990	1 183.5	153.0	19.0	965.1	46.4	11.0	6.0	28.5	20.2	8.3
1991	771.0	144.2	18.4	563.6	44.8	13.0	6.0	26.7	18.8	7.9
1992	781.0	148.6	26.9	561.2	44.3	13.0	6.0	31.6	22.5	9.1
1993	764.5	179.7	16.9	510.0	57.9	13.0	6.0	32.0	21.9	10.1
1994	861.6	156.7	22.0	625.9	57.0	13.0	6.0	30.7	21.0	9.7
1995	931.3	167.3	20.4	688.9	54.7	13.0	6.0	27.6	18.9	8.7
1996	706.2	139.7	15.8	503.2	47.4	15.5	7.0	32.3	21.8	10.5
1997	754.2	175.4	19.5	503.8	55.5	15.5	7.0	30.4	21.0	9.5
1998	954.6	263.3	22.8	544.3	124.3	15.5	9.0	37.9	24.1	13.8
1999	796.3	219.9	23.8	448.7	103.9	.	.	52.6	35.4	17.2
2000	380.2	53.8	10.0	283.4	33.0	.	.	68.7	52.9	15.8
2001	518.7	119.9	8.5	377.2	13.1	.	.	44.6	34.9	9.7
2002	818.5	149.6	10.1	632.2	26.6	.	.	72.3	56.1	16.2
2003	688.5	167.1	13.6	462.6	45.2	.	.	83.6	65.4	18.2
2004	869.0	227.7	10.1	504.3	127.0	.	.	110.2	85.4	24.8

[1]As from 1999 the taxes are no longer based on a fixed percentage rate of purchase price but are differentiated according to health and environmental risk of the substances.
Source: Norwegian Food Safety Authority.

Table C.4 Organic farming

Year	No. of holdings inspected for organic farming	Area approved as organically operated	Area under conversion	No. of dairy cows on holdings approved for organic farming	No. of sheep on holdings approved for organic farming[1]	Total grants to organic farming	Of which conversion and acreage support
		Decares				NOK million	
1986	19	..	..	..	..	-	-
1987	43	..	..	..	..	-	-
1988	55	..	..	..	..	-	-
1989	92	..	..	..	..	5	-
1990	273	..	..	..	..	13	4
1991	423	18 145	6 288	237	3 007	20	7
1992	479	26 430	5 826	193	6 524	23	8
1993	517	32 343	5 444	294	7 102	22	6
1994	561	38 278	6 916	437	10 064	22	6
1995	738	44 596	13 082	572	10 628	23	6
1996	952	46 573	32 401	766	13 291	35	14
1997	1 316	73 921	43 143	1 816	18 895	35	21
1998	1 627	105 200	50 615	2 705	29 812	33	13
1999	1 762	149 510	38 225	2 998	18 393	54	37
2000	1 840	180 841	24 387	3 531	20 776	59	35
2001	2 099	197 900	68 831	3 729	22 911	76	54
2002	2 303	252 556	72 904	4 070	47 907	85	58
2003	2 466	308 835	72 954	5 226	30 930	92	65
2004	2 484	349 567	60 793	5 643	33 589	111	81

[1]Up to and including 1998 the registration date was 31 July, in 1999-2001 the registration date was 31 December, in 2002 the registration date again was 31 July while in 2003 and onwards the registration date is 31 December.
Source: Debio and Norwegian Agricultural Authority.

Table C.5 Organic farming. Counties. 2004

	No. of holdings inspected for organic farming	Area approved as organically operated	Area under conversion	Percentage of total agricultural area in use	No. of dairy cows on holdings approved for organic farming	Percentage of total no. of dairy cows
		Decares		Per cent		Per cent
Whole country	**2 484**	**349 567**	**60 793**	**4.0**	**5 643**	**2.1**
Østfold	166	21 945	4 784	3.5	354	6.4
Akershus and Oslo	151	24 554	5 270	3.7	535	10.6
Hedmark	250	39 917	8 090	4.5	931	6.0
Oppland	256	36 186	3 738	3.8	384	1.2
Buskerud	240	28 946	8 405	7.1	216	3.6
Vestfold	83	13 372	2 411	3.7	277	10.5
Telemark	121	15 695	3 199	7.3	204	8.0
Aust-Agder	26	2 461	147	2.3	74	3.2
Vest-Agder	45	7 318	851	4.1	244	4.0
Rogaland	51	6 468	461	0.7	254	0.5
Hordaland	112	9 325	898	2.3	134	1.0
Sogn og Fjordane	166	18 185	1 321	4.1	59	0.3
Møre og Romsdal	128	15 294	3 398	3.1	227	0.9
Sør-Trøndelag	293	48 126	4 867	6.9	938	3.5
Nord-Trøndelag	232	33 318	8 346	4.7	637	2.1
Nordland	113	20 381	4 004	4.1	118	0.6
Troms	44	6 764	476	2.7	57	1.0
Finnmark	7	1 312	129	1.5	-	.

Source: Debio and agricultural statistics from Statistics Norway.

Table C.6 Number of holdings by size of agricultural area in use[1]

Year	Total	5-49 decares	50-99 decares	100-199 decares	200-499 decares	500- decares
1949	213 441	150 130	42 526	15 597	4 809	379
1959	198 315	135 830	42 126	15 074	4 870	415
1969	154 977	88 481	42 240	17 938	5 822	496
1979	125 302	62 017	32 716	21 632	8 228	709
1989	99 382	37 031	24 969	25 330	11 194	858
1999	70 740	14 517	16 720	22 286	15 640	1 577
2000	68 539	13 574	15 677	21 411	16 169	1 708
2001	65 607	11 804	14 762	20 541	16 604	1 896
2002	61 890	9 975	13 476	19 555	16 772	2 112
2003	58 231	8 211	12 230	18 669	16 828	2 293
2004*	55 697	7 461	11 163	17 705	16 900	2 468

[1]Up to and including 1989 the figures refer to holdings with at least 5 decares agricultural area in use. As from 1999, joint operations etc. with less than 5 decares agricultural area in use are included.
Source: Agricultural statistics from Statistics Norway.

Forest and uncultivated land

Appendix D

Table D.1 Forest balance 2003. 1 000 m^3 without bark

	Total	Spruce	Pine	Broad-leaved trees
Growing stock as of 01.01	723 672	318 315	242 166	163 191
Total losses	10 784	6 892	2 149	1 743
Of which total roundwood cut	8 511	5 798	1 653	1 061
Sales, excl. fuelwood	6 790	5 235	1 505	50
Fuelwood, sales and private	1 519	400	112	1 007
Own use	202	163	36	3
Other losses	2 273	1 094	496	682
Logging waste	553	348	99	106
Natural losses	1 720	747	397	576
Total increments	24 820	12 444	6 613	5 764
Volume as of 31.12	737 708	323 866	246 630	167 212

Source: Statistics Norway and Norwegian Institute for Land Inventory.

Table D.2 Growing stock under bark and annual increment. 1 000 m^3

	Growing stock				Annual increment			
	Total	Spruce	Pine	Broad-leaved	Total	Spruce	Pine	Broad-leaved
Whole country								
1933	322 635	170 960	90 002	61 673	10 447	5 835	2 535	2 077
1967	435 121	226 168	133 972	74 981	13 200	7 131	3 364	2 706
1990	578 317	270 543	188 279	119 495	20 058	10 528	5 200	4 330
2000/2004[1]	718 708	321 139	238 385	159 183	25 353	13 582	6 165	5 605
Region, 2000/2004								
Østfold, Akershus/Oslo, Hedmark	200 349	102 377	74 671	23 300	7 755	4 421	2 287	1 047
Oppland, Buskerud, Vestfold	156 416	88 344	42 681	25 390	5 632	3 553	1 020	1 059
Telemark, Aust-Agder, Vest-Agder	128 145	41 186	57 310	29 649	4 292	1 789	1 387	1 115
Rogaland, Hordaland, Sogn og Fjordane, Møre og Romsdal	92 962	25 348	35 710	31 904	3 445	1 604	853	988
Sør-Trøndelag, Nord-Trøndelag	86 379	50 943	19 273	16 164	2 555	1 644	381	530
Nordland, Troms	51 110	12 940	6 138	32 032	1 586	571	165	850
Finnmark	3 347	1	2 602	744	88	0	72	16

[1]Volume and average annual increment for all types of land use classes for 2000-2004 in counties inventoried and Finnmark.
Source: Norwegian Institute for Land Inventory. (Figures from inventories supplemented by calculations by Statistics Norway for Finnmark, where no inventory has been carried out.).

Table D.3 Registered non-harvest mortality of cervids

Hunting year	Total				Killed by motor car or train				Felled as pests, felled illegally or killed by other causes			
	Moose	Red deer	Wild rein-deer	Roe deer	Moose	Red deer	Wild rein-deer	Roe deer	Moose	Red deer	Wild rein-deer	Roe deer
1987/1988	2 167	365	279	2 044	1 200	157	6	1 396	967	208	273	648
1988/1989	2 036	444	122	2 140	1 016	200	4	1 632	1 020	244	118	508
1989/1990	2 152	411	137	1 955	962	171	4	1 537	1 190	240	133	418
1990/1991	2 466	485	124	2 684	1 210	201	4	2 065	1 256	284	120	619
1991/1992	2 554	544	132	3 034	1 324	284	5	2 427	1 230	260	127	607
1992/1993	3 748	715	233	4 195	2 048	376	5	3 327	1 700	339	228	868
1993/1994	4 155	1 061	125	6 621	2 481	461	5	4 007	1 674	600	120	2 614
1994/1995	3 405	915	72	4 601	1 757	374	-	3 057	1 648	541	72	1 544
1995/1996	2 915	874	88	4 233	1 650	383	1	3 045	1 265	491	87	1 188
1996/1997	3 378	985	89	4 587	2 010	515	4	3 513	1 368	470	85	1 074
1997/1998	2 962	995	133	3 895	1 582	443	6	3 091	1 380	552	127	804
1998/1999	3 215	958	123	4 097	1 886	488	7	3 259	1 329	470	116	838
1999/2000	3 186	1 183	104	3 893	1 921	543	5	3 118	1 265	640	99	775
2000/2001	3 338	1 082	65	4 132	1 968	461	5	3 313	1 370	621	60	819
2001/2002	3 114	1 189	51	4 094	1 945	611	7	3 350	1 169	578	44	744
2002/2003	4 071	997	58	4 444	2 602	540	5	3 579	1 469	457	53	865
2003/2004	3 408	1 067	31	4 006	2 244	629	3	3 371	1 164	438	27	635
2004/2005	2 935	1 254	46	4 354	1 762	701	11	3 752	1 173	553	35	602

Source: Statistics Norway.

Table D.4 Registered mortality of large carnivores and eagles

Hunting year	Bear	Wolf	Wolverine	Lynx	Eagle
1993/1994	3	-	13	48	56
1994/1995	1	-	17	64	51
1995/1996	1	-	16	103	47
1996/1997	3	-	17	113	58
1997/1998	3	-	19	127	51
1998/1999	5	1	22	105	59
1999/2000	5	2	31	101	54
2000/2001	6	17	41	98	32
2001/2002	3	2	48	102	42
2002/2003	1	7	38	71	59
2003/2004	4	6	39	46	34
2004/2005	1	7	50	58	43
Cause of death 2004/2005:					
Killed by vechicle or train	-	1	-	9	12
Felled by permit[1]	-	1	22	1	-
Licenced hunting of wolverine	-	-	20	-	.
Licenced hunting of wolf	-	5	-	-	.
Quota hunting of lynx	-	-	-	43	.
Other causes[1]	1	-	8	5	31

[1]Including animals felled in self-defence or illegally, unknown reasons, etc.
Source: Statistics Norway.

Fisheries, sealing, whaling and fish farming

Appendix E

Table E.1 Stock trends for some important fish stocks. 1 000 tonnes

Year	North-East Arctic cod[1]	North-East Arctic haddock[1]	North-East Arctic saithe[1]	Arctic Greenland halibut[6]	Barents Sea capelin[2, 4]	Norwegian spring-spawning herring[3]	North Sea herring[3]	North Sea cod[3]
1983	740	70	410	100	4 770	720	430	140
1984	820	50	330	90	3 300	710	680	130
1985	960	140	270	90	1 090	590	700	120
1986	1 290	290	280	90	160	470	680	110
1987	1 120	240	330	80	110	970	900	100
1988	910	160	340	80	360	2 900	1 190	90
1989	890	120	300	90	770	3 520	1 250	90
1990	960	120	250	80	4 900	3 670	1 180	80
1991	1 560	150	360	70	6 650	3 800	980	70
1992	1 910	230	540	50	5 370	3 670	700	70
1993	2 360	460	670	50	990	3 510	470	80
1994	2 150	550	640	50	260	3 960	510	80
1995	1 820	490	770	60	190	4 860	460	100
1996	1 700	420	810	70	470	6 500	450	100
1997	1 530	310	810	70	870	7 840	540	90
1998	1 230	200	870	80	1 860	7 120	710	80
1999	1 110	200	900	80	2 580	6 580	820	70
2000	1 110	180	910	80	3 840	5 290	810	50
2001	1 400	270	940	90	3 480	4 580	1 280	40
2002	1 590	310	1 050	90	2 145	4 590	1 580	40
2003	1 650	380	930	100	680	5 790	1 730	40
2004	1 580	360	930	100	723	6 970	1 890	50
2005	1 570	370	890	..	..	6 300	1 820	..

Year	North Sea haddock[3]	North Sea saithe[3, 5]	North Sea whiting[3]	North Sea plaice[3]	North Sea sole[3]	Blue whiting (northern and southern stock[3]	Mackerel (North Sea, western and southern)[3]
1983	250	210	360	320	40	1 850	2 610
1984	190	170	290	330	40	1 510	2 600
1985	230	160	290	350	40	1 650	2 570
1986	220	150	300	380	40	1 890	2 550
1987	150	150	320	450	30	1 700	2 510
1988	150	140	310	400	40	1 510	2 520
1989	120	110	300	420	30	1 450	2 570
1990	80	100	330	380	90	1 350	2 410
1991	60	90	280	340	80	1 790	2 680
1992	100	100	270	270	80	2 400	2 680
1993	130	100	240	240	60	2 360	2 500
1994	150	110	230	200	70	2 340	2 290
1995	150	130	250	180	60	2 180	2 420
1996	180	160	220	180	40	2 010	2 380
1997	190	190	190	190	30	2 070	2 440
1998	170	190	160	200	20	2 850	2 360
1999	120	200	160	160	40	3 450	2 440
2000	100	190	200	220	40	3 490	2 280
2001	270	210	220	230	30	3 680	2 320
2002	440	200	210	180	40	4 070	1 900
2003	460	220	240	210	30	4 300	1 850
2004	450	260	..	190	50	3 790	1 970
2005	..	..	..	..	..	..	..

[1]Fish aged 3 years and older. [2]Fish aged 1 year and older. [3]Spawning stock. [4]As of 1 August. [5]Including saithe west of Scotland. [6] Fish aged 5 years and older.
Source: ICES and the Institute of Marine Research.

Table E.2 Norwegian catches by species and groups of species. 1 000 tonnes

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002*	2003*	2004*
Total	2 619	2 584	2 526	2 702	2 820	3 055	3 040	2 809	2 891	2 862	2 922	2 703	2 670
Cod	219	275	374	365	358	401	321	257	219	209	228	217	231
Haddock	40	44	74	80	97	106	79	53	46	52	55	59	65
Saithe	168	188	189	219	222	184	194	198	170	170	203	212	211
Tusk	26	27	20	19	19	14	21	23	22	19	18	13	12
Ling/Blue ling	22	20	19	19	19	16	23	20	18	15	16	15	15
Greenland halibut	11	15	13	14	17	12	12	20	13	15	12	13	17
Redfish	38	33	29	22	30	23	29	31	26	29	16	17	17
Others and unspecified[2]	43	57	31	27	32	40	43	29	29	40	29	28	28
Capelin	811	530	113	28	208	158	88	92	371	483	522	249	49
Mackerel	207	224	260	202	137	137	158	161	174	181	184	163	157
Herring	227	352	539	687	763	923	832	829	800	581	574	565	616
Sprat	33	47	44	41	59	7	35	22	6	12	3	3	2
Other industrial fisheries[1]	527	541	587	745	642	798	964	828	734	811	804	922	1 036
Crustaceans and molluscs	57	61	48	49	44	45	61	68	71	70	75	73	66
Seaweed	189	170	185	185	173	192	180	179	192	175	183	153	148

[1] Includes lesser and greater silver smelt, Norway pout, sandeel, blue whiting and horse mackerel. [2] Includes the groups Other pelagic fish, Hake/pollack/whiting, Other demersal fish, Various deep water species and Other and unspecified fish.
Source: Directorate of Fisheries.

Table E.3 Consumption of antibacterial agents in fish farming. kg of active ingredients

Year	Total	Oxytetra-cyclin-chloride	Nifura-zolidone	Oxolinic acid	Trimeto-prim + sul-phadiazine (Tribrissen)	Sulpha-merazine	Flumequin	Florfenicol
1981	3 640	3 000	-	-	540	100	-	-
1982	6 650	4 390	1 600	-	590	70	-	-
1983	10 130	6 060	3 060	-	910	100	-	-
1984	17 770	8 260	5 500	-	4 000	10	-	-
1985	18 700	12 020	4 000	-	2 600	80	-	-
1986	18 030	15 410	1 610	-	1 000	10	-	-
1987	48 570	27 130	15 840	3 700	1 900	-	-	-
1988	32 470	18 220	4 190	9 390	670	-	-	-
1989	19 350	5 014	1 345	12 630	32	-	329	-
1990	37 432	6 257	118	27 659	1 439	-	1 959	-
1991	26 798	5 751	131	11 400	5 679	-	3 837	-
1992	27 485	4 113	-	7 687	5 852	-	9 833	-
1993	6 144	583	78	2 554	696	-	2 177	56
1994	1 396	341	-	811	3	-	227	14
1995	3 116	70	-	2 800	-	-	182	64
1996	1 037	27	-	841	-	-	105	64
1997	746	42	-	507	-	-	74	123
1998	679	55	-	436	-	-	53	135
1999	591	25	-	494	-	-	7	65
2000	685	15	-	470	-	-	52	148
2001	645	12	-	517	-	-	7	109
2002	1 219	11	-	998	-	-	5	205
2003	805	45	-	546	-	-	60	154
2004	1 159	9	-	1 035	-	-	4	111

Source: Norwegian Institute of Public Health.

Table E.4 Exports of some main groups of fish products. 1 000 tonnes

Year	Fresh	Frozen whole	Fillets	Salted or smoked	Dried	Canned, etc.	Meal	Oil
1981	24.6	58.7	74.0	13.6	86.2	15.0	266.5	107.3
1982	46.2	100.2	76.3	14.9	68.8	11.2	228.6	101.1
1983	91.5	62.6	91.6	24.9	59.4	22.4	283.9	128.0
1984	72.9	78.7	98.5	24.6	69.5	22.7	248.9	76.9
1985	74.5	79.5	95.9	20.3	64.6	23.4	173.9	114.3
1986	139.4	98.8	95.2	22.7	62.9	24.4	92.6	38.8
1987	189.6	114.2	105.0	38.0	40.6	24.3	88.3	71.3
1988	212.5	126.7	105.1	36.9	47.0	22.9	68.9	45.6
1989	215.1	159.8	95.2	46.2	48.0	23.2	45.4	39.1
1990	238.8	263.4	71.0	34.6	50.6	23.9	45.3	42.7
1991	249.6	366.9	68.7	48.6	50.3	23.0	110.8	58.5
1992	258.8	351.6	103.2	48.0	57.4	23.9	140.1	53.7
1993	309.1	412.4	141.3	66.4	62.6	23.9	139.6	62.0
1994	307.4	518.2	195.2	100.1	66.5	26.4	72.0	63.5
1995	341.1	579.7	210.8	94.4	70.5	20.6	66.1	85.6
1996	369.5	682.7	234.3	91.5	76.1	19.3	87.1	68.1
1997	427.2	801.5	241.4	82.3	75.7	18.0	64.0	55.1
1998	486.0	637.5	238.7	79.0	84.9	19.1	154.4	38.2
1999	490.5	791.0	247.6	65.6	65.7	17.7	153.6	48.5
2000	461.1	904.0	248.1	54.4	75.0	15.8	88.0	50.9
2001	417.0	908.8	208.1	53.6	76.4	12.9	85.8	39.0
2002	433.9	931.0	176.4	48.0	75.3	12.3	123.5	34.8
2003	512.6	822.4	203.7	43.2	71.2	9.9	74.0	34.6
2004*	492.3	760.8	189.8	43.0	82.2	13.5	68.3	22.8

Source: External Trade Statistics from Statistics Norway.

Table E.5 Exports of fish and fish products by important recipient countries. Million NOK

Year	Total	EU-countries, total	Of this				Other countries, total	Of this	
			France	Denmark	United Kingdom	Germany		Japan	USA
1982	5 931.4	2 494.0	419.9	211.4	880.9	338.3	3 437.5	229.5	421.2
1983	7 367.7	3 186.2	568.8	337.2	1 022.1	515.0	4 181.3	334.5	747.6
1984	7 675.2	3 233.3	530.3	350.3	1 026.7	545.8	4 442.1	408.2	920.1
1985	8 172.3	3 605.0	605.1	377.1	1 202.0	632.8	4 567.8	463.8	1 129.2
1986	8 749.4	4 293.9	781.0	626.9	1 014.2	705.5	4 455.5	408.8	1 194.7
1987	9 992.3	5 597.0	1 114.1	926.7	1 059.1	754.2	4 395.3	501.0	1 397.9
1988	10 693.1	6 107.2	1 318.6	1 115.1	987.2	932.3	4 585.9	808.0	1 059.6
1989	10 999.2	6 416.1	1 305.5	1 196.0	1 019.5	892.9	4 583.1	755.7	996.1
1990	13 002.4	8 119.2	1 617.1	2 046.3	868.8	1 046.5	4 883.3	1 067.5	754.7
1991	14 940.4	9 114.8	1 534.8	2 021.9	991.0	1 196.1	5 825.6	1 797.7	436.4
1992	15 385.2	10 180.2	1 850.7	1 794.1	1 388.9	1 309.3	5 205.0	1 366.3	400.0
1993	16 619.1	10 365.3	1 835.9	1 690.1	1 542.3	1 369.2	6 253.8	1 810.3	565.7
1994	19 536.9	11 709.4	2 250.3	1 767.8	1 484.5	1 698.3	7 827.5	1 999.2	723.1
1995	20 095.0	13 176.4	2 138.0	2 192.2	1 591.4	1 605.4	6 918.6	1 987.5	800.1
1996	22 444.5	13 839.2	2 167.5	2 431.0	1 765.1	1 529.5	8 605.2	2 503.8	762.7
1997	24 632.3	14 531.5	2 274.3	2 640.9	2 022.2	1 532.0	10 100.8	2 752.2	962.9
1998	28 164.5	17 845.6	2 540.3	3 112.5	2 819.2	1 948.1	10 319.0	2 797.8	999.8
1999	29 740.4	18 105.4	2 669.1	3 020.8	2 710.0	1 722.2	11 634.9	4 408.2	1 351.4
2000	31 456.7	18 295.5	2 702.4	3 654.9	2 683.1	1 655.7	13 161.4	4 218.9	1 390.3
2001	30 645.5	16 930.5	2 340.2	3 032.6	2 204.0	1 460.7	13 715.0	4 105.5	1 121.2
2002	28 718.5	15 475.2	2 190.8	2 941.9	2 002.9	1 389.1	13 243.3	3 699.3	1 296.0
2003	26 326.0	14 799.4	2 309.1	3 060.9	1 473.1	1 413.0	11 526.6	2 513.8	1 043.1
2004*	28 273.6	15 657.3	2 464.4	2 974.9	1 583.7	1 444.9	12 616.3	2 612.3	855.0

Source: External Trade Statistics from Statistics Norway.

Table E.6 Exports of salmon

Year	Total		Farmed salmon. Fresh, chilled and frozen		Fresh and frozen fillets, smoked, gravlax, other salmon, etc.[1]	
	Amount 1000 tonnes	Value Million NOK	Amount 1000 tonnes	Value Million NOK	Amount 1000 tonnes	Value Million NOK
1981	7.9	317.7	7.5	292.9	0.4	24.9
1982	9.6	422.7	9.2	395.3	0.4	27.4
1983	15.9	743.8	15.4	709.1	0.5	34.6
1984	20.4	998.5	19.6	944.8	0.7	53.7
1985	24.9	1 385.4	24.0	1 308.8	0.9	77.1
1986	40.1	1 773.4	38.9	1 663.7	1.2	109.7
1987	44.6	2 308.8	43.2	2 174.4	1.4	134.3
1988	66.9	3 175.7	66.0	3 079.7	1.0	96.0
1989	98.2	3 681.4	95.5	3 486.1	2.7	195.3
1990	132.9	5 043.3	130.7	4 834.9	2.2	208.4
1991	134.7	4 998.9	126.6	4 449.6	8.1	549.3
1992	133.3	5 117.8	122.1	4 399.9	11.1	717.9
1993	143.1	5 365.0	131.0	4 553.2	12.1	811.8
1994	170.3	6 476.4	153.8	5 425.3	16.4	1 051.1
1995	207.3	6 790.3	189.1	5 660.8	18.2	1 129.5
1996	238.1	6 991.6	214.1	5 692.9	24.0	1 298.7
1997	261.4	7 657.0	233.1	6 191.0	28.3	1 466.0
1998	282.0	8 761.9	252.3	7 135.9	29.7	1 626.0
1999	336.8	10 726.3	295.6	8 385.2	41.2	2 341.1
2000	343.1	12 271.9	304.0	9 797.7	39.1	2 474.2
2001	338.4	9 999.9	299.6	7 770.0	38.8	2 229.9
2002	360.6	9 534.2	315.6	7 358.8	45.0	2 175.5
2003	414.5	10 045.9	363.7	7 747.8	50.7	2 298.1
2004*	440.0	11 120.3	388.8	8 788.3	51.2	2 332.0

[1]Mainly farmed salmon, but other categories are also included.
Source: External Trade Statistics from Statistics Norway.

Table E.7 Catch quantities[1] and export value[2] of fish and fish products. Selected countries

Country[3]	1999		2000		2001		2002		2003	
	Catch quantity	Export value	Catch quantity	Export value	Catch quantity	Export value	Catch quantity	Export value	Catch quantity	Export value
	1000 tonnes	Million USD	1000 tonnes	Million USD	1000 tonnes	Million USD	1000 tonnes	Million USD	1000 tonnes	Million USD
World, total	93 729	52 682	95 475	55 295	92 807	56 291	93 004	58 242	90 220	63 276
China[5]	17 240	2 960	16 987	3 603	16 529	3 999	16 553	4 485	16 756	5 243
Peru	8 429	788	10 659	1 129	7 983	1 213	8 763	1 067	6 090	1 031
USA	4 750	2 945	4 718	3 055	4 944	3 316	4 937	3 260	4 939	3 399
Indonesia	4 045	1 527	4 120	1 584	4 274	1 533	4 344	1 491	4 675	1 551
Japan	5 188	720	4 988	802	4 713	768	4 364	789	4 596	923
India	3 472	1 180	3 666	1 405	3 777	1 248	3 737	1 421	3 689	1 307
Chile	5 050	1 700	4 300	1 794	3 797	1 939	4 271	1 869	3 622	2 134
Russia	4 141	1 218	3 974	1 386	3 628	1 551	3 232	1 421	3 281	1 483
Thailand	2 952	4 110	2 997	4 367	2 834	4 039	2 842	3 676	2 817	3 906
Norway	2 628	3 765	2 699	3 533	2 687	3 364	2 740	3 569	2 550	3 624
Philippines	1 873	372	1 897	400	1 949	374	2 031	415	2 169	428
Iceland	1 736	1 379	1 983	1 229	1 981	1 270	2 130	1 429	1 978	1 508
Viet Nam	1 386	940	[4]1 451	1 481	[4]1 490	1 782	[4]1 507	2 030	[4]1 667	2 208
Korea Rep.	2 119	1 393	1 825	1 386	1 991	1 156	1 671	1 046	1 648	1 003
Mexico	1 206	650	1 316	707	1 399	668	1 451	602	1 450	635

[1]Catch quantities include marine and inland waters fisheries, but not aquaculture production. Whales, seals and other marine mammals and marine plants are not included. [2]Aquaculture production is included in the export figures. [3] The countries are ranked according to catch quantities in 2003. [4] FAO estimate from available sources of information or calculation based on specific assumptions. [5]Catch data, considered to be overstated since the early 1990s, under review and subject to possible downward revisions.
Source: FAO.

Table E.8 Total catches[1] in world fisheries. 2003

	1000 tonnes	Per cent
Total catches	**90 220**	**100**
By area:		
Inland waters	8 942	9.9
Marine areas	81 278	90.1
By animal group:		
Fishes	76 439	84.7
Crustaceans	6 065	6.7
Molluscs	7 134	7.9
Others	582	0.6
Catches in marine areas by various distributions		
Marine catches, total	**81 278**	**100**
By marine fishing areas:		
North Atlantic	12 584	15.5
Central Atlantic	5 044	6.2
Mediterranean and Black Sea	1 466	1.8
South Atlantic	3 919	4.8
Indian Ocean	9 616	11.8
North Pacific	24 821	30.5
Central Pacific	12 605	15.5
South Pacific	11 223	13.8
By continents:		
Africa	4 894	6.0
North America	8 052	9.9
South America	12 378	15.2
Asia	40 323	49.6
Europe	14 196	17.5
Oceania	1 184	1.5
Other, not elsewhere specified	252	0.3
By species:		
Anchoveta - *Engraulis ringens*	6 202	7.6
Alaska pollock - *Theragra chalcogramma*	2 888	3.6
Blue whiting - *Micromesistius poutassou*	2 385	2.9
Skipjack tuna - *Katsuwonus pelamis*	2 110	2.6
Japanese anchovy - *Engraulis japonicus*	2 089	2.6
Atlantic herring - *Clupea harengus*	1 959	2.4
Chub mackerel - *Scomber japonicus*	1 851	2.3
Chilean jack mackerel - *Trachurus murphyi*	1 736	2.1
Yellowfin tuna - *Thunnus albacares*	1 485	1.8
Largehead hairtail - *Trichiurus lepturus*	1 451	1.8
Capelin - *Mallotus villosus*	1 148	1.4
European pilchard - *Sardina pilchardus*	1 049	1.3
Atlantic cod - *Gadus morhua*	851	1.0
Californian pilchard - *Sardinops caeruleus*	692	0.9
Atlantic mackerel - *Scomber scombrus*	686	0.8
Akiami paste shrimp - *Acetes japonicus*	637	0.8
European sprat - *Sprattus sprattus*	632	0.8
European anchovy - *Engraulis encrasicolus*	546	0.7
Gulf menhaden - *Brevoortia patronus*	522	0.6
Japanese flying squid - *Todarodes pacificus*	488	0.6
Round sardinella - *Sardinella aurita*	480	0.6
Argentine shortfin squid - *Illex argentinus*	479	0.6
Pacific saury - *Cololabis saira*	446	0.5
Japanese Spanish mackerel - *Scomberomorus niphonius*	439	0.5
Golden threadfin bream - *Nemipterus virgatus*	438	0.5
Southern rough shrimp - *Trachypenaeus curvirostris*	432	0.5
Bigeye tuna - *Thunnus obesus*	425	0.5

[1]Not including farmed fish. Not including whales, seals and other sea mammals and aquatic plants.
Source: FAO.

Air pollution and climate

Appendix F

Table F.1 Emissions of greenhouse gases to air

	CO_2	CH_4	N_2O	HFC 23	HFC 32	HFC 125	HFC 134	HFC 143	HFC 152	HFC 227	C_3F_8	CF_4	C_2F_6	SF_6	CO_2 equiva-lents
	Mill. tonnes	1000 tonnes		Tonnes											Mill. tonnes
GWP[1] . . .	1	21	310	11 700	650	2 800	1 300	3 800	140	2 900	7 000	6 500	9 200	23 900	
1950	..	131	7	-	-	-	-	-	-	-	..	..	..	..	..
1960	..	175	10	-	-	-	-	-	-	-	..	..	..	..	..
1970	..	216	12	-	-	-	-	-	-	-	..	..	..	..	..
1973	30.4	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1974	27.6	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1975	30.5	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1976	33.2	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1977	33.2	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1978	32.5	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1979	34.5	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1980	31.6	195	13	-	-	-	-	-	-	-	..	..	..	0	..
1981	31.6	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1982	30.7	..	..	-	-	-	-	-	-	-	..	..	..	91	..
1983	31.7	..	..	-	-	-	-	-	-	-	..	..	..	100	..
1984	33.6	..	..	-	-	-	-	-	-	-	..	..	..	185	..
1985	32.0	..	..	-	-	-	-	-	-	-	..	489	20	199	..
1986	34.5	..	..	-	-	-	-	-	-	-	..	479	20	240	..
1987	32.9	234	14	-	-	-	-	-	-	-	..	464	19	240	51.2
1988	35.3	231	15	-	-	-	-	-	-	-	..	443	18	224	53.2
1989	33.8	245	16	-	-	-	-	-	-	-	..	430	18	108	49.4
1990	34.4	246	16	-	-	-	-	-	0	-	..	479	20	92	50.1
1991	33.5	247	16	-	-	-	0	-	0	-	..	369	14	87	48.3
1992	33.8	250	14	-	-	-	0	-	1	-	..	294	11	30	46.0
1993	35.4	253	15	-	-	-	2	-	1	-	..	290	10	31	48.0
1994	37.3	256	15	0	0	0	5	0	1	-	..	251	9	37	50.0
1995	37.2	257	15	0	0	2	10	2	1	-	0	229	8	26	49.6
1996	40.4	258	16	0	0	5	17	4	1	0	0	214	5	24	52.8
1997	40.6	261	16	0	0	10	26	7	2	0	0	201	8	25	52.9
1998	40.8	253	16	0	0	15	38	10	5	0	0	185	7	31	53.3
1999	41.6	249	17	0	1	20	50	15	6	0	0	164	6	37	54.3
2000	41.1	253	17	0	1	26	61	20	8	0	0	131	5	40	53.8
2001	42.7	252	17	0	2	33	72	27	10	0	0	152	6	34	55.3
2002	41.2	244	17	0	2	41	86	35	12	1	0	163	7	11	53.5
2003* . . .	43.2	241	17	0	5	27	65	20	11	0	-	102	4	10	54.8
2004* . . .	43.7	237	18	0	8	52	91	36	11	8	-	93	4	11	55.5

[1]Impact on greenhouse effect of emission of 1 tonne of the gas compared with that of 1 tonne CO_2.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F.2 Emissions to air

	SO_2	NO_X	NH_3	Acid equivalents[1]	NMVOC	CO	Particulates[2]
				1000 tonnes			
1973	156	183	..	..	187	718	..
1974	149	180	..	..	179	679	..
1975	138	185	..	..	200	732	..
1976	146	181	..	..	201	775	..
1977	146	195	..	..	207	821	..
1978	142	188	..	..	166	847	..
1979	144	198	..	..	182	885	..
1980	136	191	20	9.6	173	877	47
1981	128	181	..	..	181	871	..
1982	110	185	..	..	188	879	..
1983	103	190	..	..	201	871	..
1984	95	205	..	..	211	897	..
1985	98	217	..	..	230	900	..
1986	91	231	..	..	249	926	..
1987	73	230	21	8.5	252	887	51
1988	67	226	19	8.1	252	917	..
1989	58	225	21	7.9	273	869	48
1990	52	224	20	7.7	295	867	70
1991	44	214	21	7.2	294	800	64
1992	36	212	22	7.0	323	779	61
1993	35	222	22	7.2	340	781	68
1994	35	220	22	7.2	353	766	69
1995	33	221	23	7.2	367	734	67
1996	33	230	24	7.4	370	707	70
1997	30	233	23	7.4	367	670	74
1998	30	235	23	7.4	362	631	67
1999	28	238	23	7.4	370	595	63
2000	26	224	23	7.1	381	565	63
2001	25	221	23	6.9	391	553	62
2002	22	211	23	6.6	345	541	64
2003*	23	220	23	6.8	300	509	60
2004*	25	221	23	6.9	266	479	58

[1] Total acidifying effect of SO_2, NO_x and NH_3. [2] PM_{10}.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F.3 Emissions of greenhouse gases to air by sector. 2002

	CO_2	CH_4	N_2O	HFC[1]	PFC[2]	SF_6	CO_2 equivalents
	Mill. tonnes	1000 tonnes		Tonnes			Mill. tonnes
Total	**41.2**	**243.8**	**17.5**	**177.2**	**169.6**	**10.6**	**53.5**
Energy sectors	**14.8**	**36.6**	**0.1**	**2.1**	**0.0**	**4.1**	**15.7**
Extraction of oil and gas[3]	12.6	35.1	0.1	1.9	0.0	-	13.4
Extraction of coal	0.0	1.1	-	0.1	-	-	0.0
Oil refining	1.8	0.2	0.0	0.1	-	-	1.8
Electricity supplies[4]	0.4	0.2	0.0	0.1	-	4.1	0.5
Manufacturing and mining	**10.0**	**15.2**	**6.4**	**33.9**	**169.5**	**6.0**	**13.7**
Oil drilling	0.2	0.1	0.0	0.1	-	-	0.2
Manufacture of pulp and paper	0.5	5.7	0.1	0.1	-	-	0.6
Manufacture of basic chemicals	2.1	1.2	6.2	0.1	-	-	4.1
Manufacture of minerals[5]	1.9	0.0	0.1	0.1	-	-	1.9
Manufacture of iron, steel and ferro-alloys	2.3	0.4	0.0	0.8	-	-	2.3
Manufacture of other metals	2.0	0.0	0.0	0.8	169.5	5.9	3.2
Manufacture of metal goods, boats, ships and oil platforms	0.3	0.0	0.0	18.7	-	0.1	0.3
Manufacture of wood, plastic, rubber, and chemical goods, printing	0.2	7.6	0.0	0.8	-	-	0.3
Manufacture of consumer goods	0.6	0.0	0.0	12.5	0.0	-	0.6
Other	**11.1**	**182.6**	**9.4**	**123.7**	**0.0**	**0.2**	**18.2**
Construction	0.7	0.1	0.1	2.1	-	-	0.7
Agriculture and forestry	0.5	93.6	8.1	1.6	-	-	4.9
Fishing, whaling and sealing	1.5	0.1	0.0	7.5	0.0	-	1.5
Land transport, domestic	3.6	0.2	0.2	9.7	0.0	-	3.7
Sea transport, domestic	1.5	0.2	0.0	3.9	0.0	-	1.5
Air transport[6]	0.9	0.0	0.0	0.6	-	-	0.9
Other private services	1.8	0.4	0.4	91.4	0.0	0.2	2.1
Public sector, municipal[7]	0.2	88.0	0.5	4.4	0.0	-	2.2
Public sector, state	0.5	0.0	0.0	2.5	0.0	-	0.5
Private households	**5.3**	**9.3**	**1.5**	**17.4**	**-**	**0.3**	**6.0**

[1]The distribution by sectors is uncertain. [2] Includes C_3F_8, CF_4 and C_2F_6. [3]Includes gas terminal, transport and supply ships. [4]Includes emissions from waste incineration plants. [5]Including mining. [6]Domestic air transport only, including emissions above 1000 m. [7]Includes water supply.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F.4 Emissions to air by sector. 2002

	SO_2	NO_X	NH_3	Acid equivalents[1]	NMVOC	CO	Particulates[2]
				1000 tonnes			
Total	**22.1**	**210.9**	**22.7**	**6.6**	**345.3**	**541.2**	**64.0**
Energy sectors	**3.0**	**60.0**	**0.0**	**1.4**	**226.9**	**10.1**	**0.9**
Extraction of oil and gas[3]	0.5	56.2	-	1.2	217.0	8.1	0.7
Extraction of coal	0.0	0.0	-	0.0	0.0	0.0	0.0
Oil refining	1.8	2.2	-	0.1	9.3	0.0	0.2
Electricity supplies[4]	0.7	1.5	0.0	0.1	0.6	2.0	0.1
Manufacturing and mining	**15.0**	**21.6**	**0.6**	**1.0**	**22.2**	**41.4**	**10.6**
Oil drilling	0.0	1.8	-	0.0	0.2	0.2	0.3
Manufacture of pulp and paper	1.7	1.8	-	0.1	0.4	3.9	0.4
Manufacture of basic chemicals	4.9	4.3	0.4	0.3	1.6	30.0	2.6
Manufacture of minerals[5]	1.4	5.7	0.2	0.2	2.0	1.0	2.3
Manufacture of iron, steel and ferro-alloys	4.4	4.7	0.0	0.2	1.5	0.3	1.9
Manufacture of other metals	1.8	1.1	0.0	0.1	0.0	0.2	2.9
Manufacture of metal goods, boats, ships and oil platforms	0.1	0.7	0.0	0.0	2.5	0.9	0.0
Manufacture of wood, plastic, rubber, and chemical goods, printing	0.2	0.6	0.0	0.0	12.4	4.2	0.1
Manufacture of consumer goods	0.6	1.0	0.0	0.0	1.4	0.9	0.1
Other	**3.1**	**112.2**	**20.6**	**3.7**	**41.5**	**91.7**	**6.8**
Construction	0.1	5.4	0.0	0.1	10.4	4.2	1.6
Agriculture and forestry	0.1	6.1	20.1	1.3	3.1	10.8	2.1
Fishing, whaling and sealing	0.9	33.8	0.0	0.8	0.8	6.9	0.2
Land transport, domestic	0.2	22.1	0.1	0.5	4.6	19.1	2.1
Sea transport, domestic	1.2	32.4	-	0.7	1.6	1.4	0.3
Air transport[6]	0.1	3.0	-	0.1	2.4	6.6	0.0
Other private services	0.4	6.1	0.4	0.2	15.1	40.1	0.4
Public sector, municipal[7]	0.1	0.2	-	0.0	1.6	0.2	0.0
Public sector, state	0.1	3.0	0.0	0.1	2.0	2.4	0.0
Private households	**1.0**	**17.2**	**1.5**	**0.5**	**54.7**	**398.0**	**45.7**

[1]Total acidifying effect of SO_2, NO_X and NH_3. [2] PM_{10}. [3] Includes gas terminal, transport and supply ships. [4]Includes emissions from waste incineration. [5]Including mining. [6]Includes only domestic air transport. [7]Includes water supplies.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F.5 Emissions to air by source[1]. 2002

	CO_2	CH_4	N_2O	SO_2	NO_X	NH_3	NMVOC	CO	Parti-culates[2]
	Mill. tonnes	1000 tonnes							
Total	**41.2**	**243.8**	**17.5**	**22.1**	**210.9**	**22.7**	**345.3**	**541.2**	**64.0**
Stationary combustion	18.3	12.4	0.3	5.6	56.4	0.1	13.4	202.7	46.3
Process emissions	7.6	228.5	14.6	13.3	9.5	20.7	277.4	30.1	12.8
Mobile combustion	15.4	2.8	2.6	3.3	145.1	1.9	54.4	308.4	4.9
Stationary combustion									
Total	**18.3**	**12.4**	**0.3**	**5.6**	**56.4**	**0.1**	**13.4**	**202.7**	**46.3**
Oil and gas extraction	11.3	3.7	0.1	0.2	42.7	-	1.4	7.8	0.5
Natural gas	8.8	3.3	0.1	-	30.4	-	0.9	6.1	0.4
Flaring	1.0	0.1	0.0	-	5.0	-	0.0	0.6	0.0
Diesel combustion	0.4	0.0	0.0	0.2	6.5	-	0.4	0.5	0.0
Gas terminals	1.1	0.3	0.0	0.0	0.8	-	0.1	0.6	0.0
Manufacturing and mining	4.9	0.7	0.1	4.0	9.5	-	1.6	10.3	0.7
Refining	1.1	0.1	0.0	0.4	1.2	-	0.6	0.0	0.1
Manufacture of pulp and paper	0.5	0.3	0.1	1.1	1.7	-	0.4	3.8	0.1
Manufacture of mineral products	0.7	0.0	0.0	0.3	3.4	-	0.1	0.3	0.0
Manufacture of chemicals	1.3	0.1	0.0	0.5	1.3	-	0.0	0.1	0.1
Manufacture of metals	0.3	0.0	0.0	0.2	0.5	-	0.0	0.3	0.0
Other manufacturing	1.0	0.1	0.0	1.4	1.3	-	0.6	5.8	0.3
Other industries	1.1	0.4	0.0	0.5	1.1	-	0.1	6.7	1.4
Dwellings	0.9	7.5	0.1	0.7	2.1	0.1	9.8	177.8	43.7
Incineration of waste and landfill gas	0.2	0.1	0.0	0.3	1.1	-	0.4	0.1	0.0
Process emissions									
Total	**7.6**	**228.5**	**14.6**	**13.3**	**9.5**	**20.7**	**277.4**	**30.1**	**12.8**
Oil and gas extraction	0.9	31.5	0.0	-	0.4	-	215.3	0.1	0.3
Venting, leaks, etc.	0.2	11.9	0.0	-	0.4	-	5.1	0.1	0.3
Oil loading at sea	0.6	16.4	-	-	-	-	193.1	-	-
Oil loading, on shore	0.0	1.4	-	-	-	-	13.7	-	-
Gas terminals	0.0	1.7	-	-	-	-	3.4	-	-
Manufacturing and mining	6.6	2.8	6.2	13.3	9.1	0.5	11.7	30.0	10.7
Refining	0.7	0.1	-	1.3	0.9	-	8.8	-	0.1
Manufacture of pulp and paper	-	-	-	0.5	-	-	-	-	0.2
Manufacture of chemicals	0.3	0.9	6.2	2.2	1.2	0.4	0.7	29.9	1.2
Manufacture of mineral products	0.9	-	-	0.6	-	0.2	-	-	3.1
Manufacture of metals	4.6	0.6	-	8.6	6.9	0.0	1.4	0.2	6.0
Iron, steel and ferro-alloys	2.8	0.6	-	6.5	6.2	-	1.4	-	3.1
Aluminium	1.7	-	-	1.5	0.7	-	-	-	2.9
Other metals	0.1	-	-	0.6	0.0	0.0	-	0.2	0.0
Other manufacturing	0.1	1.1	-	-	-	-	0.9	-	0.0
Petrol distribution	0.0	-	-	-	-	-	8.2	-	-
Agriculture	-	93.3	7.9	-	-	20.1	-	-	0.0
Landfill gas	-	100.0	-	-	-	-	-	-	-
Solvents	0.1	-	-	-	-	-	42.3	-	0.0
Road dust	-	-	-	-	-	-	-	-	1.9
Other process emissions	0.0	1.0	0.5	-	-	0.0	-	-	0.0

Table F.5 (cont.). Emissions to air by source[1]. 2002

	CO_2	CH_4	N_2O	SO_2	NO_X	NH_3	NMVOC	CO	Parti-culates[2]
	Mill. tonnes	1000 tonnes							
Mobile combustion									
Total	**15.4**	**2.8**	**2.6**	**3.3**	**145.1**	**1.9**	**54.4**	**308.4**	**4.9**
Road traffic	9.3	2.1	2.1	0.5	43.2	1.9	35.6	242.3	2.3
Petrol engines	4.9	1.8	1.9	0.3	17.3	1.9	26.6	208.6	0.3
Passenger cars	4.3	1.7	1.8	0.3	15.1	1.8	24.1	187.8	0.3
Other light vehicles	0.5	0.1	0.1	0.0	1.7	0.1	2.2	19.0	0.0
Heavy vehicles	0.0	0.0	0.0	0.0	0.5	0.0	0.3	1.8	0.0
Diesel engines	4.3	0.1	0.2	0.2	25.7	0.0	3.5	12.6	2.0
Passenger cars	0.6	0.0	0.0	0.0	1.4	0.0	0.4	1.8	0.4
Other light vehicles	1.3	0.0	0.1	0.1	2.5	0.0	0.9	4.6	0.7
Heavy vehicles	2.5	0.1	0.1	0.1	21.8	0.0	2.3	6.2	1.0
Motorcycles, mopeds	0.1	0.2	0.0	0.0	0.2	0.0	5.6	21.0	0.0
Motorcycles	0.1	0.1	0.0	0.0	0.2	0.0	2.8	15.7	0.0
Mopeds	0.0	0.0	-	0.0	0.0	-	2.8	5.3	0.0
Snow scooters	0.0	0.0	-	0.0	0.0	-	1.8	3.4	0.0
Small boats	0.2	0.2	0.0	0.0	1.1	-	8.9	22.7	0.3
Motorized equipment	0.8	0.1	0.3	0.1	12.0	0.0	3.9	25.6	1.4
Railways	0.0	0.0	0.0	0.0	0.6	-	0.1	0.2	0.1
Air traffic	1.2	0.0	0.0	0.1	4.2	-	1.9	8.7	0.0
Domestic < 1000 m	0.3	0.0	0.0	0.0	1.0	-	0.4	2.2	0.0
Domestic > 1000 m	0.9	-	0.0	0.1	3.2	-	1.5	6.5	0.0
Shipping	3.7	0.3	0.1	2.5	83.9	-	2.4	5.6	0.8
Coastal traffic, etc.	2.2	0.2	0.1	1.6	48.8	-	1.6	1.8	0.5
Fishing vessels	1.5	0.1	0.0	0.9	33.7	-	0.7	3.7	0.2
Mobile oil rigs, etc.	0.1	0.0	-	0.0	1.4	-	0.1	0.1	0.0

[1] Does not include international sea traffic. [2] PM_{10}.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority

Table F.6 Emissions to air by source[1]. 2003*

	CO_2	CH_4	N_2O	SO_2	NO_x	NH_3	NMVOC	CO	Particulates[2]
	Mill. tonnes	1000 tonnes							
Total	**43.2**	**240.8**	**17.2**	**22.8**	**220.2**	**22.8**	**300.1**	**509.2**	**60.1**
Stationary combustion	20.1	12.8	0.4	5.7	63.3	0.1	13.9	197.4	44.0
Process emissions	7.5	225.1	14.1	12.4	9.1	20.7	234.3	22.6	11.4
Mobile combustion	15.6	2.9	2.8	4.7	147.8	2.0	51.8	289.2	4.8
Stationary combustion									
Total	**20.1**	**12.8**	**0.4**	**5.7**	**63.3**	**0.1**	**13.9**	**197.4**	**44.0**
Oil and gas extraction	12.2	4.0	0.1	0.5	48.2	-	1.6	8.2	0.5
Natural gas	9.3	3.5	0.1	0.0	33.2	-	0.9	6.4	0.5
Flaring	1.0	0.1	0.0	0.0	5.2	-	0.0	0.6	0.0
Diesel combustion	0.6	0.0	0.0	0.4	8.8	-	0.5	0.4	0.0
Gas terminals	1.2	0.4	0.0	0.0	1.0	-	0.1	0.8	0.1
Manufacturing and mining	5.4	0.7	0.2	3.9	10.5	-	1.8	11.3	0.6
Refining	1.3	0.1	0.0	0.2	1.5	-	0.6	-	0.1
Manufacture of pulp and paper	0.5	0.3	0.1	1.3	1.8	-	0.4	3.8	0.1
Manufacture of mineral products	0.7	0.0	0.0	0.3	3.9	-	0.1	0.3	0.0
Manufacture of chemicals	1.5	0.1	0.0	0.7	1.4	-	0.1	0.9	0.2
Manufacture of metals	0.3	0.0	0.0	0.1	0.5	-	0.0	0.3	0.0
Other manufacturing	1.1	0.1	0.0	1.3	1.4	-	0.6	6.0	0.3
Other industries	1.3	0.4	0.0	0.4	1.2	-	0.2	5.9	1.1
Dwellings	1.0	7.5	0.1	0.6	2.2	0.1	9.9	171.9	41.7
Incineration of waste and landfill gas	0.2	0.2	0.0	0.3	1.2	-	0.5	0.2	0.0
Process emissions									
Total	**7.5**	**225.1**	**14.1**	**12.4**	**9.1**	**20.7**	**234.3**	**22.6**	**11.4**
Oil and gas extraction	0.7	28.9	-	-	0.1	-	172.2	0.0	0.2
Venting, leaks, etc.	0.1	13.0	-	-	0.1	-	6.8	0.0	0.2
Oil loading at sea	0.5	13.0	-	-	-	-	152.9	-	-
Oil loading, on shore	0.0	1.2	-	-	-	-	9.5	-	-
Gas terminals	0.0	1.6	-	-	-	-	3.1	-	-
Manufacturing and mining	6.7	3.0	5.5	12.4	9.0	0.5	11.6	22.5	9.3
Refining	0.9	0.1	-	1.6	1.1	-	8.7	-	0.1
Manufacture of pulp and paper	-	-	-	0.5	-	-	-	-	0.2
Manufacture of chemicals	0.3	0.7	5.5	1.3	1.4	0.4	0.6	22.4	0.8
Manufacture of mineral products	0.9	-	-	0.7	-	0.1	-	-	3.4
Manufacture of metals	4.5	0.6	-	8.3	6.5	0.0	1.3	0.2	4.8
Iron, steel and ferro-alloys	2.5	0.6	-	6.1	5.7	-	1.3	-	2.7
Aluminium	1.9	-	-	1.5	0.8	-	-	-	2.2
Other metals	0.1	-	-	0.7	0.0	0.0	-	0.2	0.0
Other manufacturing	0.1	1.6	-	-	-	-	1.0	-	0.0
Petrol distribution	0.0	-	-	-	-	-	8.2	-	-
Agriculture	-	94.6	8.1	-	-	20.2	-	-	0.0
Landfill gas	-	97.6	-	-	-	-	-	-	-
Solvents	0.1	-	-	-	-	-	42.3	-	0.0
Road dust	-	-	-	-	-	-	-	-	1.9
Other process emissions	0.0	1.0	0.5	-	-	0.0	-	-	0.0

Table F.6 (cont.). Emissions to air by source[1]. 2003*

	CO_2	CH_4	N_2O	SO_2	NO_x	NH_3	NMVOC	CO	Parti-culates[2]
	Mill. tonnes	1000 tonnes							
Total	**15.6**	**2.9**	**2.8**	**4.7**	**147.8**	**2.0**	**51.8**	**289.2**	**4.8**
Road traffic	9.6	2.0	2.3	0.5	41.6	2.0	33.2	225.5	2.2
Petrol engines	4.9	1.7	2.1	0.2	15.6	2.0	23.8	190.7	0.3
Passenger cars	4.3	1.6	2.0	0.1	13.7	1.9	21.6	172.4	0.2
Other light vehicles	0.5	0.1	0.1	0.0	1.5	0.1	1.9	16.7	0.0
Heavy vehicles	0.1	0.0	0.0	0.0	0.5	0.0	0.3	1.6	0.0
Diesel engines	4.6	0.1	0.2	0.3	25.8	0.0	3.5	12.6	1.9
Passenger cars	0.7	0.0	0.0	0.0	1.5	0.0	0.4	2.0	0.4
Other light vehicles	1.3	0.0	0.1	0.1	2.6	0.0	0.8	4.8	0.6
Heavy vehicles	2.6	0.1	0.1	0.2	21.7	0.0	2.3	5.8	0.9
Motorcycles, mopeds	0.1	0.2	0.0	0.0	0.2	0.0	5.9	22.1	0.0
Motorcycles	0.1	0.1	0.0	0.0	0.2	0.0	3.0	16.4	0.0
Mopeds	0.0	0.0	-	0.0	0.0	-	3.0	5.7	0.0
Snow scooters	0.0	0.0	-	-	0.0	-	1.8	3.5	0.0
Small boats	0.2	0.2	0.0	0.0	1.1	-	8.9	22.7	0.3
Motorized equipment	0.8	0.1	0.3	0.2	11.7	0.0	3.8	25.4	1.4
Railways	0.0	0.0	0.0	0.0	0.6	-	0.1	0.1	0.0
Air traffic	1.0	0.0	0.0	0.1	3.3	-	1.4	6.2	0.0
Domestic < 1000 m	0.3	0.0	0.0	0.0	1.0	-	0.3	2.0	0.0
Domestic > 1000 m	0.7	-	0.0	0.1	2.3	-	1.1	4.3	0.0
Shipping	4.0	0.5	0.1	3.9	89.5	-	2.6	5.7	0.8
Coastal traffic, etc.	2.5	0.4	0.1	2.8	55.9	-	1.9	2.0	0.6
Fishing vessels	1.4	0.1	0.0	1.1	32.6	-	0.6	3.6	0.2
Mobile oil rigs, etc.	0.0	0.0	-	0.0	1.0	-	0.1	0.1	0.0

[1] Does not include international sea traffic. [2] PM_{10}.

Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F.7 Emissions to air by county. 2003*

	CO_2	CH_4	N_2O	SO_2	NO_x	NH_3	NMVOC	CO	Particulates[4]
	Mill. tonnes	1000 tonnes							
Total	**43.5**	**240.8**	**17.2**	**23.3**	**222.4**	**22.8**	**300.2**	**509.7**	**60.1**
Of this, national emission figures	43.3	240.8	17.2	22.8	220.2	22.8	300.1	509.2	60.1
Of this, international sea and air traffic[1]	0.2	0.0	0.0	0.4	2.2	-	0.2	0.6	0.0
Østfold	1.3	9.6	0.8	1.8	4.8	1.2	7.4	29.0	3.2
Akershus	1.8	9.5	1.0	0.4	7.2	1.0	12.4	48.6	3.8
Oslo	1.4	4.0	0.3	0.4	4.8	0.2	9.8	23.3	0.9
Hedmark	0.8	12.7	1.0	0.2	4.0	1.8	5.3	28.6	3.7
Oppland	0.7	16.2	0.9	0.1	3.6	2.2	5.1	28.8	4.2
Buskerud	1.1	10.8	0.6	0.8	4.9	0.8	6.3	31.2	3.7
Vestfold	1.2	6.7	0.5	1.1	4.3	0.7	7.6	24.1	2.4
Telemark	2.6	7.0	4.3	0.8	6.6	0.8	5.1	21.8	3.0
Aust-Agder	0.5	4.7	0.2	1.1	1.7	0.3	3.0	33.2	2.2
Vest-Agder	1.2	7.7	0.3	1.5	3.1	0.5	4.4	18.5	2.4
Rogaland	3.1	28.0	1.3	0.8	7.3	3.5	12.1	34.1	4.5
Hordaland	4.0	18.5	0.6	1.9	9.5	1.1	27.9	35.3	3.6
Sogn og Fjordane	1.2	9.3	0.5	1.6	3.7	1.2	2.5	11.8	2.4
Møre og Romsdal	1.5	13.4	0.7	0.5	5.3	1.3	6.2	25.0	4.1
Sør-Trøndelag	1.2	13.2	0.8	1.8	4.6	1.7	6.3	27.8	3.9
Nord-Trøndelag	0.7	12.4	0.9	0.9	3.1	2.1	3.6	22.8	4.0
Nordland	2.1	14.2	2.1	2.4	7.5	1.5	5.1	22.6	3.5
Troms	0.7	6.0	0.3	0.8	3.4	0.6	3.4	15.0	2.5
Finnmark	0.3	5.4	0.1	0.1	1.6	0.2	1.9	7.5	0.8
Svalbard and Jan Mayen	0.1	1.6	0.0	0.3	0.2	0.0	0.1	0.2	0.1
Continental shelf	14.8	30.0	0.2	3.6	120.1	-	163.4	14.8	1.3
Airspace[2]	0.8	0.0	0.0	0.1	2.9	-	1.3	5.0	0.0
Open sea[3]	0.4	0.0	0.0	0.3	8.3	-	0.2	0.9	0.1

[1] Emissions from international sea traffic in Norwegian ports and international air traffic below 100 metres. [2] Domestic air transport. [3] Emissions from Norwegian fishing vessels outside the Norwegian Economic Zone. [4] PM_{10}.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F.8 Emissions factors

	Tonnes CO_2 / tonne of energy	Tonnes CO_2 / TJ of energy
LPG	3.00	65.08
Motor gasoline	3.13	71.30
Other gasoline	3.13	71.30
Heating kerosene	3.15	73.09
Kerosene type jet fuel	3.15	73.09
Auto diesel	3.17	73.55
Marine gas oil	3.17	73.55
Light fuel oil	3.17	73.55
Heavy fuel oil	3.20	78.82
Natural gas (2004)	2.75	58.35
Coal	2.52	89.68
Coal coke	3.19	111.93
Petrol coke	3.59	102.57
Fuelwood and black liquor	-	-
Garbage	0.25	23.90
Refinery gas	2.80	57.61
Fuel gas	2.50	50.00
Methane	0.28	5.48

Source: Statistics Norway.

Table F.9 Selected factors for mobile emissions to air, by source[1]. 2003

	CO_2	CH_4	N_2O	SO_2	NO_X	NH_3	NMVOC	CO	Particulates[2]
	kg/kg				g/kg				
Petrol engines									
Passenger cars	3.13	1.18	1.43	0.10	9.96	1.354	15.74	125.51	0.169
Other light vehicles	3.13	0.65	0.74	0.10	8.99	0.719	11.49	102.54	0.127
Heavy vehicles	3.13	1.10	0.04	0.10	29.44	0.077	18.16	96.07	0.100
Diesel engines									
Passenger cars	3.17	0.06	0.21	0.20	6.85	0.022	1.72	9.05	1.768
Other light vehicles	3.17	0.07	0.15	0.20	6.14	0.014	2.02	11.44	1.541
Heavy vehicles	3.17	0.11	0.13	0.20	26.55	0.003	2.77	7.11	1.061
Motorcycles	3.13	4.94	0.05	0.20	7.01	0.051	127.75	710.50	0.145
Mopeds	3.13	5.85	0.06	0.20	2.74	0.053	367.53	699.88	0.140
Snow scooters	3.13	5.85	0.06	0.20	2.74	0.053	367.53	699.88	0.140
Small boats petrol[3]	3.13	5.10	0.02	0.20	6.00	-	240.00	415.00	8.000
Small boats diesel	3.17	0.18	0.03	0.60	54.00	-	27.00	25.00	4.000
Motorized equipment petrol[4]	3.13	5.50	0.07	0.20	10.00	0.005	110.00	1 200.00	1.000
Motorized equipment diesel	3.17	0.17	1.30	0.60	50.00	0.005	6.00	15.00	4.000
Railways	3.17	0.18	1.20	0.60	47.00	-	4.00	11.00	3.800
Air traffic									
Domestic < 100 m	3.15	0.19	0.10	0.30	6.85	-	1.67	18.76	0.025
Domestic 100-1000 m	3.15	0.03	0.10	0.30	13.21	-	0.27	2.04	0.025
Domestic > 1000 m	3.15	-	0.10	0.30	12.11	-	0.57	3.08	0.007
Shipping[5]									
Coastal traffic, etc.	3.17	0.23	0.08	2.00	67.90	-	2.40	2.90	0.700
Fishing vessels	3.17	0.23	0.08	2.00	71.81	-	1.40	7.90	0.500
Mobile oil rigs, etc.	3.17	0.80	0.02	2.00	70.00	-	5.00	7.00	0.500

[1] Does not include international sea traffic. [2] PM_{10}. [3] 2 stroke. [4] 4 stroke. [5] Marine fuel.

Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F.10 Emissions to air of carbon dioxide (CO_2) from energy use[1]. Million tonnes

	1980	1990	2000	2001	2002	Per unit GDP (kg/1 000 USD) 2002[2]	Per capita (tonnes/ capita) 2002
World, total	**18 123**	**20 664**	**23 006**	**23 156**	**23 710**	**..**	**3.8**
OECD	10 928	11 141	12 486	12 511	12 600	497	11.0
Norway	29	29	36	35	36	282	7.8
Denmark	61	49	50	52	51	362	9.5
Finland	59	53	55	60	65	522	12.6
Iceland	2	2	2	2	2	292	7.7
Sweden	69	48	46	49	51	234	5.8
Belgium	126	107	121	121	113	440	11.1
France	472	364	355	375	369	260	6.2
Greece	45	69	85	88	88	511	8.2
Ireland	26	32	40	43	42	363	10.9
Italy	370	397	427	428	430	332	7.4
Luxembourg	12	10	8	8	9	481	20.9
Netherlands	154	156	172	176	177	442	11.0
Poland	439	352	295	296	292	820	7.6
Portugal	25	40	60	59	63	375	6.1
Slovak Republic	63	55	35	39	39	625	7.2
Spain	192	212	286	288	303	401	7.5
United Kingdom	584	569	542	555	532	403	8.8
Switzerland	40	43	41	45	43	215	5.9
Czech Republic	165	150	122	123	121	846	11.8
Turkey	73	138	205	186	193	459	2.8
Germany	1 077	971	840	868	848	440	10.3
Hungary	81	68	55	57	56	462	5.5
Austria	58	59	64	69	67	335	8.3
Canada	429	421	516	513	507	581	16.2
Mexico	244	297	360	365	380	467	3.8
United States	4 765	4 852	5 699	5 643	5 705	616	19.8
Japan	913	1 075	1 168	1 164	1 178	372	9.2
Republic of Korea	125	237	440	448	472	657	9.9
Australia	212	261	328	322	334	679	17.0
New Zealand	17	23	32	34	33	432	8.4

[1]The Norwegian figures in this OECD survey diverge somewhat from the most recent emission calculations. [2]GDP 2002 expressed in 1995 prices adjusted to local purchasing power.
Source: OECD Environmental Data. Compendium 2004

Table F.11 International emissions of SO_X[1]. Emissions per unit GDP and per capita

	1990	1995	1999	2000	2001	2002	Per unit GDP[2]	Per capita
			1000 tonnes				kg/1000 USD	kg per capita
Norway	52	33	28	27	25	22	0.2	4.9
Denmark	176	136	53	27	24	24	0.2	4.5
Finland	237	97	85	76	87	85	0.7	16.4
Sweden	106	77	59	55	57	58	0.3	6.5
Belgium	355	256	176	169	159	151	0.6	14.7
France	1 326	978	705	627	570	537	0.4	9.0
Italy	1 773	1 287	922	771	736	655	0.5	11.5
Netherlands	204	142	105	91	90	85	0.2	5.3
Poland	3 210	2 376	1 719	1 511	1 564	1 455	4.1	38.1
Portugal	322	333	343	312	295	295	1.7	28.4
Russian Fed.[3]	..	6 612	..	..	..	..	..	..
Spain	2 178	1 808	1 640	1 522	1 464	1 541	2.0	37.4
United Kingdom	3 722	2 364	1 230	1 190	1 116	1 003	0.8	16.6
Switzerland	45	29	20	18	21	19	0.1	2.6
Czech Republic	1 876	1 091	268	264	251	237	1.7	23.2
Germany	5 326	1 937	735	636	643	611	0.3	7.4
Hungary	1 010	705	590	486	400	359	3.0	35.3
Austria	80	52	38	35	38	36	0.2	4.5
Canada	3 260	2 626	2 500	2 379	2 405	2 394	2.7	76.3
United States	20 925	16 881	15 856	14 767	14 413	13 847	1.5	48.0
Japan	1 001	938	848	857	857	857	0.3	6.7
Republic of Korea	1 611	1 532	951	..	..	..	..	..

[1]The Norwegian figures in this OECD survey diverge somewhat from the most recent emission calculations. [2]GDP at 1995 prices and purchasing power parities. [3]Data for Russian Fed. are from OECD 2002.
Source: OECD (2002) and OECD (2005).

Table F.12 International emissions of NO_X[1]. Emissions per unit GDP and per capita

	1990	1995	1999	2000	2001	2002	Per unit GDP[2]	Per capita
			1000 tonnes				kg/1000 USD	kg per capita
Norway	224	221	237	224	220	213	1.7	46.9
Denmark	276	265	216	198	193	191	1.4	35.5
Finland	311	259	248	236	210	211	1.7	40.5
Sweden	324	298	262	250	247	242	1.1	27.1
Belgium	365	354	304	307	298	290	1.1	28.1
France	1 895	1 702	1 510	1 429	1 393	1 350	1.0	22.7
Italy	1 927	1 789	1 451	1 373	1 358	1 267	1.0	21.8
Netherlands	599	518	464	447	436	430	1.1	26.6
Poland	1 280	1 120	951	838	805	796	2.2	20.8
Portugal	255	287	291	290	285	288	1.7	27.8
Russian Fed.[3]	4 023	3 119	..	..	..	..	..	..
Spain	1 256	1 338	1 399	1 417	1 393	1 432	1.9	34.8
United Kingdom	2 775	2 192	1 815	1 723	1 652	1 587	1.2	26.3
Switzerland	167	124	104	100	95	90	0.5	12.4
Czech Republic	544	370	313	321	332	318	2.2	31.2
Germany	2 745	1 916	1 632	1 553	1 482	1 417	0.7	17.2
Hungary	238	190	201	185	185	180	1.5	17.7
Austria	207	184	184	185	191	200	1.0	24.8
Canada	2 615	2 528	2 475	2 548	2 487	2 459	2.8	78.4
United States	22 830	22 405	20 510	20 263	19 394	18 833	2.0	65.3
Japan	2 052	2 143	2 047	2 064	2 029	2 018	0.6	15.8
Republic of Korea	925	1 153	1 136	..	..	..	..	..

[1]The Norwegian figures in this OECD survey diverge somewhat from the most recent emission calculations. [2]GDP at 1995 prices and purchasing power parities. [3]Data for Russian Fed. are from OECD 2002.
Source: OECD (2002) and OECD (2005).

Table F.13 Emissions to air of hazardous substances

	Lead	Cadmium	Mercury	Arsenic	Chromium	Copper	PAHs	Dioxins
	Tonnes	kg					Tonnes	Grammes
1990	187	1 636	1 491	3 098	12 459	21 887	156	130
1991	144	1 565	1 391	2 998	12 384	22 352	143	98
1992	127	1 559	1 226	2 968	12 268	19 335	144	96
1993	87	1 630	914	3 152	12 006	19 340	147	95
1994	24	1 175	947	3 558	11 311	19 103	145	94
1995	22	1 005	862	2 897	11 028	18 747	145	70
1996	10	1 044	890	2 999	11 096	19 019	151	50
1997	10	1 066	890	2 823	12 031	19 569	158	41
1998	10	1 130	855	3 283	11 541	20 520	150	35
1999	9	970	901	3 283	10 929	20 677	141	39
2000	7	707	750	2 455	8 414	19 402	144	34
2001	6	697	698	2 183	6 671	19 811	150	34
2002	8	656	649	1 748	5 456	19 352	173	31
2003*	7	672	666	1 604	3 026	19 849	144	29

Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F.14 Emissions to air of hazardous substances[1] by source. 2003*

	Lead	Cadmium	Mercury	Arsenic	Chromium	Copper	PAH	Dioxins
	kg	kg	kg	kg	kg	kg	Tonnes	Grammes
Total	**7 221.6**	**672.2**	**666.1**	**1 604.3**	**3 025.6**	**19 848.8**	**143.9**	**29.4**
Stationary combustion	1 061.7	382.9	241.9	754.7	2 236.1	2 367.4	58.7	15.8
Process emissions	3 437.7	232.3	253.4	558.5	443.8	11 640.7	74.8	8.1
Mobile combustion	2 722.3	57.0	170.8	291.1	345.8	5 840.7	10.4	5.4
Stationary combustion								
Total	**1 061.7**	**382.9**	**241.9**	**754.7**	**2 236.1**	**2 367.4**	**58.7**	**15.8**
Oil and gas extraction	12.2	9.0	10.2	23.1	101.5	79.5	0.2	0.7
Natural gas	0.9	6.4	3.7	14.2	78.7	60.0	0.1	0.2
Flaring	0.1	0.7	0.4	1.6	8.9	6.8	0.0	0.0
Diesel combustion	11.1	1.1	5.5	5.5	4.4	5.5	0.2	0.4
Gas terminals	0.1	0.8	0.4	1.7	9.4	7.1	0.0	0.0
Manufacturing and mining	744.4	203.7	86.5	432.6	1 792.2	1 603.3	0.5	2.3
Refining	29.9	3.4	6.3	30.0	332.4	251.0	0.0	0.0
Manufacture of pulp and paper	447.7	135.3	40.3	265.7	882.4	906.9	0.2	1.3
Manufacture of mineral products	72.0	13.4	7.7	13.5	276.8	137.6	0.2	0.1
Manufacture of chemicals	28.1	7.7	6.2	19.9	33.7	30.5	0.0	0.1
Manufacture of metals	8.1	1.9	1.2	4.6	16.6	17.0	0.0	0.0
Other manufacturing	158.5	42.2	24.8	99.1	250.3	260.3	0.1	0.8
Other industries	66.0	16.8	30.9	40.7	79.6	103.4	2.9	1.7
Dwellings	110.3	145.0	29.1	246.1	232.8	520.4	54.1	10.5
Incineration of waste and landfill gas	128.8	8.3	85.3	12.3	30.0	60.9	1.0	0.6
Process emissions								
Total	**3 437.7**	**232.3**	**253.4**	**558.5**	**443.8**	**11 640.7**	**74.8**	**8.1**
Oil and gas extraction	-	-	-	-	-	-	0.1	0.1
Venting, leaks, etc.	-	-	-	-	-	-	0.1	0.1
Oil loading at sea	-	-	-	-	-	-	-	-
Oil loading, on shore	-	-	-	-	-	-	-	-
Gas terminals	-	-	-	-	-	-	-	-
Manufacturing and mining	2 014.6	199.2	207.3	558.3	389.0	1 704.7	63.3	8.0
Refining	-	-	-	-	-	-	-	0.0
Manufacture of pulp and paper	-	-	-	-	-	-	-	-
Manufacture of chemicals	164.2	23.9	2.1	11.6	118.6	165.6	1.2	-
Manufacture of mineral products	219.5	43.5	17.8	4.5	74.6	92.9	-	0.2
Manufacture of metals	1 630.9	131.8	187.4	542.2	195.8	1 446.3	62.1	7.8
Iron, steel and ferro-alloys	1 554.6	70.6	178.5	162.0	186.7	250.1	1.9	6.5
Aluminium	2.4	2.5	0.0	0.3	9.1	6.2	54.2	1.2
Other metals	74.0	58.7	8.9	379.8	-	1 190.0	6.0	0.1
Other manufacturing	-	-	-	-	-	-	0.0	0.1
Petrol distribution	-	-	-	-	-	-	-	-
Agriculture	-	-	-	-	-	-	-	-
Landfill gas	-	-	-	-	-	-	-	-
Solvents	-	-	-	-	-	-	11.1	-
Road dust	1 409.3	32.5	2.3	0.2	54.6	8 945.3	0.4	-
Use of products	-	-	42.0	-	-	-	-	-
Other process emissions	13.8	0.7	1.8	0.0	0.1	990.6	0.0	0.0

Table F.14 (cont.). Emissions to air of hazardous substances[1] by source. 2003*

	Lead	Cadmium	Mercury	Arsenic	Chromium	Copper	PAH	Dioxins
	kg	kg	kg	kg	kg	kg	Tonnes	Grammes
Mobile combustion								
Total	**2 722.3**	**57.0**	**170.8**	**291.1**	**345.8**	**5 840.7**	**10.4**	**5.4**
Road traffic	193.2	30.4	72.8	152.1	152.2	5 169.9	7.3	0.3
Petrol engines	46.6	15.5	-	77.6	77.6	2 640.0	1.6	0.2
Passenger cars	41.0	14.0	-	69.0	69.0	2 336.0	1.4	0.1
Other light vehicles	5.0	2.0	-	8.0	8.0	276.0	0.2	0.0
Heavy vehicles	-	-	-	1.0	1.0	28.0	0.0	0.0
Diesel engines	145.7	14.6	72.8	72.9	72.9	2 476.8	5.7	0.1
Passenger cars	22.0	2.0	11.0	11.0	11.0	379.0	1.0	0.0
Other light vehicles	42.0	4.0	21.0	21.0	21.0	712.0	1.8	0.0
Heavy vehicles	82.0	8.0	41.0	41.0	41.0	1 386.0	2.9	0.1
Motorcycles, mopeds	0.9	0.3	-	1.6	1.6	53.1	0.1	0.0
Motorcycles	0.7	0.2	-	1.2	1.2	39.3	0.0	0.0
Mopeds	0.2	0.1	-	0.4	0.4	13.8	0.0	0.0
Snow scooters	0.1	0.0	-	0.2	0.2	8.5	0.0	0.0
Small boats	2.7	0.6	0.7	2.8	2.8	96.1	0.1	0.0
Motorized equipment	23.7	2.5	11.6	12.5	12.4	419.4	0.8	0.0
Railways	1.3	0.1	0.6	0.6	0.6	21.8	0.0	0.0
Air traffic	2 298.5	3.1	9.2	15.5	15.5	21.0	0.1	0.0
Domestic < 1000 m	454.0	1.0	3.1	5.1	5.1	6.2	0.0	0.0
Domestic > 1000 m	1 844.6	2.1	6.1	10.3	10.3	14.8	0.1	0.0
Shipping	202.7	20.3	75.9	107.3	162.0	104.0	2.0	5.0
Coastal traffic, etc.	152.8	15.3	51.9	82.1	138.8	78.9	1.3	3.2
Fishing vessels	48.5	4.9	23.3	24.5	22.6	24.4	0.7	1.8
Mobile oil rigs, etc.	1.4	0.1	0.7	0.7	0.6	0.7	0.0	0.1

[1] Does not include international sea and air traffic.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Waste

Appendix G

Table G.1 Waste in Norway. By material type. 1995-2004* and projections for 2005-2010. 1 000 tonnes

	Total	Paper, card-board and paste-board	Metals	Plastic	Glass	Wood waste	Textiles	Bio-degrad-able waste	Con-crete	Other	Hazard-ous
1995	7 006	922	974	339	176	1 139	94	964	661	1 109	628
1996	6 960	932	1 001	356	168	1 094	99	1 005	665	1 032	608
1997	7 306	975	1 025	384	170	1 059	103	1 057	726	1 211	596
1998	7 681	1 013	1 024	402	166	1 047	108	1 076	751	1 386	709
1999	7 728	1 015	986	416	163	1 021	109	1 102	735	1 553	628
2000	7 932	1 097	984	441	165	1 047	110	1 177	715	1 534	662
2001	7 965	1 066	1 014	465	170	1 038	114	1 253	733	1 517	593
2002	8 116	1 051	1 031	492	176	1 061	119	1 328	726	1 498	634
2003*	8 375	1 124	1 041	488	182	1 100	124	1 254	746	1 522	794
2004*	8 576	1 160	1 047	515	183	1 077	132	1 313	758	1 569	822
2005	8 749	1 192	1 052	537	185	1 068	138	1 363	775	1 600	839
2006	8 916	1 223	1 058	558	190	1 066	143	1 407	798	1 623	851
2007	9 001	1 243	1 061	569	193	1 070	146	1 432	807	1 629	850
2008	9 051	1 253	1 061	573	195	1 068	148	1 449	817	1 637	851
2009	9 132	1 265	1 061	581	196	1 057	149	1 472	835	1 657	859
2010	9 231	1 279	1 061	591	197	1 041	152	1 500	853	1 686	873
By product type, 2002											
Total	8 116	1 051	1 031	492	176	1 061	119	1 328	726	1 498	634
Buildings and building products	1 019	0	58	115	62	146	-	-	627	-	11
Electrical and electronic equipment	155	-	83	52	10	4	-	-	3	-	3
Packaging	636	304	60	110	55	105	1	-	-	-	-
Clothing, footwear and other textile products	67	-	0	5	-	-	61	-	-	-	-
Food	800	-	-	-	-	-	-	800	-	-	-
Furniture and household products	311	50	26	32	24	144	35	-	-	-	-
Park and garden waste	84	-	-	-	-	-	-	84	-	-	-
Machines and tools	114	-	105	7	1	2	0	-	-	-	-
Means of transport excl. ships	249	-	112	98	7	3	1	-	-	27	-
Printed matter	579	579	-	-	-	-	-	-	-	-	-
Other	1 591	6	443	61	4	11	18	-	25	402	621
Residues from manufacturing	2 511	111	144	11	13	646	3	444	70	1 069	-

Source: Waste statistics from Statistics Norway.

Table G.2 Waste in Norway. By source of origin. 1995-2004* and projections for 2005-2010. 1000 tonnes

	Total	House-holds[1]	Agricul-ture, forestry and fishing	Mining and quarrying	Manufac-turing	Electricity, gas and water supply	Construc-tion	Service industries	Unspeci-fied
1995	7 006	1 228	73	41	3 139	22	710	742	1 051
1996	6 960	1 424	102	45	3 026	19	715	784	845
1997	7 306	1 326	107	113	3 151	18	774	836	982
1998	7 681	1 452	86	125	3 287	18	815	899	999
1999	7 728	1 491	123	116	3 340	18	784	883	973
2000	7 932	1 561	97	126	3 417	21	766	918	1 026
2001	7 965	1 602	89	127	3 384	27	790	927	1 019
2002	8 116	1 708	91	142	3 413	17	772	928	1 044
2003*	8 375	1 784	103	108	3 484	17	800	949	1 132
2004*	8 576	1 897	101	109	3 511	17	808	968	1 165
2005	8 749	1 995	102	108	3 526	17	828	983	1 188
2006	8 916	2 086	103	107	3 537	17	858	999	1 210
2007	9 001	2 140	105	101	3 537	17	871	1 012	1 217
2008	9 051	2 170	106	97	3 542	18	885	1 017	1 218
2009	9 132	2 204	107	90	3 556	18	906	1 026	1 225
2010	9 231	2 241	108	84	3 576	18	927	1 038	1 239
By material type, 2002									
Total	8 116	1 708	91	142	3 413	17	772	928	1 044
Paper, cardboard and pasteboard	1 051	493	4	3	167	2	21	323	36
Metals	1 031	171	-	-	191	-	45	103	522
Plastic	492	190	-	-	43	-	7	129	123
Glass	176	60	-	-	16	-	56	21	23
Wood waste	1 061	32	-	-	699	-	141	48	142
Textiles	119	98	5	-	5	-	0	11	0
Biodegradable waste	1 328	533	82	-	600	-	1	91	22
Concrete	726	3	-	-	167	-	502	-	54
Other	1 130	128	-	25	892	15	0	43	27
Hazardous	634	-	-	101	381	-	-	57	94
Sludge	369	-	-	13	252	-	-	103	-

[1]Covers, in addition to ordinary household waste, scrapped cars and waste treated in the household, e.g. as kindling.
Source: Waste statistics from Statistics Norway.

Table G.3 Waste in Norway. By way of treatment. 1995-2002. 1000 tonnes

	Total	Material recovery	Biological treatment	Energy recovery	Incineration without energy recovery	Landfill	Other or unspecified
1995	7 006	1 751	200	770	148	1 687	2 450
1996	6 960	1 850	247	761	148	1 709	2 244
1997	7 306	1 973	310	782	158	1 599	2 485
1998	7 681	2 072	343	786	159	1 596	2 723
1999	7 728	2 241	353	804	155	1 415	2 761
2000	7 932	2 274	388	863	175	1 481	2 751
2001	7 965	2 394	427	825	197	1 431	2 691
2002	8 116	2 490	449	869	192	1 462	2 654
By material type, 2002							
Total	8 116	2 490	449	869	192	1 462	2 654
Paper, cardboard and pasteboard	1 051	530	-	115	56	350	-
Metals	1 031	686	-	-	-	45	300
Plastic	492	22	-	63	15	284	107
Glass	176	47	-	-	-	128	-
Wood waste	1 061	295	110	399	52	129	76
Textiles	119	11	-	20	8	80	-
Biodegradable waste	1 328	632	241	136	61	241	18
Concrete	726	150	-	-	-	70	506
Other	1 130	110	-	27	-	-	992
Hazardous	634	-	-	-	-	-	634
Sludge	369	7	98	108	-	135	20

Source: Waste statistics from Statistics Norway.

Table G.4 Hazardous waste entering approved treatment. By material. 2003. Tonnes

	Collected
Total	**782 038**
Waste containing petroleum products	194 743
Solvents	29 341
Other organic	8 375
Waste containing heavy metals	315 077
Corrosive waste	213 334
Other inorganic	7 783
Processing water	7 296
Photo chemicals	3 123
Unknown	2 971

Source: Waste statistics from Statistics Norway.

Table G.5 Hazardous waste entering approved treatment. By treatment/disposal operation. 2003. Tonnes

	Collected
Total	**782 038**
Material recycling	51 467
Energy recovery	75 445
Pretreatment [1]	64 929
Final treatment/disposal [2]	513 515
Export	76 687

[1] Net weight reduction. Includes all treatment products from a pretreatment operation not classified as hazardous waste.
[2] Includes all types of landfilling, permanent storage, incineration without energy recovery and treatment operations producing only non-hazardous treatment products.
Source: Waste statistics from Statistics Norway.

Table G.6 Quantities of household waste. Total and separated for recovery[1]

	Total	For recovery	Total	For recovery	Percentage for recovery
	kg per capita		1 000 tonnes		
1974	174	..	693	..	..
1985	200	..	831	..	..
1992	235	20	1 012	86	9
1995	269	49	1 174	213	18
1996	272	60	1 195	260	22
1997	287	83	1 259	366	29
1998	308	102	1 365	453	33
1999	314	118	1 397	524	38
2000	324	130	1 452	581	40
2001	334	149	1 507	668	44
2002	354	161	1 613	732	45
2003	365	167	1 671	764	45
2004	378	185	1 746	854	49
2004 by material					
Paper and cardboard	129	59	597	271	45
Glass	12	9	57	41	72
Plastic	27	2	126	8	6
Metals	22	11	100	53	53
EEE waste	..	7	..	31	..
Biodegradable waste	91	34	422	156	37
Wood waste	31	25	142	113	80
Park- and gardening waste	..	24	..	110	..
Textiles	17	2	80	9	11
Hazardous waste	..	3	..	16	..
Other	48	10	221	45	20

[1]The figures have been adjusted downwards to correct for the intermixture of waste from industrial sectors.
Source: Waste statistics from Statistics Norway and Heie (1998).

Table G.7 Household waste, by recovery or disposal. 1992-2004. 1 000 tonnes

	Total	Separated for recovery	Landfilled	Incinerated	Other
1992	1 012	86	657	269	0
1995	1 174	213	648	314	0
1998	1 365	453	592	320	0
2000	1 454	581	467	406	0
2001	1 507	668	382	445	11
2002	1 613	732	384	492	4
2003	1 671	764	357	544	4
2004	1 746	854	345	539	8

Source: Waste statistics from Statistics Norway.

Table G.8 Municipal consumer waste: Investments, costs, fee income, cost coverage ratio, and annual fee. By county. 2003

	Investment in collection of waste	Investment in waste treatment	Total invest-ment	Mainte-nance, running and over-head costs	Capital costs	Annual costs	Fee income	Cost cov-erage ratio
	1 000 NOK							Per cent
Total								
2002[1]	57 955	111 748	169 703	2 806 642	204 137	3 010 779	2 760 925	92
2003[2]	30 611	60 486	91 094	3 062 346	208 991	3 271 335	2 988 480	91
Counties, 2003								
Østfold	6 481	558	7 039	166 141	13 154	179 295	179 964	100
Akershus	1 424	20 993	22 417	299 028	8 019	307 047	339 370	111
Oslo	5 375	2 591	7 966	331 480	83 000	414 480	345 009	83
Hedmark	199	951	1 150	106 007	981	106 988	107 973	101
Oppland	3 306	-	3 306	117 384	3 709	121 093	117 575	97
Buskerud	-20 150	-2 358	-22 508	69 619	3 070	72 688	80 088	110
Vestfold	-3 601	75	-3 526	147 853	6 325	154 178	155 189	101
Telemark	2 192	6 078	8 269	135 041	9 800	144 841	148 587	103
Aust-Agder	1 286	-646	640	82 323	1 112	83 435	80 813	97
Vest-Agder	618	148	766	130 321	5 999	136 320	129 689	95
Rogaland	8 263	11 218	19 481	225 195	21 996	247 191	240 199	97
Hordaland	-272	1 849	1 578	374 642	12 280	386 923	366 724	95
Sogn og Fjordane	696	227	922	138 773	3 524	142 297	65 767	46
Møre og Romsdal	6 815	5 358	12 173	185 504	10 096	195 600	184 180	94
Sør-Trøndelag	7 261	2 310	9 572	146 589	9 099	155 687	154 928	100
Nord-Trøndelag	2 397	5 093	7 490	57 059	5 192	62 251	55 917	90
Nordland	602	1 879	2 477	49 022	5 459	54 481	49 087	90
Troms	7 635	3 977	11 613	118 769	5 184	123 952	116 918	94
Finnmark	84	185	269	181 596	992	182 588	70 503	39

[1]Annual fee for the year 2003. [2]Annual fee for the year 2004.
Source: Environmental protection expenditure statistics from Statistics Norway.

Water resources and water pollution Appendix H

Table H.1 Water sources, number of water works and number of people supplied. By county. 2003

	Total		Lake[1]		River/stream		Ground water	
	Number of water works[3]	Number of people	Number of water works	Number of people	Number of water works	Number of people	Number of water works	Number of people
Whole country[3]	**1 544**	**4 117 680**	**622**	**3 355 994**	**379**	**356 746**	**574**	**404 940**
Østfold	24	231 156	13	155 728	4	56 706	8	18 722
Akershus	30	443 813	19	321 883	2	119 153	10	2 777
Oslo	1	520 000	1	520 000	-	-	-	-
Hedmark	97	158 028	11	78 136	8	1 620	80	78 272
Oppland	76	127 803	19	70 606	7	3 170	50	54 027
Buskerud	63	224 509	16	152 622	-	-	47	71 887
Vestfold	37	215 521	13	209 580	-	-	24	5 941
Telemark	58	142 388	23	113 385	3	12 693	34	16 310
Aust-Agder	32	84 294	17	75 950	5	2 371	10	5 973
Vest-Agder	39	143 613	14	123 501	5	1 088	20	19 024
Rogaland	53	361 886	37	353 654	7	2 760	12	5 472
Hordaland	160	379 598	89	332 662	34	26 293	38	20 643
Sogn og Fjordane	103	79 836	43	49 144	37	15 010	27	15 682
Møre og Romsdal	155	224 898	57	178 114	53	25 853	49	20 931
Sør-Trøndelag	117	255 116	53	223 244	13	2 546	52	29 326
Nord-Trøndelag	78	108 060	41	98 119	8	1 751	31	8 190
Nordland	213	212 133	88	166 753	86	38 110	43	7 270
Troms	127	132 486	32	99 497	78	28 495	20	4 494
Finnmark Finnmárku	80	70 842	35	32 246	28	18 597	19	19 999
Svalbard[2]	1	1 700	1	1 170	1	530	-	-

[1]Including 3 waterworks supplying 280 persons from sea water in Sør-Trøndelag and Nordland county. [2]One waterworks in Svalbard has two main water sources of different types. [3]The table contains information from 1544 water works. As some water works use several sources of water of different types, the total figure given in the table is higher than 1544.
Source: Norwegian Institute of Public Health.

Table H.2 Number of municipal waste water treatment plants. By county. 2003

County/region	Total[1]	Direct discharges	Mecha-nical	Chemical	Biological	Chemical-biological	Other treatment	Individual treatment facilities (<50 PE)
Total 2001	**2 639**	**700**	**976**	**256**	**125**	**299**	**283**	**336 321**
Total 2002	**2 530**	**570**	**1 027**	**250**	**129**	**278**	**276**	**340 204**
Total 2003	**2 549**	**558**	**1 029**	**250**	**133**	**296**	**283**	**368 330**
North Sea counties (01-10)	653	11	38	211	31	226	136	192 090
Rest of the counties (11-20)	1 896	547	991	39	102	70	147	176 240
01 Østfold	37	-	1	10	-	23	3	19 916
02-03 Akershus and Oslo	59	4	1	26	-	18	10	22 303
04 Hedmark	92	2	-	31	3	35	21	39 495
05 Oppland	157	1	5	18	4	66	63	31 598
06 Buskerud	87	-	1	47	2	20	17	19 326
07 Vestfold	40	-	2	12	3	18	5	22 167
08 Telemark	74	-	2	34	11	17	10	14 781
09 Aust-Agder	40	-	3	17	2	15	3	11 434
10 Vest-Agder	67	4	23	16	6	14	4	11 070
11 Rogaland	201	22	136	9	6	5	23	21 236
12 Hordaland	323	31	236	1	25	12	18	30 093
14 Sogn og Fjordane	177	21	132	2	11	6	5	14 095
15 Møre og Romsdal	475	202	236	2	2	4	29	25 349
16 Sør-Trøndelag	119	10	41	7	19	14	28	23 519
17 Nord-Trøndelag	113	6	40	10	21	20	16	13 214
18 Nordland	250	125	90	2	13	2	18	29 680
19 Troms	125	54	56	4	3	3	5	11 823
20 Finnmark	113	76	24	2	2	4	5	7 231

[1]Individual treatment facilities are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H.3 Hydraulic capacity (1 000 PE) of waste water treatment plants. Whole country 1993-2003. By county, 2003

County/region	Total	Direct discharges	Mechanical	Chemical	Biological	Chemical-biological	Other treatment
Total 1993	**[1]4 837**	**..**	**1 282**	**2 685**	**61**	**752**	**49**
Total 1995	**[1]5 219**	**..**	**1 318**	**3 326**	**70**	**411**	**68**
Total 1997	**5 801**	**576**	**1 358**	**2 568**	**95**	**1 115**	**89**
Total 1999	**6 250**	**541**	**1 744**	**2 189**	**72**	**1 575**	**129**
Total 2000	**6 257**	**541**	**1 750**	**2 194**	**71**	**1 574**	**127**
Total 2001	**6 326**	**554**	**1 420**	**2 289**	**116**	**1 566**	**382**
Total 2002	**5 912**	**529**	**1 294**	**2 295**	**123**	**1 591**	**80**
Total 2003	**6 093**	**524**	**1 425**	**2 207**	**133**	**1 701**	**102**
North Sea counties (01-10)	3 528	66	68	1 660	58	1 617	59
Rest of the counties (11-20)	2 564	458	1 357	547	75	84	43
01 Østfold	350	-	0	318	-	22	10
02-03 Akerhus and Oslo	1 392	11	0	182	-	1 197	2
04 Hedmark	261	30	-	94	4	102	30
05 Oppland	301	2	20	79	9	180	10
06 Buskerud	318	-	0	263	1	52	2
07 Vestfold	268	-	1	247	0	17	2
08 Telemark	242	-	5	211	6	18	2
09 Aust-Agder	156	-	5	109	21	21	0
10 Vest-Agder	241	23	35	156	17	8	1
11 Rogaland	512	68	164	247	26	3	4
12 Hordaland	537	28	411	66	10	18	5
14 Sogn og Fjordane	125	10	100	0	4	11	1
15 Møre og Romsdal	308	100	178	20	0	1	9
16 Sør-Trøndelag	387	14	196	144	9	19	5
17 Nord-Trøndelag	173	1	77	61	16	13	5
18 Nordland	232	90	129	2	8	1	3
19 Troms	182	81	75	7	1	9	9
20 Finnmark	109	67	28	1	1	11	2

[1]Direct discharges are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H.4 Number of people connected to different types of treatment plants. Whole country 2000-2003. By county, 2003[1]

County/region	Total[2]	Direct discharges	Mecha-nical	Chemical	Bio-logical	Chemical-biological	Other treatment	Individual treatment facilities (<50 PE)	Propor-tion con-nected to the sewage system[2]
Total 2000	**3 580 550**	**262 520**	**964 285**	**1 331 811**	**40 049**	**957 686**	**24 200**	**892 796**	**80**
Total 2001	**3 640 136**	**320 859**	**823 459**	**1 392 459**	**75 751**	**935 425**	**92 183**	**930 673**	**81**
Total 2002	**3 640 173**	**294 632**	**777 502**	**1 408 410**	**80 927**	**1 026 775**	**51 927**	**869 161**	**80**
Total 2003	**3 696 147**	**274 560**	**841 076**	**1 302 132**	**81 738**	**1 137 801**	**58 840**	**877 999**	**81**
North Sea counties (01-10)	2 207 977	16 750	36 058	984 448	35 062	1 095 816	39 843	390 444	87
Rest of the counties (11-20)	1 488 170	257 810	805 018	317 684	46 676	41 985	18 997	487 555	74
01 Østfold	228 242	-	-	209 016	-	12 710	6 516	33 716	89
02-03 Akershus and Oslo	967 997	2 482	-	93 803	-	871 410	302	50 808	96
04 Hedmark	138 625	-	-	59 047	2 023	72 355	5 200	72 617	74
05 Oppland	125 093	847	9 990	37 382	4 129	72 317	428	69 423	68
06 Buskerud	178 795	-	165	148 482	320	29 077	751	44 955	74
07 Vestfold	206 002	-	1 295	169 498	203	9 629	25 377	32 253	94
08 Telemark	145 681	-	3 850	127 484	3 320	10 427	600	36 254	88
09 Aust-Agder	78 396	-	3 818	47 684	12 306	14 439	149	25 248	76
10 Vest-Agder	139 146	13 421	16 940	92 052	12 761	3 452	520	25 170	87
11 Rogaland	305 809	26 309	97 505	153 404	24 981	1 980	1 630	61 115	85
12 Hordaland	321 537	15 954	235 356	54 000	4 161	10 372	1 694	98 033	72
14 Sogn og Fjordane	62 130	6 898	50 401	155	2 300	2 067	309	44 592	60
15 Møre og Romsdal	202 577	58 560	122 766	15 025	82	1 104	5 040	63 123	83
16 Sør-Trøndelag	193 042	7 985	113 290	51 459	4 127	13 069	3 112	52 720	71
17 Nord-Trøndelag	86 956	419	29 812	41 313	6 015	7 719	1 678	36 120	69
18 Nordland	141 820	47 665	87 165	790	4 410	350	1 440	75 887	60
19 Troms	111 644	49 902	54 622	1 294	310	2 427	3 089	40 868	73
20 Finnmark	62 655	44 118	14 101	244	290	2 897	1 005	15 097	86

[1]The reported number of persons connected to the sewage system might differ slightly from the official population statistics. [2]The number of persons connected to individual treatment facilities are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H.5 Discharges of phosphorus by county and treatment methods. 2003. Tonnes

County/region	Total[1]	Direct dis-'charges	Mecha-nical	Che-mical	Bio-logical	Chemical-biological	Other treat-ment	Individual treatment facilities (<50 PE)	Discharg-es per in-habitant, kilograms[1]	Average treat-ment ef-ficiency, Per cent[1]
Total 1993	[2] **534**	..	..	..	..	..	..	..	..	..
Total 1995	[2] **601**	..	..	..	..	..	..	..	..	..
Total 1997	[2] **570**	..	..	..	..	..	..	..	..	..
Total 1999	**836**	..	..	..	..	..	..	..	..	..
Total 2000	**825**	**198**	**482**	**87**	**10**	**45**	**5**	..	**0.18**	**66.8**
Total 2001	**795**	**182**	**443**	**89**	**13**	**58**	**11**	**362**	**0.18**	**67.6**
Total 2002	**725**	**170**	**416**	**76**	**10**	**45**	**7**	**347**	**0.16**	**69.9**
Total 2003	**756**	**151**	**421**	**80**	**34**	**63**	**8**	**351**	**0.17**	**69.0**
North Sea counties (01-10)	134	9	9	56	3	51	6	125	0.05	91.2
Rest of the counties (11-20)	622	141	412	23	31	12	2	203	0.30	36.2
01 Østfold	19	-	-	18	0	1	1	14	0.08	89.1
02-03 Akershus and Oslo	44	1	0	4	0	39	0	19	0.04	93.1
04 Hedmark	11	0	-	3	0	7	1	18	0.06	93.8
05 Oppland	4	0	0	1	0	2	0	16	0.02	95.7
06 Buskerud	11	-	0	9	0	1	0	15	0.05	90.0
07 Vestfold	14	-	1	10	0	0	4	19	0.07	89.7
08 Telemark	8	-	0	7	0	0	0	12	0.05	91.4
09 Aust-Agder	5	-	2	1	1	1	0	7	0.05	88.1
10 Vest-Agder	17	8	6	3	0	0	0	6	0.11	76.4
11 Rogaland	93	15	48	9	20	0	0	24	0.24	58.8
12 Hordaland	123	9	108	3	2	1	0	38	0.28	28.2
14 Sogn og Fjordane	41	4	27	0	1	9	0	17	0.39	25.2
15 Møre og Romsdal	94	32	61	1	0	0	1	30	0.38	24.5
16 Sør-Trøndelag	89	5	75	6	4	1	0	29	0.33	48.4
17 Nord-Trøndelag	23	0	15	5	1	0	0	17	0.18	55.8
18 Nordland	71	25	42	0	4	0	0	49	0.30	16.1
19 Troms	56	26	29	0	0	0	0	17	0.36	16.9
20 Finnmark	32	25	7	0	0	0	0	7	0.44	17.5

[1]Discharges from individual treatment facilities are not included. [2]Direct discharges are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H.6 Discharges of nitrogen by county and treatment methods. 2003. Tonnes

County/region	Total[1]	Direct dis-charges	Mecha-nical	Che-mical	Biolo-gical	Chemical-biological	Other treat-ment	Individual treat-ment fa-cilities (<50 PE)	Discharg-es per in-habitant, kilograms[1]	Average treatment effi-ciency, Per cent[1]
Total 1998	**13 554**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**
Total 1999	**13 492**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**..**
Total 2000	**13 191**	**1 478**	**3 824**	**4 921**	**126**	**2 686**	**156**	**..**	**2.95**	**27.7**
Total 2001	**12 303**	**1 384**	**3 022**	**5 146**	**247**	**2 200**	**304**	**3 560**	**2.73**	**28.3**
Total 2002	**11 785**	**1 284**	**2 979**	**5 134**	**280**	**1 925**	**183**	**3 246**	**2.61**	**29.0**
Total 2003	**11 426**	**1 133**	**3 065**	**4 560**	**341**	**2 138**	**189**	**3 338**	**2.50**	**30.8**
North Sea counties (01-10)	5 866	73	104	3 447	102	2 000	140	1 391	2.32	41.0
Rest of the counties (11-20)	5 559	1 060	2 961	1 113	239	137	49	1 947	2.72	14.2
01 Østfold	818	-	-	737	0	58	23	111	3.19	16.6
02-03 Akershus and Oslo	1 629	11	-	326	0	1 291	1	181	1.61	63.2
04 Hedmark	528	-	-	196	3	312	18	246	2.80	22.6
05 Oppland	415	4	18	185	14	191	3	243	2.26	35.6
06 Buskerud	442	-	1	392	1	45	3	156	1.82	42.0
07 Vestfold	765	-	5	639	1	32	88	150	3.48	16.2
08 Telemark	541	-	14	478	12	34	2	127	3.25	16.9
09 Aust-Agder	228	-	14	157	28	28	1	88	2.21	35.8
10 Vest-Agder	502	59	51	337	44	9	2	90	3.14	20.5
11 Rogaland	1 199	114	362	538	173	7	6	214	3.08	16.8
12 Hordaland	1 125	69	813	189	15	34	5	334	2.53	15.5
14 Sogn og Fjordane	240	30	194	1	7	7	1	161	2.23	13.9
15 Møre og Romsdal	762	238	455	53	0	4	12	252	3.12	11.2
16 Sør-Trøndelag	697	34	417	180	14	43	8	251	2.58	16.6
17 Nord-Trøndelag	299	2	104	145	20	25	3	131	2.34	18.8
18 Nordland	521	191	316	3	8	1	2	386	2.20	10.4
19 Troms	465	195	247	5	1	8	9	141	3.04	11.8
20 Finnmark	253	187	52	1	1	10	2	77	3.46	4.9

[1]Discharges from individual treatment facilities are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H.7 Disposal of sewage sludge. By county. 2003. Tonnes dry weight

County	Total[1]	Agriculture	Parks and green spaces	Delivered producer of fertilizer	Cover on landfills	Deposited	Other use[2]	Delivered treatment plant
Total 2001	**107 101**	**48 039**	**14 160**	**..**	**4 217**	**11 659**	**29 026**	**4 995**
Total 2002	**103 135**	**43 560**	**8 995**	**5 714**	**6 160**	**9 929**	**28 776**	**40 364**
Total 2003	**104 585**	**39 850**	**9 351**	**3 317**	**8 476**	**..**	**43 592**	**48 908**
Østfold	8 171	5 737	409	369	572	..	1 084	1 274
Akershus and Oslo	36 786	29 398	1 278	113	599	..	5 397	7 850
Hedmark	2 271	-	-	437	102	..	1 732	2 768
Oppland	4 340	-	-	-	805	..	3 535	4 191
Buskerud	7 524	130	3 017	430	-	..	3 948	6 342
Vestfold	5 918	4 005	668	175	-	..	1 070	1 195
Telemark	3 612	224	1 362	641	-	..	1 384	1 804
Aust-Agder	1 861	-	70	6	207	..	1 578	1 208
Vest-Agder	5 648	-	-	-	2 043	..	3 606	4 592
Rogaland	3 188	105	3		190	..	2 890	38
Hordaland	10 648	-	1 985	73	1 104	..	7 486	8 815
Sogn og Fjordane	3 302	250	233	-	254	..	2 565	2 067
Møre og Romsdal	4 394	-	-	-	694	..	3 701	2 687
Sør-Trøndelag	1 196	-	-	993	26	..	176	99
Nord-Trøndelag	883	-	50	-	-	..	833	843
Nordland	2 468	-	75	-	985	..	1 408	2 458
Troms	1 706	-	200	80	763	..	663	679
Finnmark	669	-	-	-	133	..	536	-

[1] "Delivered treatment plant" is not included. [2] "Other use" may also include sewage sludge where exact use is unknown.
Source: Waste water treatment statistics from Statistics Norway.

Table H.8 Municipal water sector: Investment, costs, income and cost coverage ratio. Counties. 2003

	Investment in production of water	Investment in distribution	Total investment	Maintenance, running and overhead costs	Capital costs	Annual costs	Fee income	Cost coverage ratio
	NOK Million							Per cent
Total	**368**	**1 112**	**1 480**	**2 082**	**1 203**	**3 285**	**3 325**	**101**
Østfold	4	55	59	128	54	182	186	102
Akershus	6	104	110	270	82	352	363	103
Oslo	81	126	207	119	106	226	240	107
Hedmark	19	20	39	71	33	104	114	109
Oppland	27	69	96	87	54	141	144	102
Buskerud	4	81	85	106	55	161	182	113
Vestfold	5	49	54	114	47	162	169	104
Telemark	9	34	43	60	49	109	121	112
Aust-Agder	23	19	42	47	27	75	75	100
Vest-Agder	11	22	32	66	33	99	94	95
Rogaland	12	102	114	217	93	310	312	101
Hordaland	41	59	100	225	137	362	340	94
Sogn og Fjordane	39	58	97	43	42	85	85	100
Møre og Romsdal	11	71	82	112	69	181	181	100
Sør-Trøndelag	10	56	66	112	85	197	205	104
Nord-Trøndelag	5	28	34	64	40	104	102	98
Nordland	37	84	121	122	101	223	203	91
Troms	12	49	60	72	67	138	133	96
Finnmark	13	27	39	44	29	73	76	105

Source: Environmental protection expenditure statistics from Statistics Norway.

Table H.9 Municipal wastewater sector: Investment, costs, fee income, and cost coverage ratio. Total for Norway, 1993-2003. County figures, 2003

	Investment in waste-water treat-ment plants	Investment in sewerage network	Total invest-ment	Mainte-nance, run-ning and overhead costs	Capital costs	Annual costs	Fee income	Cost cover-age ratio
				NOK Million				Per cent
1993	347	964	1 311	..	..	..	..	..
1994	392	1 044	1 436	1 596	1 340	2 936	2 753	94
1995	313	1 118	1 431	1 706	1 407	3 113	2 957	95
1996	279	1 066	1 344	1 776	1 411	3 187	3 094	97
1997	196	1 229	1 424	1 846	1 339	3 184	3 280	103
1998	471	1 337	1 807	1 929	1 499	3 428	3 455	101
1999	601	1 362	1 963	2 074	1 832	3 906	3 668	94
2000	503	1 256	1 759	2 181	1 826	4 007	4 024	100
2001	436	1 250	1 686	2 394	2 003	4 397	3 993	91
2002	338	1 407	1 745	2 415	1 802	4 216	4 067	96
2003	401	1 456	1 857	2 574	1 706	4 280	4 280	100
North Sea counties	171	867	1 038	1 620	991	2 611	2 619	102
Rest of the counties	230	589	819	954	715	1 669	1 661	100
Østfold	-3	108	105	180	144	323	331	102
Akershus	40	139	179	321	158	479	496	104
Oslo	5	131	136	294	159	453	375	83
Hedmark	13	53	66	117	61	178	184	104
Oppland	50	86	136	144	77	221	230	104
Buskerud	10	127	137	138	106	244	280	115
Vestfold	7	84	91	144	93	236	250	106
Telemark	22	46	68	109	68	178	170	96
Aust-Agder	7	43	50	78	63	141	137	97
Vest-Agder	19	52	71	97	62	159	166	105
Rogaland	4	133	137	189	136	325	332	102
Hordaland	22	96	118	227	149	376	368	98
Sogn og Fjordane	7	37	43	42	31	73	72	98
Møre og Romsdal	13	69	81	100	72	172	176	102
Sør-Trøndelag	116	57	172	109	109	218	230	105
Nord-Trøndelag	27	31	57	82	54	136	132	97
Nordland	11	84	95	104	84	189	174	92
Troms	29	59	88	65	64	129	123	96
Finnmark	2	25	27	35	16	51	55	107

Source: Environmental protection expenditure statistics from Statistics Norway.

Table H.10 Water fees, for a private dwelling of 120 m². Counties. 2005. NOK

	Fixed annual fee	Two-level fee system		Payment by water used		Connection fee	
		Variable portion (per m³ water used)	Fixed portion	Variable portion (per m³ water used)	Minimum use charged	Lowest level	Highest level
					m³		
Country average							
2003	2 055	7.04	1 044	9.08	177	7 544	10 556
2004	2 076	7.06	1 145	9.16	146	7 331	10 556
2005	2 132	7.22	1 079	8.05	149	7 596	10 828
County average							
Østfold	1 553	8.68	672	8.95	85	5 919	7 486
Akershus	1 966	10.08	821	9.42	95	9 098	18 326
Oslo	912	..	84	9.02	..	..	..
Hedmark	2 576	11.51	742	11.33	82	8 704	11 035
Oppland	2 206	10.16	855	10.92	121	6 739	12 988
Buskerud	2 414	9.50	530	11.11	104	8 413	13 249
Vestfold	1 788	5.41	823	6.07	110	10 111	13 120
Telemark	1 993	7.65	1 408	8.13	135	3 875	5 493
Aust-Agder	1 867	5.35	1 032	5.58	143	9 690	8 303
Vest-Agder	1 667	5.28	750	5.41	68	10 050	11 806
Rogaland	1 607	5.37	811	5.53	234	8 647	9 356
Hordaland	2 396	6.85	1 317	8.26	128	10 904	12 096
Sogn og Fjordane	2 447	7.00	1 340	7.67	167	6 898	9 333
Møre og Romsdal	2 143	4.08	1 398	7.41	207	6 604	9 724
Sør-Trøndelag	2 464	7.40	1 430	8.17	220	9 716	13 471
Nord-Trøndelag	2 136	7.07	1 202	8.11	164	5 714	9 685
Nordland	2 254	7.02	1 384	7.92	178	6 146	9 377
Troms	2 088	5.66	1 140	6.14	202	4 637	5 041
Finnmark Finnmárku	2 111	5.85	1 281	5.90	483	8 099	7 274

Source: Environmental protection expenditure statistics from Statistics Norway.

Table H.11 Wastewater treatment fees, for a private dwelling of 120 m². Counties. 2005. NOK

	Fixed annual fee	Two-level fee system		Payment by water used		Connection fee	
		Variable portion (per m³ wastewater)	Fixed portion	Variable portion (per m³ wastewater)	Minimum use charged	Lowest level	Highest level
					m³		
Country average							
2003	2 425	8.95	1 310	12.22	179	8 843	12 800
2004	2 491	7.06	1 145	9.16	143	8 369	13 039
2005	2 479	9.90	1 175	10.57	149	8 643	13 164
North Sea counties	2 979	10.99	1 170	12.82	98	8 949	12 318
Rest of the counties	2 131	7.59	1 131	7.83	220	7 770	11 094
County average							
Østfold	3 197	18.56	1 113	16.62	93	8 145	9 739
Akershus	2 925	11.33	1 441	13.08	95	13 181	22 746
Oslo	1 243	..	84	6.53	..	..	..
Hedmark	3 527	14.25	1 009	16.63	76	9 909	13 182
Oppland	3 375	15.22	1 247	16.42	121	9 441	17 739
Buskerud	3 574	10.85	730	16.51	104	9 363	15 569
Vestfold	2 817	8.65	1 008	10.17	142	12 431	16 070
Telemark	3 145	11.60	2 004	13.01	135	3 870	4 988
Aust-Agder	3 140	9.44	1 763	9.52	143	10 910	6 633
Vest-Agder	2 845	10.03	1 300	9.70	68	12 239	16 517
Rogaland	1 843	6.15	795	6.28	234	9 343	14 198
Hordaland	2 080	6.90	938	7.68	128	11 477	12 426
Sogn og Fjordane	2 351	7.82	1 269	8.04	167	6 883	9 383
Møre og Romsdal	1 795	6.37	977	6.97	195	8 386	15 994
Sør-Trøndelag	2 320	8.18	1 052	9.16	229	9 052	14 541
Nord-Trøndelag	2 841	11.89	1 756	11.55	165	6 622	11 945
Nordland	1 792	7.76	1 191	7.72	187	5 624	8 759
Troms	2 168	7.21	1 228	6.78	197	5 062	5 280
Finnmark Finnmárku	1 992	6.00	976	6.25	483	7 482	7 318

Source: Environmental protection expenditure statistics from Statistics Norway.

Land use

Appendix I

Table I.1 Urban settlements with more than 20 000 inhabitants. 1 January 2005

	Population	Inhabitants per km²	Total urb. settlemt. area km²	Percentage urb. settlemt. area built on	Percentage urb. settlemt. area covered by roads	Percentage change urb. settlemt. pop. 2000-2005	Percentage change urb. settlemt. area 2000-2005
All urban settlements in Norway	3 560 137	1 604	2 219.3	9.7	15.4	4.8	3.8
Oslo	811 688	2 930	277.0	12.0	14.7	4.9	2.9
Bergen	213 585	2 418	88.3	11.3	17.8	3.8	2.6
Stavanger/Sandnes	173 132	2 381	72.7	13.5	16.3	6.8	4.2
Trondheim	147 139	2 472	59.5	12.7	13.8	4.6	2.3
Fredrikstad/Sarpsborg	97 094	1 534	63.3	10.2	15.0	4.1	1.3
Drammen	90 722	1 901	47.7	11.0	16.3	4.6	2.6
Porsgrunn/Skien	85 136	1 539	55.3	9.2	15.8	2.1	3.7
Kristiansand	63 814	2 123	30.1	11.4	16.4	3.9	2.6
Tromsø	52 436	2 389	22.0	10.9	17.1	6.2	3.3
Tønsberg	44 959	1 511	29.8	9.6	15.0	3.7	1.3
Ålesund[1]	44 096	1 517	29.1	8.4	15.5	23.1	36.9
Haugesund	40 321	1 790	22.5	11.5	18.4	3.1	3.5
Sandefjord	39 633	1 506	26.3	9.3	14.8	6.5	7.0
Moss	34 492	1 966	17.5	11.0	13.9	4.3	7.3
Bodø	34 073	2 467	13.8	11.9	17.5	5.3	4.1
Arendal	30 916	1 243	24.9	7.6	15.4	2.5	3.6
Hamar	28 801	1 658	17.4	12.7	17.2	4.7	4.9
Larvik	23 113	1 690	13.7	12.0	16.4	4.1	4.6
Halden	21 970	1 619	13.6	10.3	15.5	3.2	8.6

[1]As of 1 January 2002, urban settlement 6025 Ålesund/Spjelkavik was combined with Langevåg urban settlement to form 6025 Ålesund urban settlement.

Source: Land use statistics and population statistics from Statistics Norway.

Table I.2 Area and land use in urban settlements. Whole country. 2005.

	Area in km²				Land use			
	Total	Of which transport	Of which buildings	Within edge[1]	Number of buildings	Number of residents	Number of businesses	Number of employees
Total	2 219.2	352.7	216.1	244.6	1 690 192	3 560 133	273 575	1 571 192
Detached houses area	811.8	137.5	107.8	47.7	1 161 904	2 160 145	82 281	71 816
Row houses area	60.0	10.3	12.8	1.8	129 214	389 806	10 856	7 160
Multi-dwelling house area	29.4	4.4	8.0	0.5	27 727	448 158	17 546	14 088
Other dwelling area	78.6	12.6	6.8	14.5	92 190	86 476	7 814	25 531
Business area	181.8	18.8	48.2	22.3	106 678	182 993	104 724	992 084
Recreational and green areas	520.7	41.4	10.6	147.6	68 082	71 713	8 119	50 259
Other built up areas	72.7	49.0	8.0	10.2	14 580	59 241	18 143	216 097
Unclassified	464.3	78.6	13.9	93.7	89 817	161 601	24 092	194 157

[1]The edge is a 15 meter wide belt from the outer limit of the urban settlement and inwards.

Source: Land use statistics from Statistics Norway.

Table I.3 Percentage day care centres, schools, residential housing and residents with safe access to recreational areas. 2004*.

	Day care centres	Schools	Blocks of flats	Row, detached, etc. houses	Residents
Whole country	**85**	**88**	**65**	**83**	**80**
Østfold	82	86	68	78	76
Akershus	82	88	77	76	77
Oslo	75	80	61	63	67
Hedmark	87	89	66	86	82
Oppland	90	94	72	90	87
Buskerud	87	91	71	84	82
Vestfold	81	81	55	73	71
Telemark	91	92	75	85	84
Aust-Agder	93	88	64	88	87
Vest-Agder	93	85	67	88	86
Rogaland	77	83	59	73	71
Hordaland	88	89	52	88	83
Sogn og Fjordane	92	96	74	94	91
Møre og Romsdal	88	86	68	89	86
Sør-Trøndelag	83	86	61	83	79
Nord-Trøndelag	89	90	72	89	86
Nordland	91	94	75	92	90
Troms	94	94	73	92	90
Finnmark	94	93	82	90	89

Source: Land use statistics from Statistics Norway.

Table I.4 Percentage of coastline within 100 m from buildings

	1985	1990	2000	2004	2005
Whole country	**22.2**	**22.5**	**23.3**	**23.5**	**23.6**
County nos. 01-03 and 06-12	37.0	37.5	38.7	39.1	39.2
01 Østfold	41.6	41.8	42.3	42.4	42.4
02 Akershus	70.8	71.0	71.5	71.7	71.8
03 Oslo	:	:	:	79.1	79.1
06 Buskerud	67.0	67.7	68.5	68.6	68.7
07 Vestfold	43.2	43.6	44.3	44.5	44.5
08 Telemark	57.3	57.9	59.5	59.9	60.1
09 Aust-Agder	49.3	49.7	50.5	50.9	51.0
10 Vest-Agder	34.6	35.5	36.9	37.4	37.5
11 Rogaland	30.4	30.9	32.1	32.4	32.6
12 Hordaland	32.4	32.9	34.0	34.4	34.6
14 Sogn og Fjordane	21.9	22.4	23.1	23.4	23.5
15 Møre og Romsdal	27.8	28.2	29.0	29.3	29.3
16 Sør-Trøndelag	14.7	14.9	15.4	15.6	15.8
17 Nord-Trøndelag	13.6	13.8	14.4	14.6	14.5
18 Nordland	13.2	13.5	14.1	14.3	14.4
19 Troms	27.4	27.6	28.4	28.7	28.8
20 Finnmark	12.3	12.4	12.7	12.9	12.9

Source: Land use statistics from Statistics Norway.

Table I.5 Protected areas[1]. Number[2] and area[3], by county. 31 December

	National parks		Nature reserves		Landscape protected areas		Other area protections[4]	
	Number	Area	Number	Area	Number	Area	Number	Area
		Hectares		Hectares		Hectares		Hectares
1975	13	508 660	53	14 775	8	21 586	2	115
1980	14	622 840	295	21 930	25	63 849	4	200
1985	15	965 040	630	89 515	52	179 524	28	5 193
1990	17	1 255 840	909	142 677	70	422 882	66	10 239
1995	18	1 378 840	1 220	220 966	80	465 867	73	10 776
1996	18	1 378 840	1 293	228 895	82	467 117	75	10 869
1997	18	1 378 840	1 318	242 906	86	506 303	76	11 052
1998	18	1 386 840	1 319	243 019	86	506 303	76	11 052
1999	18	1 386 840	1 352	257 315	88	506 843	76	11 052
2000	18	1 386 840	1 441	279 590	97	779 825	75	9 325
2001	19	1 493 000	1 485	299 500	106	827 800	75	9 300
2002	19	1 702 200	1 615	322 000	126	1 139 300	79	9 700
2003	21	1 839 455	1 659	328 590	135	1 228 405	98	12 406
2004	24	2 165 000	1 701	341 800	153	1 407 100	98	12 500
2003[5]								
Østfold	-	-	73	6 922	4	1 017	-	-
Akershus and Oslo	-	-	102	12 352	9	6 020	4	155
Hedmark	5	103 591	84	47 767	10	88 528	-	-
Oppland	6	251 498	86	20 792	15	87 309	6	451
Buskerud	1	84 679	90	17 228	10	44 180	-	-
Vestfold	-	-	68	1 600	6	486	1	26
Telemark	1	77 264	103	10 008	11	71 496	4	3 322
Aust-Agder	-	-	83	10 239	8	163 225	-	-
Vest-Agder	-	-	85	4 817	6	82 806	14	453
Rogaland	-	-	118	6 115	13	105 320	11	1 410
Hordaland	1	182 533	136	8 407	11	52 314	-	-
Sogn og Fjordane	2	155 407	87	9 711	6	111 828	4	370
Møre og Romsdal	1	58 302	128	13 872	7	168 750	17	571
Sør-Trøndelag	3	142 455	78	18 367	19	110 577	9	254
Nord-Trøndelag	2	68 807	99	38 702	1	272	23	4 843
Nordland	4	325 262	174	53 299	18	83 940	4	454
Troms	4	161 300	53	12 300	6	12 810	2	97
Finnmark Finnmárku	4	228 357	51	36 092	9	37 527	-	-
Svalbard[6]	6	1 381 300	21	2 582 800	-	-	1	1 400

[1]The table does not include nature relics (99 geological+about 190 trees) and flora and fauna protections. [2]Some areas are located in more than one county. Thus the sum of the number in the counties is higher than the total number. [3]From 31. 12. 2003 onwards the area figures are calculated based on digital overlay analysis, a higher accuracy are thus obtained. [4]Flora and fauna protection areas (biotop protections). [5]Figures for protected areas by county have not been calculated since 2003. [6]Protected according to the Svalbard law. These areas are not included in the sum figures for protected areas.
Source: Directorate for Nature Management.

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