Natural Resources and the Environment 2003. Norway

Statistisk sentralbyrå • Statistics Norway
Oslo–Kongsvinger

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ISBN 82-537-6519-3 Printed version
ISBN 82-537-6520-7 Electronic version
ISSN 0804-3221

Emnegruppe
01 Naturressurser og naturmiljø

Design: Siri Boquist
Printed: PDC Tangen / 450

Standard symbols in the tables	Symbol
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Data not available	..
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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 2003* starts with an updated presentation of indicators that illustrate aspects of the government's priority areas for environmental policy. 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 2003*.

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 2003 edition was edited by Frode Brunvoll and Henning Høie. Alison Coulthard and Veronica Harrington have translated the Norwegian version into English.

Natural Resources and the Environment 2003 is also available at http://www.ssb.no/english/subjects/01/sa_nrm/ . More detailed information within the different subjects can be found at http://www.ssb.no/english/subjects/ and in StatBank Norway at http://www.ssb.no/english.

Statistics Norway
Oslo/Kongsvinger 7 November 2003

Svein Longva

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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 of the environment and natural resources occupies an important place in the public debate and frequently makes the headlines in the media. The development of strategies for sustainable development at both national and international level is 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.

Important tasks in the field of environmental statistics are 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, to provide detailed background data, and to present key information in the form of indicators.

1.1. Introduction

The next section of this chapter presents some indicators or key figures (see box 1.1) for driving forces, based on data from the OECD. These are data that are presented by the OECD itself in its compendium of environmental data, and that provide important background information for an evaluation of the causes of environmental pressures.

Sections 1.3 and 1.4 go on to present some indicators that can be used to describe the state of the environment and environmental pressures in Norway. In section 1.5, we describe some features of economic developments in Norway and discuss how these affect the environment. Environmental protection expenditure in manufacturing industries is also discussed.

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 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 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 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 way of structuring environmental indicators that is generally recognized is the PSR model (Pressure-State-Response), which was developed by the OECD (e.g. OECD 1994, 1998 and 2001a). 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 three 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), *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 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. These are:

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 recovery of waste
7. Climate change, air pollution and noise
8. International cooperation on environmental issues and environmental protection in the polar areas

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 key figures for each of the priority areas.

Natural Resources and the Environment 2003 describes environmental pressures in several of the priority areas of environmental policy and presents several of the key figures that have been selected.

For more information, see: Ministry of the Environment (1999, 2001 and 2003).

1.2. Selected indicators for important driving forces influencing environmental trends

This section presents some important indicators for driving forces, based on data from the most recent OECD compendium of environmental data (OECD 2002). The compendium gives detailed figures for all OECD members and various regions of the world. Where possible, it also provides global figures. In the following, figures for Norway are presented and compared with figures for selected regions.

Box 1.3. The OECD

The OECD - the Organisation for Economic Co-operation and Development - has 30 member states today:

Australia	Finland	Ireland	New Zealand	Spain
Austria	France	Italy	Norway	UK
Belgium	Germany	Japan	Poland	Sweden
Canada	Greece	Luxembourg	Portugal	Switzerland
Czech Republic	Hungary	Mexico	Slovakia	Turkey
Denmark	Iceland	Netherlands	Korea	USA

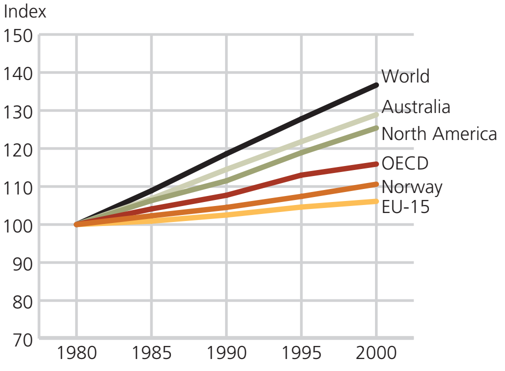
The OECD grew out of the Organisation for European Economic Co-operation (OEEC), which was formed to administer US and Canadian aid under the Marshall Plan after World War II. The OECD is organised in a number of committees and directorates, including the Environment Directorate and the Statistics Directorate. Its decision-making body is the Council, which holds ministerial-level meetings once a year. The Environment Directorate has been working with environmental data and statistics for many years, and has issued a Compendium of Environmental Data every other year since 1985. Since the early 1990s, the organisation has been conducting environmental performance reviews of its member countries. In recent years, efforts to promote sustainable development have become a more important element of the OECD's work, and is one of its horizontal activities, meaning that it involves cooperation between various parts of the organisation.

For more information, see : http://www.oecd.org/home/ .

Population

Population growth has a decisive influence on environmental pressures and trends. As the population grows, the potential for adverse environmental impacts also increases because of rising production, consumption and pressure on land.

Figure 1.1. Population growth 1980-2000. Norway and other selected regions[1]. Index, 1980=100



[1]North America includes Canada, USA and Mexico.
Source: OECD Environmental Data Compendium 2002 (OECD 2002).

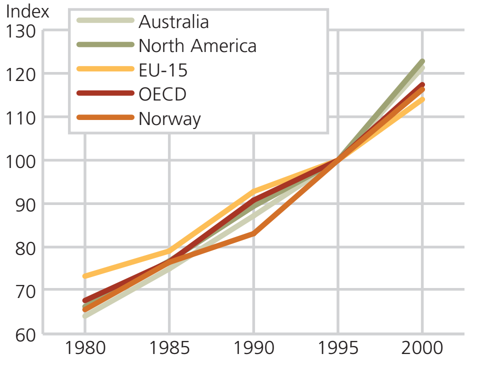
Population growth and density

- World population has risen by almost 40 per cent since 1980, and was 6.1 billion in 2000.
- Of the regions shown in figure 1.1, Norway and the EU have shown slowest population growth.
- However, population growth in Norway in 2002 was the highest for the past 30 years, with the exception of 1999.
- Population density is lowest in the Australia/New Zealand region, where it was 2.9 inhabitants per km^2 in 2000.
- In the same year, population density in Norway was 13.9 inhabitants per km^2, while the figures for the EU and for the world as a whole were 116.5 and 45.2 respectively.
- The OECD member country with the highest population density is Korea, at 473 inhabitants per km^2.

Main aspects of economic development. Gross domestic product (GDP)

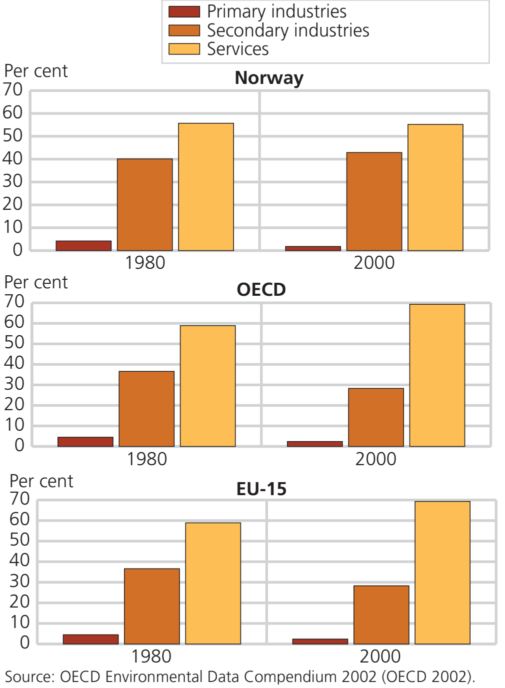
Changes in the level of economic activity and associated changes in production and consumption patterns also have a decisive influence on the potential for environmental pressure. Such changes may have both positive and negative effects. For example, economic growth may result in higher consumption and pollution, but also provide more resources for technological advances and other measures that can limit pollution (see Bruvoll et al. 1999 and 2000).

Figure 1.2. Trends in GDP 1980-2000. Norway and other selected regions. Index (volume of GDP), 1995=100[1]



[1]GDP at 1995 prices and purchasing power parities.
Source: OECD Environmental Data Compendium 2002 (OECD 2002).

Figure 1.3. Structure of GDP 1980 and 2000. Percentages



Source: OECD Environmental Data Compendium 2002 (OECD 2002).

Trends in GDP

- GDP has grown substantially in all regions shown in figure 1.2, but there are regional differences. In the period 1995-2000, growth was strongest in North America (Canada, USA and Mexico) and weakest in the EU.
- Measured in constant prices, Norway's GDP has grown by about 80 per cent in the period 1980-2000.

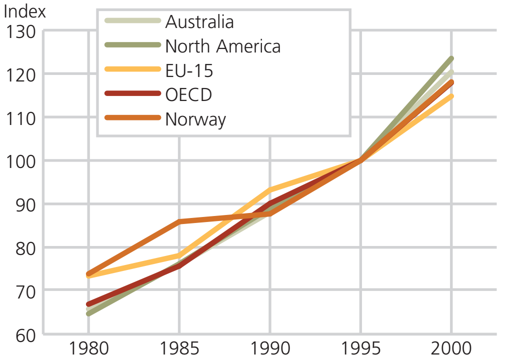
Structure of GDP

- The contribution of primary industries (agriculture, forestry, hunting and fishing) to GDP has been roughly halved in Norway since 1980, as it has in the EU and in the OECD.
- The shift from secondary industries (manufacturing, mining including the petroleum industry, and construction) to service industries (tertiary sector, including the public administration) in the EU and the OECD has not been evident in Norway, where the proportion of GDP deriving from secondary industries in fact rose somewhat from 1980 to 2000. The growth of petroleum and petroleum-related industries has been an important trend in Norway in this period.
- In Norway, employment in manufacturing industries and mining dropped from 394 000 in 1974 to just under 300 000 in 2000. Employment figures indicate that the main "de-industrialisation period" in Norway was 1981-1992 (Statistics Norway 2003). The drop in employment in manufacturing industries and mining in Norway has continued after 2000.

Consumption

Consumption and consumption patterns are important driving forces behind various environmental pressures and the generation of waste.

Figure 1.4. Private consumption expenditure[1] 1980-2000. Norway and other selected regions. Index, 1995=100

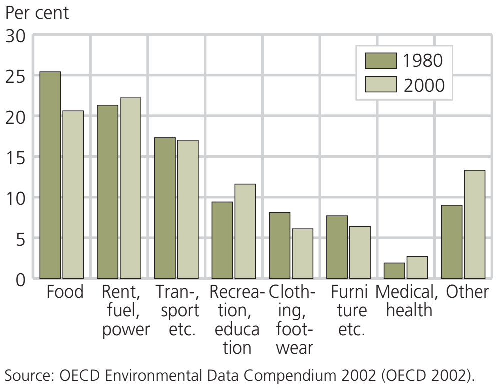


[1] Expressed in 1995 prices and purchasing power parities.
Source: OECD Environmental Data Compendium 2002 (OECD 2002).

Trends in consumption expenditure

- Consumption expenditure has risen considerably in Norway and in all the other regions shown in figure 1.4. The rise has been highest in North America.
- In Norway, private consumption expenditure has risen by 60 per cent since 1980. The rise in per capita expenditure has been about 50 per cent.

Figure 1.5. Structure of households' consumption expenditure. Norway, 1980 and 2000. Percentages



Source: OECD Environmental Data Compendium 2002 (OECD 2002).

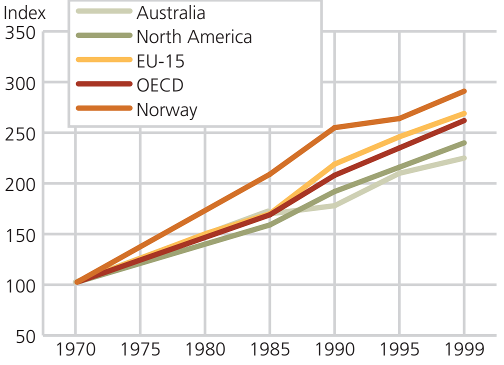
Structure of consumption expenditure

- The main changes in the structure of private consumption expenditure in Norway from 1980 to 2000 are as follows:
- The share used for food, beverages and tobacco has dropped: the same is true for clothing and footwear and furniture and household equipment, etc.
- The percentage spent on rent, fuel and power and on medical care and health has risen somewhat.
- The share used for transport and communications has remained more or less unchanged, while the proportion used for recreation, education, etc., has risen.

Transport

Transport is one of the most important human activities in relation to environmental pressure. Building a road network involves physical restructuring and fragmentation of the surroundings. The production and use of motor vehicles requires substantial resources - materials, energy and land. The transport sector causes serious environmental problems in the form of air pollution and noise, and congestion and accidents have negative effects on human welfare.

Figure 1.6. Road traffic volumes: motor vehicles 1970-1999. Norway and other selected regions. Index, 1970=100

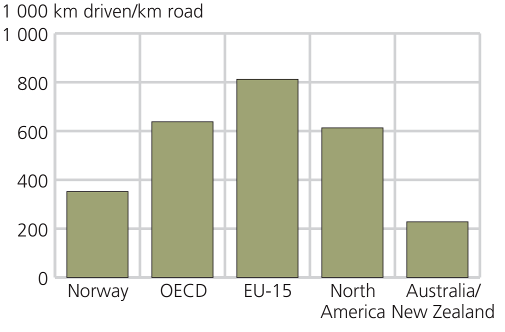


Source: OECD Environmental Data Compendium 2002 (OECD 2002).

Road traffic volumes

- The volume of road traffic in Norway has almost trebled since 1980. In 2000, the total distance travelled by road vehicles was 33 billion kilometres. Passenger transport accounted for about 85 per cent of this.
- In the OECD member countries, the total distance travelled by road vehicles in 1999 was almost 9 000 billion kilometres, of which 68 per cent was passenger transport.

Figure 1.7. Road traffic intensity: motor vehicles. Norway and other selected regions. 1 000 km driven[1] per km of road



[1] Vehicle-kilometres.
Source: OECD Environmental Data Compendium 2002 (OECD 2002).

Road traffic intensity

- Average traffic intensity in the OECD, measured as the number of kilometres driven per km of road, is almost twice as high as in Norway. In the EU, traffic intensity is almost two and a half times higher than in Norway.
- Italy and Greece are the countries where traffic intensity is highest.
- The total length of roads in the EU in 1999 was 3.4 million km. The corresponding figure for the OECD countries was 13.9 million km, which is equivalent to 347 times round the equator or 18 times back and forth to the Moon.
- In 1999, there were 2.2 million motor vehicles in Norway, more than 2.5 times the number in 1970. The total length of roads was 91 000 km.
- In the world as a whole, there were more than 720 million motor vehicles. Of these, 570 million (80 per cent) belonged to the OECD countries. The number of vehicles worldwide has almost trebled since 1970.

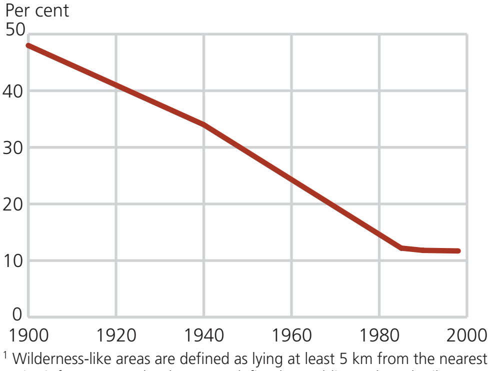
1.3. The state of the environment in Norway

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

Human activities are influencing and threatening biological diversity in many different ways, and calculations show alarmingly high figures for losses of both species and habitats (SSB/SFT/DN 1994). Such losses may be a direct result of various forms of development or over-exploitation, or they may be caused indirectly when our activities cause pollution or result in climate change, thus altering or worsening conditions for animals and plants. One important way of responding to these problems is to protect areas in some way. At the end of 2002, about 31 734 km^2 or 9.8 per cent of the total area of Norway was protected. This is a substantial increase from the year before (about 20 per cent), and is mainly due to the expansion of national parks and the establishment of a number of new protected landscapes.

Figure 1.8. Wilderness-like areas[1] as a percentage of Norway's total land area[2]. 1900-1998



[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, especially in the period 1940 to 1985. Since 1985, the loss of wilderness-like habitat has continued, but at a much slower pace. The results of a new assessment of the size of these areas will be available towards the end of 2003.

For more information, see Chapter 9: Land use.

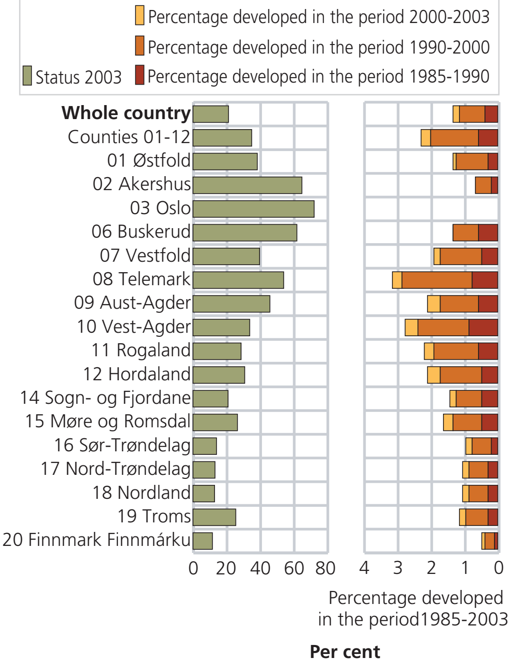
National targets - biological diversity

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 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 1.9. Proportion of the coastline less than 100 m from the nearest building in 2003. Changes from 1985 to 2003



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 1.4 per cent, or 1 166 km, of the shoreline from 1985 to 2003.
- 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.

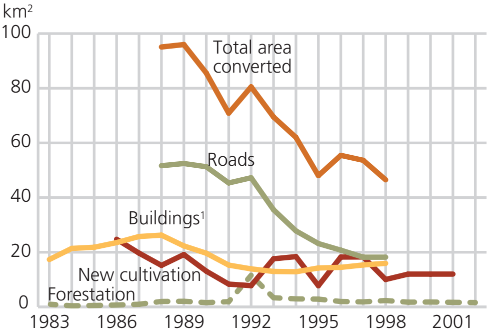
National targets - outdoor recreation

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. Cultural monuments and sites and cultural environments are often damaged by changes in land use. The extent of changes in land use can tell us something about the pressure on the cultural heritage.

Figure 1.10. Annual conversion of land for roads, new buildings[1], forestation and new cultivation. 1983-2002



[1] The area of the buildings is multiplied by 5 to take into account the fact that areas immediately around the buildings are also changed significantly.
Sources: Statistics Norway, Norwegian Agricultural Economics Research Institute and Directorate of Public Roads.

Conversion of land for other purposes

- During the 1990s, the area per year converted for other purposes has been reduced. This is mainly because less land has been used for new roads, especially forest roads.
- The area cultivated for the first time has varied a good deal from year to year, while areas built on for the first time have shown an upward trend since the early 1990s.

More information: the indicator is not discussed further in this publication, but 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

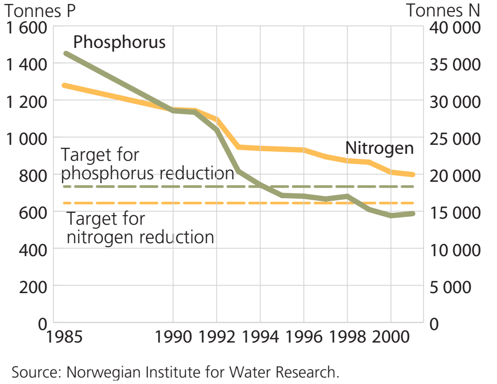
1. Annual losses of archaeological and architectural monuments and sites and cultural environments as a result of demolition, damage or decay shall be minimized, and by the year 2008 shall not exceed 0.5 per cent of the total.
2. The representative selection of monuments, sites and cultural environments shall be maintained at a standard corresponding to the 1998 level, and a standard requiring only normal maintenance shall be achieved for protected buildings and installations by 2010.
3. The selection of permanently protected monuments, sites and cultural environments shall include a wider range in terms of geography, social class, ethnicity and time periods, so that any important categories that are poorly represented or missing are better represented by 2004 than in 1998.

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 1.11. Trends in anthropogenic discharges of phosphorus (P) and nitrogen (N) to the North Sea (from the border with Sweden to Lindesnes at the southernmost tip of Norway). 1985-2001



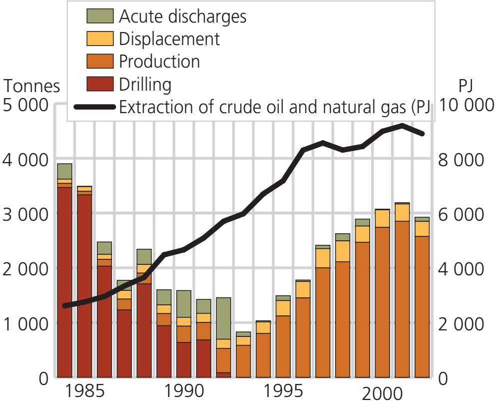
Source: Norwegian Institute for Water Research.

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 38 and 60 per cent respectively from 1985 to 2001.
- 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 1.12. Discharges of oil from petroleum activities. Tonnes. Extraction of crude oil and natural gas. PJ. 1984-2002



Sources: 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, and have been rising more rapidly than oil production.
- Acute discharges from oil production and other activities have varied widely in the period 1984-2002, but have been relatively small in recent years. Both total discharges and production were somewhat reduced in 2002.

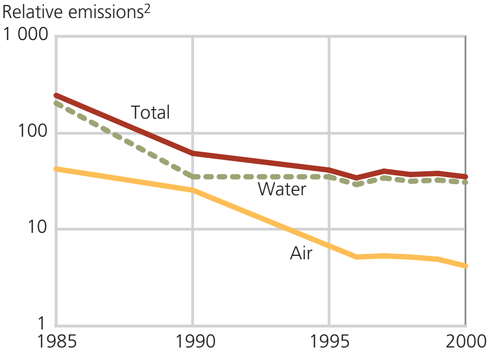
National targets - eutrophication and oil pollution

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, our health and the health of future generations. The most harmful chemicals, including persistent organic pollutants (POPs) such as PCBs and dioxins, can cause damage even at very low concentrations. Emissions of the most dangerous chemicals from Norwegian industry have been reduced, but the total consumption of chemicals is rising, and it is therefore uncertain whether the overall impact on health and the environment has been reduced.

Figure 1.13. Index for emissions of hazardous chemicals[1]



[1] Chemicals on the priority list drawn up by the Norwegian environmental authorities. Each substance is weighted according to how dangerous it is.
[2] Logarithmic scale.
Source: Norwegian Pollution Control Authority.

Emissions of POPs and heavy metals

- The total index for emissions of priority hazardous chemicals has been reduced by 15 per cent from 1995 to 2000. Further reductions in emissions are needed to meet the authorities' targets.
- In 1985, emissions of lead from leaded petrol made the largest contribution to the index for emissions to air, whereas in 2000 the largest contributions were from PAHs (polycyclic aromatic hydrocarbons) and mercury.
- In 1985, emissions of lead and cadmium from manufacturing and emissions of organotin compounds from antifouling preparations used on ships and in the fish farming industry made the largest contributions to the index for emissions to water. In 2000, organotin compounds from ships and copper from ships and the fish farming industry were important sources.
- The index is uncertain and only provides an approximation of trends in emissions.

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

National targets - hazardous substances

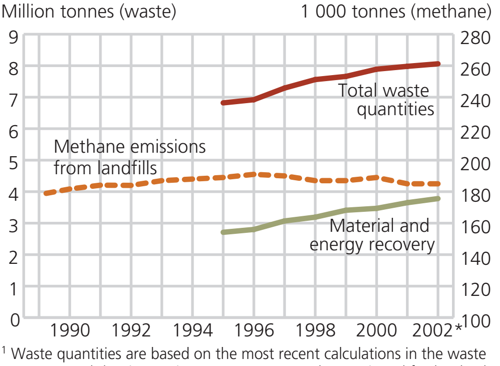
1. Emissions of certain environmentally hazardous substances shall be eliminated or substantially reduced by 2000, 2005 or 2010.
2. Emissions and use of substances that pose a serious threat to health or the environment shall be continuously reduced with a view to eliminating them within one generation (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. Pollution of soil, water and sediments caused by earlier activities, inappropriate disposal of waste, etc., shall not entail a risk of serious pollution problems.

Priority area: Waste and waste recovery

Waste gives rise to environmental problems because waste treatment releases pollutants. Landfilling of waste generates emissions of methane, which is a greenhouse gas. Landfills, particularly the older ones, also contain various kinds of POPs and heavy metals, 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 1.14. Methane emissions from landfills, total quantity of waste generated[1,2] and waste delivered for recovery. 1989-2002*



[1] Waste quantities are based on the most recent calculations in the waste accounts, and the time series cannot at present be continued further back than 1995. The figures for 2001 and 2002 are projections.
[2] Hazardous waste is not included.
Sources: 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 generated rose by about 16 per cent from 1996 to 2002.
- The quantity of waste delivered for material recovery and energy recovery has risen by 35 per cent in the same period. In 2002, 47 per cent of all waste was dealt with by material or energy recovery. Norway's goal is to reach an overall recovery rate of 75 per cent.
- Methane emissions, which are considered to be one of the most serious environmental problems associated with waste management, have changed little since 1989.

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 quantity of waste delivered for final treatment is to be reduced to an appropriate level in economic and environmental terms. Using this as a basis, the target is for 25 per cent of the total quantity of waste generated to be delivered for final treatment in 2010.
3. Practically all hazardous waste is to be dealt with in an appropriate way, so that it is either recycled/recovered or sufficient treatment capacity is provided within Norway.

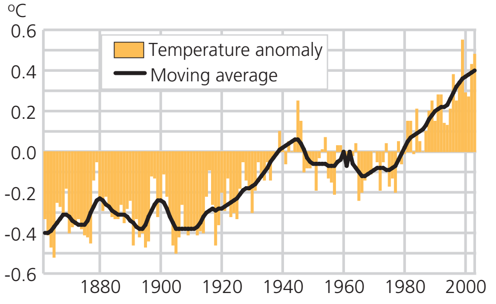
Priority area 7: Climate change, air pollution and noise

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 160 000 years. 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.

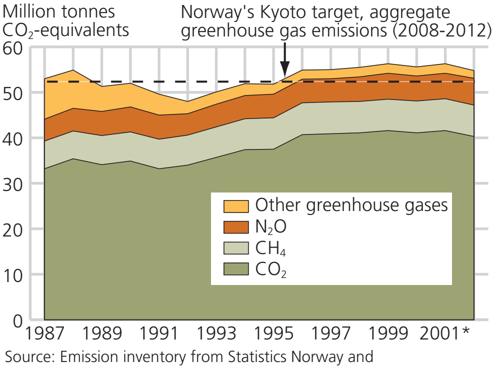
If greenhouse gas emissions continue to rise, there will be a growing risk of extensive and damaging climate change accompanied by the more frequent occurrence of extreme weather conditions. To solve the problem will require a complete reorganization of world energy use, which is the most important source of greenhouse gas emissions. The countries of the world are trying to organize emission reductions within the framework of the Kyoto Protocol (see Chapter 6, boxes 6.5 and 6.6).

Figure 1.15. Global mean temperature[1]. 1861-2002



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

Figure 1.16. Greenhouse gas emissions in Norway. Historical figures and Kyoto target. 1987-2002



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

Global mean temperature

- The global mean temperature has risen by between 0.3 and 0.6 °C since 1861. 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. 2002 was the second warmest year registered in the whole of this period.

Greenhouse gas emissions in Norway

- Norwegian greenhouse gas emissions rose by more than 5 per cent from 1990 to 2002. 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 2001 to 2002, Norway's greenhouse gas emissions dropped by 2.5 per cent, mainly as a result of lower emissions of CO_2 and SF_6.
- CO_2 accounts for three quarters of Norway's greenhouse gas emissions.

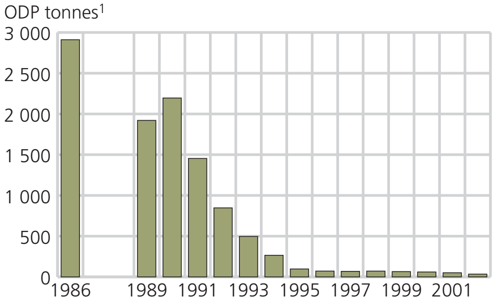
For more information, see Chapter 6.1.

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. UV radiation is expected to rise most as a result of depletion of the ozone layer in the polar marine ecosystems.

Since 1969, the thickness of the earth's ozone layer has been reduced by an average of 5 per cent at mid-latitudes. Reductions of up to 10 per cent have been registered in winter and spring above Europe, North America and Australia. In summer and autumn, the reductions are up to 5 per cent. If we disregard other factors that affect the ozone layer, such as climate change and volcanic eruptions, it is assumed that the ozone layer has now reached a minimum. Over Oslo, records have shown an average annual reduction of 0.25 per cent in the thickness of the ozone layer in the period 1979-2002 (Norwegian Institute for Air Research 2003). 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 1.17. Imports of ozone-depleting substances to Norway. 1986-2002



[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. 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 such substances has been reduced by 98 per cent since 1986.

National targets - climate change, air pollution and noise

Climate

1. In the period 2008-2012, greenhouse gas emissions shall not be more than 1 per cent higher than in 1990.

Depletion of the ozone layer

1. The consumption of halons, all types of chlorofluorocarbons (CFCs), tetrachloromethane, methyl chloroform and hydrobromofluorocarbons (HBFCs) shall be eliminated.
2. Consumption of methyl bromide shall be stabilized in 1995 and phased out by 2005.
3. Consumption of hydrochlorofluorocarbons (HCFCs) shall be stabilized in 1995 and phased out by 2015.

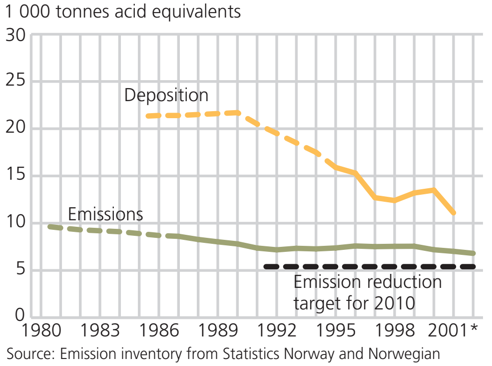
Long-range air pollution

Acid rain is still one of the most serious environmental problems 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. In the atmosphere, sulphur and nitrogen react chemically with water vapour to form sulphuric acid and nitric acid. Acid rain 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 severely affected by acid rain, but 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.

Deposition of sulphur is still the most important cause of acidification in Norway, while nitrogen accounts for about 10 per cent of acid deposition in most parts of the country. Because sulphur emissions are being reduced more rapidly than nitrogen emissions, the relative importance of nitrogen as a source of pollution is increasing (Norwegian Pollution Control Authority 2003).

The areas of Norway where critical loads for acidification are exceeded have been reduced by more than 30 per cent since 1985. In 1994, critical loads were exceeded across 19 per cent of the total area of Norway. The situation has improved further since 1994. Both the area where critical loads are exceeded and the degree to which they are exceeded have been reduced. The greatest improvements have occurred in Eastern Norway (Ministry of the Environment 2003). 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 (Norwegian Pollution Control Authority 2003).

Figure 1.18. Emissions and deposition of acidifying substances (NO_x, SO_2 and NH_3) in Norway. 1980-2002*



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

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 has dropped considerably in the last 10 years.
- However, 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.

For more information, see Chapter 6.2.

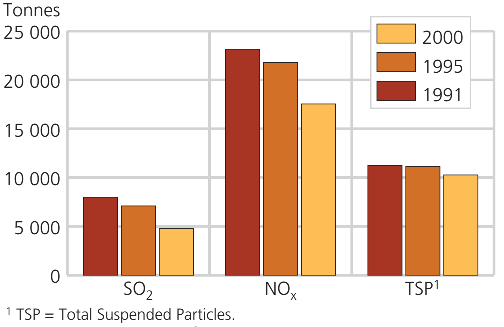
Local air quality

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.

Several hundred thousand people in Norway are exposed to levels of air pollution that entail a health risk. The socio-economic costs of the resulting health problems are estimated to be several billion NOK a year (Rosendahl 2000).

Figure 1.19. Emissions of particulate matter (TSP[1]), SO_2 and NO_x in the 10 largest towns in Norway. Tonnes. 1991, 1995 and 2000



[1] TSP = Total Suspended Particles.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority

For more information, see Chapter 6.6.

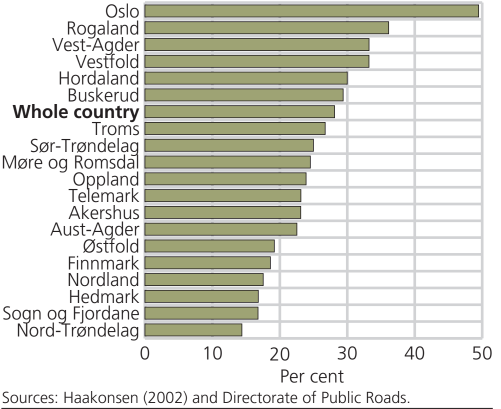
Emissions of harmful substances in urban settlements

- There has been a certain 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 noise annoyance is caused by road traffic. Industry accounts for 14 per cent and air traffic and railways 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 1.4.

Figure 1.20. Proportion of the population exposed to road traffic noise levels exceeding 55 dBA, by county. 2001*



Sources: Haakonsen (2002) and Directorate of Public Roads.

Distribution of road traffic noise by county

- About 1.3 million people in Norway are exposed to road traffic noise exceeding a 24-hour average of 55 dBA (decibels). In Oslo, half the population is exposed to noise exceeding this level.
- More than 36 000 people in Norway were exposed to noise levels above 70 dBA in 2001. Well over half of these, 21 000 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. In the period up to 2010, annual emissions shall not exceed the 1987 level.
3. Total annual emissions of volatile organic compounds (VOCs) shall be reduced to the 1988 level at the earliest possible date, and from 2010 onwards shall not exceed 195 000 tonnes. Annual VOC emissions from the entire mainland and the Economic Zone of Norway south of 62° N shall be reduced by 30 per cent from the 1989 level at the earliest possible date.
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 1.4. Noise and measurement of noise

Road traffic is much the largest source of noise in Norway, and accounts for almost three quarters of all noise annoyance. In all, 1.3 million Norwegians are exposed to road traffic noise. The overall level of noise annoyance in Norway has been fairly stable from 1999 to 2001. However, noise annoyance caused by air traffic is an exception to this, and has decreased by 6 per cent in this period. These results are from a pilot project carried out by Statistics Norway and commissioned by the Norwegian Pollution Control Authority.

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. The table below shows that there were only small changes in the index from 1999 to 2001. The changes in the number of people exposed to noise are also small. The level of uncertainty in these calculations is high, but it seems clear that a number of steps will have to be taken to reach the target.

Noise annoyance index, by source of noise[1,2]. 1999 and 2001

	Index 1999	Index 2001	Percentages, 2001	Change 1999-2001 Per cent
Total, all sources	**630 000**	**629 000**	**100**	**0**
Road traffic	460 000	459 000	73	0
Industry	81 000	82 000	13	1
Air traffic	27 000	25 000	4	-6
Railways	24 000	24 000	4	0
Construction	21 000	21 000	3	0
Firing ranges (military)	..	..	..	.
Shooting ranges	12 000	12 000	2	0
Motor racing tracks	5 000	5 000	1	0
Products used outdoors	..	..	..	.

[1] The figures do not show the number of people annoyed, but the index values.
[2] Index for road traffic noise applies to noise levels exceeding 55dBA.
Source: Noise model, Statistics Norway.

Road traffic the most important source of noise

Road traffic is much the most important source of noise annoyance in Norway, and accounted for 73 per cent of noise annoyance in 2001.

In Statistics Norway's 1997 survey of living conditions, 22 per cent of those asked said that noise outside their homes was only a little, significantly or highly annoying. These figures are not entirely comparable with Statistics Norway's new calculations of noise annoyance, but indicate that the new results are reasonable. The noise annoyance index, like this survey, is related to noise levels outside people's homes. In the survey of living conditions, 16 per cent of those asked also said that they were exposed to road traffic noise inside their homes.

Cont.

..cont.

Less noise from air traffic

Noise annoyance from air traffic dropped by 6 per cent from 1999 to 2001. This is explained by a reduction in the number of flights both before and after 11 September 2001. The number of landings and take-offs at civilian airports in Norway dropped considerably during this period. For example, there was a 10 per cent reduction in the number of flights at both Oslo (Gardermoen) and Bergen (Flesland). This is not expected to be a long-term trend: both traffic and noise annoyance caused by aircraft are likely to increase again.

Air traffic accounted for 4 per cent of estimated noise annoyance in 2001, and fighter planes around military airports contributed substantially to this. Even though air traffic is only a minor source of noise annoyance as a percentage of the total, it can cause serious problems for those who are affected. Rogaland, Østfold and Nordland are the three counties where noise annoyance from air traffic as measured by the index is highest. Each of these counties accounted for 21-22 per cent of the total in 2001.

Most industrial noise from stamp mills and car breaking yards

Industrial noise accounted for 13 per cent of estimated noise annoyance in 1999. Noise annoyance from this source rose by just over 1 per cent up to 2001. This was because the level of activity rose in certain of the industrial sectors that generate most noise. The highest noise annoyance level was in Oslo, closely followed by Rogaland. Counties such as Østfold and Telemark, where manufacturing industries dominate, are further down the list. The noise level from this type of industry is generally lower.

About the model

Statistics Norway was commissioned by the Norwegian Pollution Control Authority to develop a model to calculate exposure to noise and noise annoyance in Norway, 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. The model calculates data for noise exposure from various sources (measured as the number of people exposed to different noise levels, L_{eq}) and noise annoyance (measured using the noise annoyance index) in Norway.

A GIS model has been developed to calculate and record noise levels outside individual dwellings throughout Norway. Additional calculations are being made for dwellings that have not been included in earlier surveys.

For more information see: Haakonsen (2002).

Box 1.5. Statistics on chemicals

One of the targets of Norway's environmental policy is to bring about substantial reductions in the use and emissions of chemicals that pose a serious threat to health or the environment. Key figures that are to be used to monitor progress towards this target are figures for trends in the use of dangerous chemicals (split by branch of industry), selected product types and selected substances and groups of substances.

Statistics on chemicals are not currently part of the official statistics compiled by Statistics Norway. However, in 2002 a pilot project was carried out, commissioned by the Norwegian Pollution Control Authority, to develop a methodology for a set of indicators that can show trends in the use of certain products that contain hazardous substances. The project focused on household products, since households use a wide range of products that may contain hazardous chemicals. Branches such as services and the construction industry were also included, since the use of chemicals in these industries also involves some exposure of the general public. The analysis was based on data from the Product Register, which runs the central register of chemicals in Norway, and dealt mainly with paints, varnishes and cleaning products. It would have been interesting to include cosmetics and plant protection products as well, but since the Product Register does not contain information on these products, they were omitted for the present.

Ideally, a set of indicators should show the consumption of hazardous substances related to different products over time. As a way of achieving this goal, the project looked at the risk phrases used on the warning labels for the products. Using the risk phrases, the products were aggregated into a number of groups:

Grouping of risk phrases according to type of effects:

1 CMR substances (carcinogenic, mutagenic or toxic for reproduction)

2 Toxic

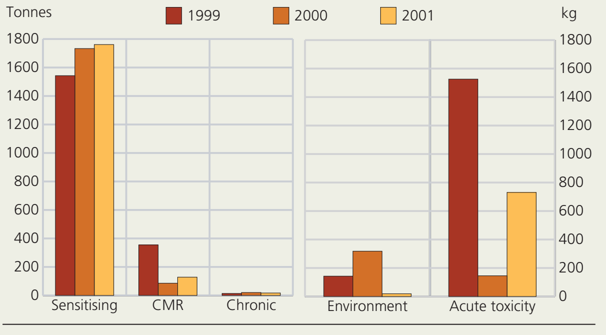
3 Chronic effects

4 Sensitising effects

5 Dangerous for the environment

6 Harmful (less serious effects than 1-4)

Consumption of products containing substances classified on the basis of CMR, chronic or sensitising effects (all in tonnes), or acute toxicity or danger for the environment (in kg)



The results of the pilot project show that 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 is that the textile industry has cut its consumption of such substances after a tax was introduced on perchloroethylene in cleaning products. However, the consumption of products containing sensitising substances rose by 14 per cent in the same period.

For more information, see: Finstad and Rypdal (2003): Bruk av helse- og miljøfarlige produkter i husholdningene - et forprosjekt (Use of hazardous products by households - a pilot project). Notater 2003/29, Statistics Norway and Finstad (2003): Kraftig nedgang i bruk av kreftfremkallende produkter (Use of products containing carcinogenic chemicals greatly reduced). http://www.ssb.no/english/magazine/

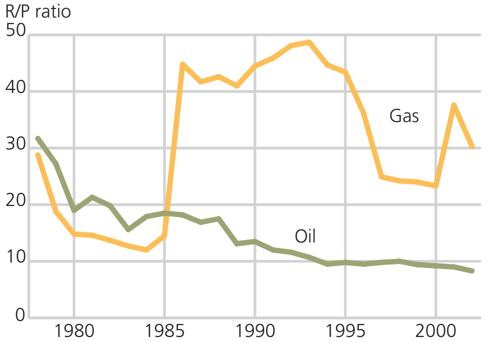
1.4. Natural resources

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

In 2003, Norway's oil and gas reserves corresponded to just over 1 per cent of the world's petroleum reserves. In 2002, however, Norway accounted for 4.4 per cent of the world's oil production and 2.6 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 1.21. R/P ratio[1,2] for Norwegian oil and gas reserves. 1978-2002



[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.
Sources: Energy statistics from Statistics Norway and Norwegian Petroleum Directorate.

R/P ratio for oil and gas reserves

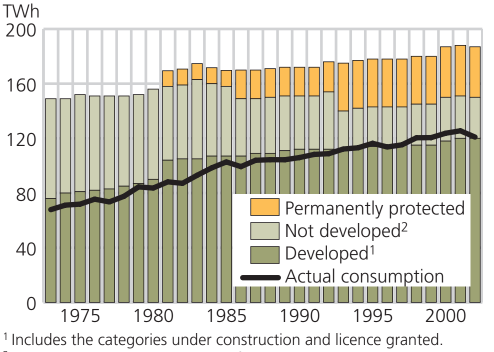
- The length of time that Norway's oil and gas reserves will last at the current rate of production, expressed as the R/P ratio, is calculated to be 8.3 years for oil and 30.3 years for gas.
- BP (2003) quotes the following R/P ratios for the whole world at the end of 2002: oil 40.6 years and natural gas 60.7 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 industrialization of the country. The rich supplies of hydropower have a great influence on the energy mix. Almost 100 per cent of electricity consumption in Norway is based on hydropower, and in 2000, electricity accounted for 46 per cent of total domestic energy use (52 per cent if energy commodities used as raw materials are excluded: see Appendix, table B5). This is the highest percentage in the world.

Figure 1.22. Hydropower resources: developed[1], not developed[2] and protected. Actual electricity consumption. 1973-2002



[1] Includes the categories under construction and licence granted.
[2] Includes the categories prior notification submitted and licence application submitted.
Source: Norwegian Water Resources and Energy Directorate.

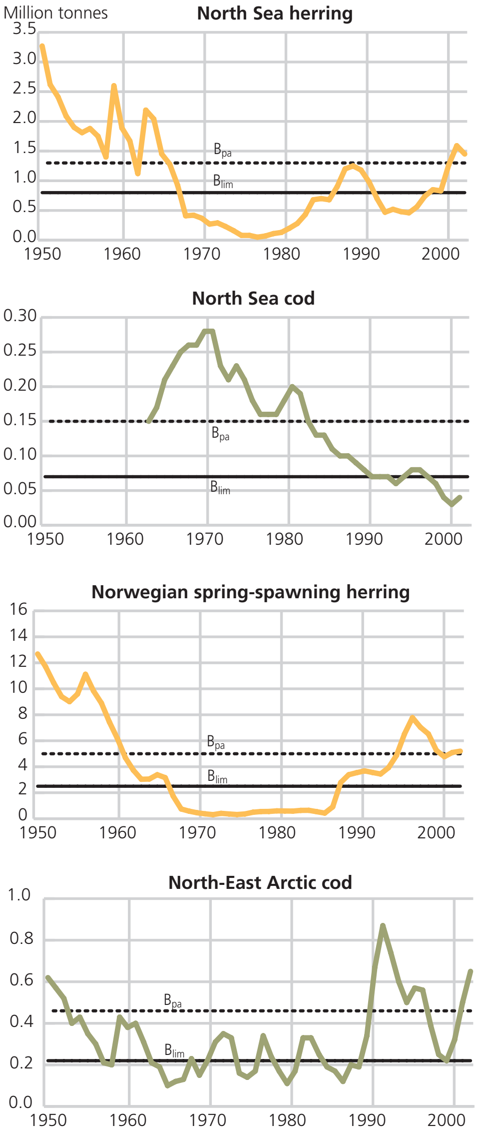
- Norway's hydropower potential is evaluated on a continuous basis and depends on technological and economic factors. The calculated hydropower potential may therefore change from year to year. In addition, the resources in fact available vary from year to year depending on rainfall.
- In the last 30 years, electricity consumption has risen faster than power supplies, and is now higher than production in a normal year.
- Of Norway's total hydropower potential, about 36 per cent has not been developed, and rather more than half of this is protected.

For more information, see Chapter 2: Energy.

Fish stocks

In its annual report on marine resources (Michalsen 2003), the Institute of Marine Research states that great caution must still be shown in harvesting several of the important fish stocks. This is particularly the case for demersal fish stocks: the pelagic stocks are generally in a better state. The North Sea cod stock appears to be at a particularly low level. This stock has been and is still being very heavily exploited.

Figure 1.23. Actual spawning stocks and critical (B_{lim}) and precautionary (B_{pa}) reference points for four important fish stocks. 1950-2002



Sources: ICES and Institute of Marine Research.

Spawning stocks

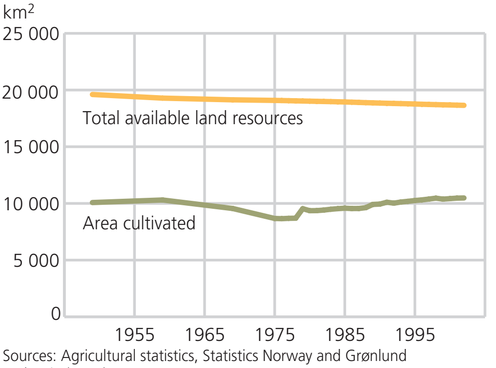
- The North Sea herring stock is still within safe biological limits.
- The North Sea cod stock appears to have been greatly depleted, and the spawning stock is well below safe biological limits.
- The spawning stock of Norwegian spring-spawning herring is considered to be within safe biological limits. However, it is considerably lower than it was in 1997.
- The spawning stock of North-East Arctic cod has risen considerably in the past year, and is now definitely above the precautionary level. The precautionary level for this stock was reduced somewhat this year, while the lower, critical level for the spawning stock was raised somewhat.

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. The scarcity of land resources means that the current self-sufficiency rate is between 40 and 50 per cent.

Figure 1.24. Cultivated land and available land resources in Norway. 1949-2002*



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

Available land resources and cultivated land

- In the past 100 years, the cultivated area of Norway has varied between 11 200 km^2 at the end of the 1930s and 8 700 km^2 in the 1970s, and is now about 10 400 km^2.
- The available land resources (cultivated and cultivable area) have dropped by almost 1 000 km^2 or 5 per cent from 1949 to 2002 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 2002, as compared with 51 per cent in 1949.

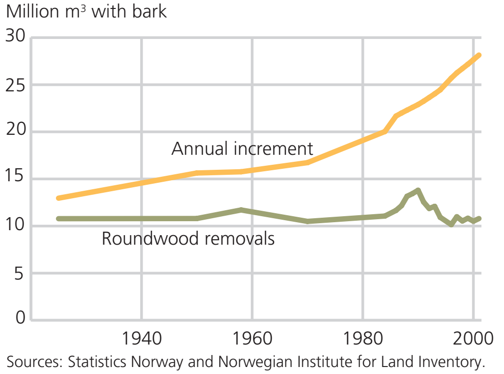
For more information, see Chapter 3: Agriculture.

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 1.25. Roundwood removals and annual increment in Norwegian forest. 1925-2001



Sources: 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.
- In recent years, only 50 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.

1.5. The relationship between environment and economy - indicators for selected sectors

There is a close relationship between economic activity and many environmental problems. Pollution and disturbance of the natural environment are often side effects of production and/or consumption, and such effects 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) shows that two factors have been particularly important: more efficient use of energy and increasing use of technology to control emissions. In addition, the use of cleaner types of energy, other technological advances and political measures have helped to reduce air pollution, but to a much smaller extent.

Box 1.6. Why is the economy growing more rapidly than emissions?

Two general developments are mainly responsible for the fact that emissions to air have not grown as rapidly as the economy (measured as GDP). One is that technological developments are improving the resource efficiency of production and enabling us to make greater cuts in emissions. As a result, emissions per unit produced are dropping (emission intensity drops and eco-efficiency rises). The other is that industries that are not pollution-intensive have been growing faster than the general rate of GDP growth. For example, service industries (including wholesale and retail trade, maintenance and repair of motor vehicles and hotels and restaurants) accounted for 34 per cent of total value added in 1990, rising to 40 per cent in 2001, but the sector's share of emissions has not risen correspondingly. *Decoupling* is a term that is used to describe a situation where economic growth is clearly greater than the growth in emissions or environmental pressure.

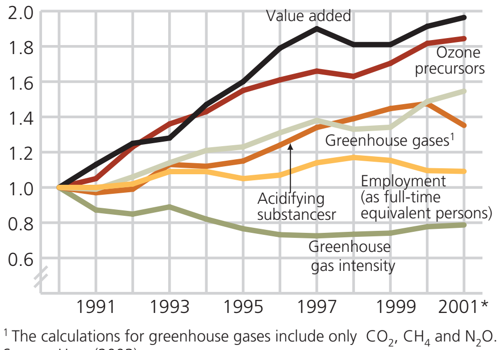
General economic developments

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. According to preliminary figures from the national accounts, mainland GDP expanded by 1.3 per cent in 2002.

Mining and extraction of crude oil and natural gas

In the period 1990-2001, value added in this sector rose by 96 per cent, and this in itself will tend to cause a rise in emissions. In 2001, these industries accounted for 13.5 per cent of Norway's value added. They also generated 9 per cent of Norway's emissions of acidifying substances, 19 per cent of its greenhouse gas emissions and 30 per cent of emissions of ozone precursors (Hass 2003). For more information, see Chapter 2: Energy and Chapter 6: Air Pollution and Climate Change.

Figure 1.26. Economic, air emission and greenhouse gas intensity trends for mining and quarrying and the extraction of crude oil and natural gas. 1990-2001*. Index: 1990=1[1]



[1] The calculations for greenhouse gases include only CO_2, CH_4 and N_2O.
Source: Hass (2003).

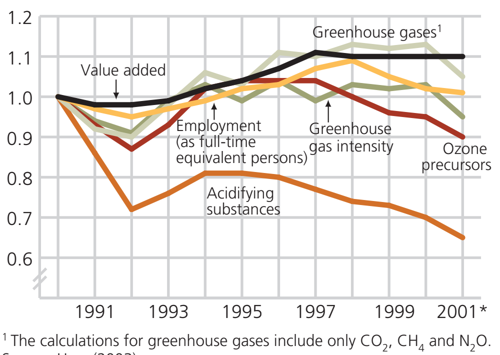
Mining and extraction of crude oil and natural gas: Environmental and economic indicators

- The Norwegian authorities have focused on reducing emissions to air from this sector for many years. Even so, emissions of greenhouse gases and acidifying gases have risen, but more slowly than value added. It is only recently that measures to reduce emissions have begun to give results.
- Greenhouse gas intensity (measured as emissions per NOK of value added) gives an idea of the eco-efficiency of production. There was a general improvement in the efficiency of this sector up to and including 1996, but after 1999 eco-efficiency has dropped (emissions per NOK of value added have risen).

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 2001, manufacturing generated 7 per cent of Norway's emissions of acidifying substances, 26 per cent of its greenhouse gas emissions and 6 per cent of emissions of ozone precursors, and accounted for 11.7 per cent of Norway's total value added.

Figure 1.27. Economic, air emission and greenhouse gas intensity trends for manufacturing in Norway. 1990-2001*. Index: 1990=1[1]



[1] The calculations for greenhouse gases include only CO_2, CH_4 and N_2O.
Source: Hass (2003).

Manufacturing: Environmental and economic indicators

- Preliminary figures 2001 for manufacturing show that all types of emissions have dropped. This was because there was a decline in activity in certain types of manufacturing, and production was therefore lower.
- The drop in greenhouse gas emissions in 2000 and 2001 is explained by the closure of one of Norway's three oil refineries and the closure of plants in the ferro-alloy industry and primary production of magnesium.
- Emissions of acidifying substances from manufacturing are showing a long-term downward trend. This is largely due to lower SO_2 emissions as a result of technological improvements and the use of fuel with a lower sulphur content.
- Greenhouse gas intensity has varied between 91 and 104 per cent in the period 199-2001, showing that there is no consistent decoupling (see box 1.6) of value added and greenhouse gas emissions in manufacturing as a whole.

Box 1.7. Improvements in productivity and environmental improvements in Norwegian enterprises

Traditional measures of growth in productivity do not take environmental factors into account. More productive use of conventional factor inputs results in cost savings for a company, but does not in itself provide any incentive to reduce emissions. It is therefore possible that productivity indicators based on conventional factor inputs will show more rapid technological progress than indicators that also include environmental factors. On the other hand, some emissions are taxed or regulated. This gives companies incentives to invest in technology that will reduce emissions per unit of production, in which case indicators including environmental factors would show more rapid progress than indicators based on conventional inputs only.

A study of technological progress in the most polluting Norwegian companies gave some results that agreed with each of these possibilities. The study estimated technological progress in the period 1992-2000 using a *conventional productivity index* including the traditional factor inputs (labour, capital and intermediates) and a *productivity index corrected for environmental factors*, which also includes emissions of various pollutants. For about half of the sectors tested, it was found that productivity as measured by conventional factor inputs grew more than productivity including environmental factors. In other words, if only the conventional factor inputs are taken into account, overall technological progress is overestimated.

Disagreement between the results may partly be explained by interactions between different pollution problems. In the pulp and paper industry, for example, the conventional productivity index was higher than the environmentally-corrected index for discharges to water, but the opposite was true for emissions to air. Regulation of discharges of organic compounds to water has helped to increase the environmentally-corrected productivity index, which includes discharges to water. However, these discharges have been reduced by collecting and incinerating black liquor from the production process, which results in sulphur emissions to air. This demonstrates that when the effect of a particular environmental policy is evaluated, it must be corrected for side effects on other environmental problems.

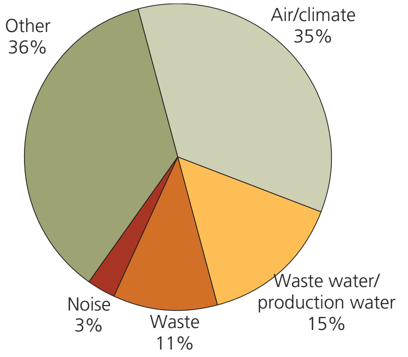
In general, technological progress has meant adaptation to the latest available technology. However, some companies are lagging behind, so that the distance to the technology frontier has increased over time. In this study, it was estimated that in 2000, it was technically possible to reduce both emissions and the use of factor inputs by up to 10 per cent in the pulp and paper industry without reducing production. However, it should be noted that such environmental improvements will involve economic costs.

For more information, see: Bruvoll, A., T. Bye, J. Larsson and K. Telle (2003): *Technological changes in the pulp and paper industry and the role of uniform versus selective environmental policy*, Discussion Paper no. 357, Statistics Norway.

Environmental protection expenditure in manufacturing industries
In 2000, 5.2 per cent of expenditure in mining and manufacturing was on environmental protection. Manufacturing industries invested a total of NOK 782 million in end-of-pipe equipment. This is equipment to treat, prevent, control or measure pollution. In the mining sector (excluding petroleum extraction), environmental protection expenditure was NOK 12 million (see Appendix, table A1).

Almost 21 per cent of the metal industry's investments, or NOK 330 million, were in environmental protection measures, while the corresponding figures for the pulp and paper industry were 24 per cent and NOK 219 million. Although the amounts involved were not particularly large, environmental protection expenditure accounted for a substantial proportion of the total in the manufacture of paints and varnishes (22 per cent) and in recycling (17 per cent). In most other industries, this type of expenditure makes up 1-2 per cent of total gross investments.

Figure 1.28. Environmental protection expenditure (end-of-pipe equipment), according to environmental domain. 2000. Manufacturing and mining and quarrying. Percentages



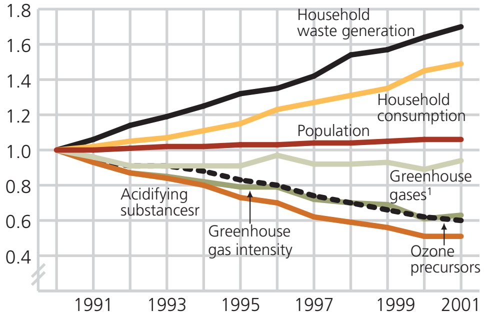
Source: Statistics Norway (2002a)
http://www.ssb.no/english/subjects/01/06/20/miljokostind_en/

- Environmental protection expenditure is classified on the basis of the type of pollution it is related to: air/climate, water/waste water (including production water), waste, noise and other pollution. In all, 35 per cent of environmental protection expenditure was related to measures to reduce emissions to air, 15 per cent was related to waste water and 11 per cent to waste.
- The data do not include all types of environmental protection expenditure in manufacturing industries. When investments are made in new or modified production processes where environmental protection equipment is integrated into the production process, it is difficult to determine and quantify the proportion of the expenditure that is for environmental purposes. Such expenditure is not included in the statistics at present.

Households

Some environmental problems are closely related to household consumption, but the relationships are not clear-cut. In 2001, households accounted for 3 per cent of Norway's emissions of acidifying substances, 11 per cent of emissions of ozone precursors and 9 per cent of greenhouse gas emissions. Household consumption in 2001 was NOK 629 billion.

Figure 1.29. Consumption, air emission and greenhouse gas intensity trends for households. 1991-2000*. Index: 1990=1[1]



[1] The calculations for greenhouse gases include only CO_2, CH_4 and N_2O.
Source: Hass (2003).

Households: Environmental and economic indicators

- Household consumption has risen by 49 per cent during the period 1990-2001. Generation of household waste has also risen throughout the period, and at a faster pace than consumption (70 per cent rise).
- Emissions to air from transport are an important source of direct emissions from households. The number of private cars has risen by 19 per cent from 1990 to 2001, and this has contributed to a steep rise in the total distance driven. Cars fitted with catalytic converters have mixed effects on emission to air: lead and NO_x emissions are reduced, but N_2O emissions rise. Diesel vehicles generate higher emissions of CO and CO_2 than vehicles with petrol engines. Improvements in technology help to reduce emissions from cars, but this is offset by the rise in the distance driven.
- Greenhouse gas intensity (measured as consumption per unit emissions of greenhouse gases) is dropping. This is mainly because household consumption includes imported products, so that consumption by Norwegian households results in emissions in the countries where these goods are produced, and these emissions are not included in the current analysis.

Box 1.8. Breaches of environmental rules by many Norwegian companies

In the last few years, the Norwegian Pollution Control Authority has found breaches of environmental rules during about 80 per cent of its inspections of enterprises that have been issued with discharge permits pursuant to the Pollution Control Act (figure 1). Despite this, very few enterprises are reported to the police.

The Pollution Control Authority has issued discharge permits to about 1 600 companies in Norway. The Authority is also responsible for monitoring compliance with the conditions set out in discharge permits and with the Pollution Control Act, and has the authority to enforce the Act. Minor breaches of discharge permits or the legislation have been found during most inspections of industrial enterprises during the 1990s. However, serious breaches of the rules are not very widespread, and there seem to be few companies where there have been repeated serious breaches of the rules.

After an inspection, the Pollution Control Authority considers whether the company should be inspected more or less often. After 13 per cent of the inspections, the Authority concluded that a company should be followed up closely, and in some of these cases, it also considered whether to report the company to the police. Most companies have only been in this category once in the period 1992-2000.

Figure 1. Proportion of inspections where breaches of environmental rules were revealed. 1997-2000

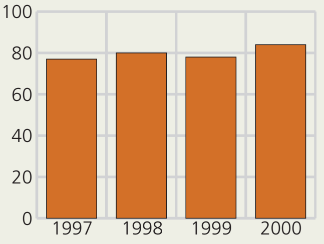
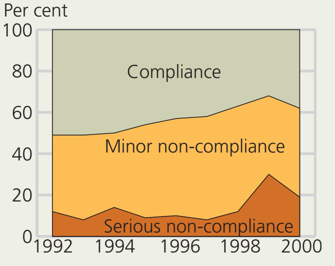


Figure 2. Percentage of companies whose own reports indicated non-compliance with environmental rules



Three of five companies reported non-compliance with the rules themselves

In addition to being inspected by the Pollution Control Authority, many of the companies that hold discharge permits are required to produce annual environmental reports. In the period 1992 - 2000, only 42 per cent of these reports did not include information on non-compliance with environmental rules. In all, 44 per cent of the reports described minor breaches of the rules, while 15 per cent reported more serious cases, or breaches of the rules that the company had not taken action to remedy. During the 1990s, more and more companies have reported non-compliance with the rules, and the proportion of serious breaches of the rules has risen substantially in the past few years (figure 2). This may be because the Pollution Control Authority has taken a stricter view of which cases of non-compliance should be defined as breaches of the rules rather than because there has been a real increase.

Few companies are reported to the police

The Norwegian Pollution Control Authority rarely reports companies to the police for breaches of environmental legislation. The Authority's response depends on how serious the breach is and how likely it is that the company will be convicted. The Authority only considers reporting companies to the police after 3 per cent of the inspections. It is up to the prosecuting authority and in the final instance the courts to determine any penal measures.

Even though few cases result in penal measures, some form of sanction appears to be imposed in most cases where non-compliance with the rules is revealed. These may include more frequent inspections (for which the company has to pay) or coercive fines. In addition, there are less formal types of sanctions such as publication of the results of an inspection, which can result in extensive media coverage. Negative exposure in the media is something that management and owners prefer to avoid, and can feel like additional penal measures. For example, it may reduce the demand for a company's products and thus have a direct financial effect.

Even though the costs of sanctions make breaking the law less attractive, sanctions may nevertheless cost less than complying with the law, so that it is "worthwhile" to break the rules.

Sources: Tønnessen (2003): *Norske bedrifter og miljøreguleringene, 1992-2000. Brudd på miljøreguleringene i 4 av 5 kontroller* (Norwegian companies and environmental legislation, 1992-2000. Breaches of the rules found during 4 of 5 inspections). Statistical Magazine (http://www.ssb.no/vis/magasinet/miljo/art-2003-05-05-01.html), Nyborg et al. (2003), Walle (2003).
More information may be obtained from: kjetil.telle@ssb.no

Box 1.9. Statistics on environmental offences

The statistics include information on offences that have been reported and investigated, penal sanctions imposed and numbers of persons imprisoned. Statistics Norway compiles statistics on environmental crime, defined as breaches of the following acts:

- Penal Code §§ 152b, 255 (embezzlement of unlawfully killed game or wildlife found dead), 317, first paragraph (receiving unlawfully killed game or wildlife found dead)
- Wildlife Act
- Act relating to sea-water fisheries, etc.
- Act relating to salmonids and fresh-water fish, etc
- Act relating to the registration and marking of fishing vessels
- Pollution Control Act
- Cultural Heritage Act
- Act Relating to motor traffic on uncultivated land and in watercourses
- Nature Conservation Act
- Product Control Act
- Water Resources Act
- Forestry Act
- Outdoor Recreation Act
- Act relating to nuclear energy activities
- Act relating to the economic zone of Norway
- Gene Technology Act
- Act relating to pesticides
- Act relating to the use of X-rays and radium

In principle, statistics on reported and investigated offences are available back to 1991, and statistics on sanctions for some years more. The official statistics show all environmental crime as one category (see for example Statistics Norway 2002b). However, the source material makes it possible to split this up further according to the act, section or paragraph involved.

The table below gives more details of reported offences within the category environmental crime.

Reported offences, environmental crime. 1999 - 2002

	1999	2000	2001	2002
Environmental crime, total	3 710	3 498	3 541	3 005
Fauna, flora and habitats	2 566	2 364	2 291	2 015
Pollution	482	452	478	433
Cultural heritage	37	24	24	26
Other environmental crimes	625	658	748	531

Source: Crime statistics, Statistics Norway.

Relatively few cases of environmental crime are reported to the police (less than 1 per cent of the total), and random variations can result in substantial differences from one year to another. It is difficult to determine how many offences in this category go unreported, but the numbers are probably rather higher than for crimes of gain.

For more information see: Gundersen and Hustad (2000) and *Crime Statistics 2000* (Statistics Norway 2002b).

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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. 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 2002, extraction of energy commodities in Norway was 9 times higher than domestic consumption. Most of this is extraction of oil and gas, which accounted for 94 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 30 years' time. The lifetime of the remaining resources depends on the rate of extraction, on new finds, on decisions concerning the development of proven fields and on whether a larger proportion of the oil and gas is extracted from fields that are on stream. Norway has 1 per cent of the world's oil reserves, but accounted for 4.4 per cent of world oil production in 2002. 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. Petroleum extraction accounted for about 18 per cent of GDP and 42 per cent of Norway's export revenues in 2002. This is only a small change from the year before: prices have dropped slightly, while extraction has risen by about 3 per cent.

Hydropower is Norway's other major energy resource, although electricity production from this source corresponded to only about 5 per cent of petroleum extraction in 2002. However, hydropower is a renewable energy source, unlike petroleum resources, which are depleted as they are extracted. In 2002, Norway produced 131 TWh of electricity, of which about 10 TWh was exported. Autumn 2002 was very dry, and as a result of the high level of production, water levels in the reservoirs reached an all-time low in autumn-winter 2002-2003. Electricity prices rose to record levels, and there appeared to be an imminent threat of an electricity crisis. The degree of filling of the reservoirs corresponded to about 18 TWh less at the beginning of 2003 than at the beginning of 2002.

Consumption of energy commodities dropped in 2002 to about the same level as in 1999 and 2000. In the last 20-30 years, energy use has grown considerably more slowly than general economic growth.

Energy production and use has major environmental impacts. In 2001, extraction of oil and gas generated 26 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 63 per cent of Norway's hydropower potential has now been developed.

2.1. Resource base and reserves

World fossil energy reserves

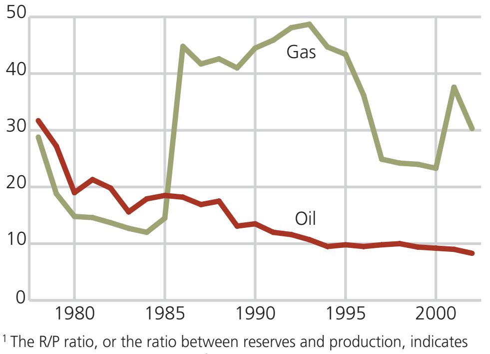
- Reserves are defined here as resources that are fairly certainly recoverable given the current economic and technological framework.
- BP (2003) quotes the following R/P ratios (estimates for the length of time remaining reserves will last at the current rate of production) for the whole world at the end of 2002: oil 40.6 years, natural gas 60.7 years and coal 204 years. Despite the large quantities that have been extracted, the estimate for oil was 55 per cent higher than 20 years earlier, and the estimate for natural gas was 80 per cent higher. This is explained by new finds and technological advances.

Table 2.1. World reserves of fossil energy commodities as of 1 January 2003

	Oil		Gas		Coal	
	Billion tonnes	Per cent	Billion tonnes o.e.	Per cent	Billion tonnes	Per cent
World	142.7	100	140.2	100	984.5	100
North America[1]	6.4	4.5	6.4	4.6	257.8	26.2
Latin America	14.1	9.9	6.4	4.5	21.8	2.2
Europe incl. former Soviet Union	13.3	9.3	54.9	39.2	355.4	36.1
Middle East	93.4	65.5	50.5	36.0	1.7	0.2
Africa	10.3	7.2	10.7	7.6	55.4	5.6
Asia and Oceania	5.2	3.6	11.3	8.1	292.5	29.7
OPEC	111.9	78.4	..	..	..	..
OECD	9.4	6.6	13.8	9.9	445.8	45.3
Norway	1.4	1.0	2.0	1.4	..	..

[1] Including Mexico.
Source: BP 2003.

Figure 2.1. R/P ratio[1,2] for Norwegian oil and gas reserves[3]. 1978-2002



[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.
[3] Resources include all estimated petroleum deposits, whereas reserves include only recoverable resources in fields that are already developed or where development has been approved.
Sources: Energy statistics from Statistics Norway and Norwegian Petroleum Directorate.

Norwegian petroleum reserves

- The estimates of reserves are revised annually, and new fields are included in the estimates almost every year (see Appendix, tables B1 and B2). Norway has been producing crude oil and natural gas for 30 years, and by 31 December 2002 a total of 3 517 million Sm^3 oil and gas had been sold and delivered from the Norwegian continental shelf in the North Sea. The remaining reserves are calculated at 3 776 million Sm^3 (Norwegian Petroleum Directorate 2003).
- According to the Petroleum Directorate's figures, the R/P ratios for Norway's reserves were 8.3 years (oil) and 30.3 years (gas). The drop in the R/P ratio for natural gas from 2001 to 2002 is explained by a sharp rise in gas production.

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	Transport	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 (2002)[2]	40.0 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)	16.8 GJ/tonne	..	..	..	..
Black liquor (dry wt)	14.0 GJ/tonne	..	..	..	..
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).
Sources: 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	1.058	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	40.0	11.1	0.9	7.1	1.11	1	0.038
1 quad	1053	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)

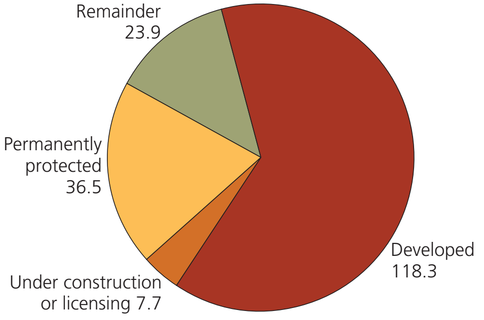
1 MSm^3 o.e. oil = 1 million Sm^3 oil

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

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

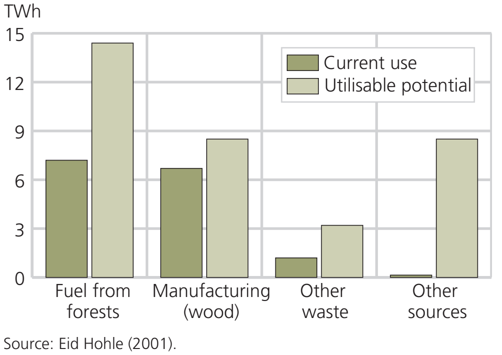
Source: Energy statistics, Statistics Norway and Norwegian Petroleum Directorate.

Figure 2.2. Norway's hydropower resources as of 1 January 2003. TWh per year



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

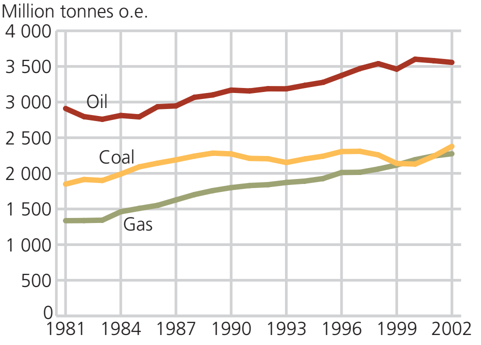
- As of 1 January 2003, Norway's hydropower potential totalled 186.5 TWh per year (see Appendix, table B3), and 63 per cent of this has been developed.
- Hydropower accounts for almost 100 per cent of electricity production in Norway, as compared with 19 per cent for the world as a whole (World Energy 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.
- Hydropower developments have a significant impact on biological diversity, the cultural landscape and opportunities for outdoor recreation. The only large river in Norway that is untouched by hydropower developments is the Tana in Finnmark.
- Environmental restrictions and the need to consider profitability make it uncertain how much of the remaining hydropower potential is likely to be developed.

Bioenergy resources in Norway

- Annual consumption of bioenergy resources in Norway is about 15 TWh, and the utilisable potential is calculated to be about 35 TWh (Eid Hohle 2001).
- 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. 1981-2002



Source: BP (2003).

World production of fossil energy commodities

- In 2002, total global extraction of fossil energy commodities was equivalent to 8 200 million tonnes oil equivalents, which is a rise of 35 per cent since 1981. The rise has been largest for natural gas production, which has increased by 70 per cent. Measured in oil equivalents, gas production has now reached the same level as coal production.
- The USA is one of the three largest producers of all three fossil energy commodities (see table 2.2).
- Almost half of the world's coal is produced in Asia/Oceania, while North America and Europe (including the whole of Russia: much of Russia's gas is produced in Siberia) account for almost 70 per cent 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

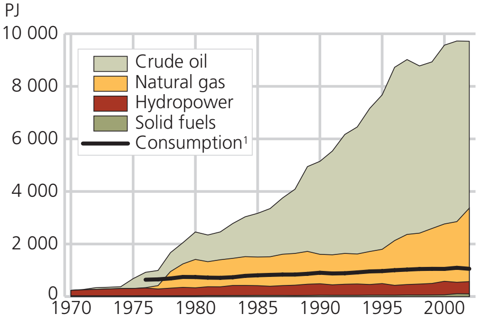
Name	Symbol	Factor
Kilo	k	10^3
Mega	M	10^6
Giga	G	10^9
Tera	T	10^{12}
Peta	P	10^{15}
Exa	E	10^{18}

Table 2.2. World production of fossil energy commodities in 2002

	Oil		Gas		Coal	
	Million tonnes	Per cent	Million tonnes o.e.	Per cent	Million tonnes o.e.	Per cent
Regions						
World	3 556.8	100.0	2 274.7	100.0	2 379.4	100
OPEC	1 364.2	38.4	..	..	..	..
OECD	1 009.7	28.4	981.8	43.2	1 003.4	42.2
North America[1]	664.4	18.7	689.4	30.3	612.9	25.8
Latin America	335.7	9.4	92.7	4.1	34.1	1.4
Europe incl. former Soviet Union	784.2	22.0	889.3	39.1	421.8	17.7
Middle East	1 014.6	28.5	212.0	9.3	0.4	0.0
Africa	376.4	10.6	119.9	5.3	130.6	5.5
Asia and Oceania	381.4	10.7	271.4	11.9	1 179.6	49.6
Major producers						
Oil	Million tonnes	Per cent				
Saudi Arabia	418.1	11.8				
Russia	379.6	10.7				
USA	350.4	9.9				
Mexico	178.4	5.0				
China	168.9	4.8				
Iran	166.8	4.7				
Norway	157.4	4.4				
Venezuela	151.4	4.3				
Gas	Million toe	Per cent				
Russia	499.4	22.0				
USA	492.9	21.7				
Canada	165.2	7.3				
UK	92.8	4.1				
Algerie	72.3	3.2				
Indonesia	63.5	2.8				
Norway	58.9	2.6				
Iran	58.1	2.6				
Coal	Million toe	Per cent				
China	703.0	29.5				
USA	571.7	24.0				
Australia	183.6	7.7				
India	168.4	7.1				
South Africa	126.8	5.3				
Russia	113.8	4.8				
Poland	70.8	3.0				
Indonesia	63.3	2.7				
Germany	54.8	2.3				

[1] Including Mexico
Source: BP 2003.

Figure 2.5. Extraction and consumption[1] of energy commodities in Norway. 1970-2002*

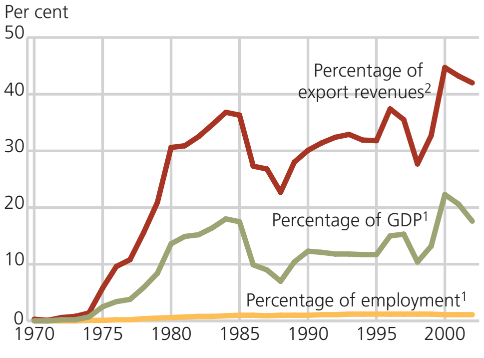


[1] Including the energy sectors, excluding international maritime transport.
Sources: Energy statistics, Statistics Norway, Norwegian Petroleum Directorate and Norwegian Water Resources and Energy Directorate.

Total extraction of energy commodities in Norway

- There was a slight drop in total extraction of energy commodities in Norway from 2001 to 2002. Gas production rose by 21 per cent, while crude oil production dropped by more than 7 per cent. Extraction of solid fuels dropped as well. Oil and gas extraction accounted for 94 per cent of the total in 2002.
- Hydropower production was about 7 per cent higher in 2002 than the year before.
- In 2002, extraction of primary energy commodities was almost 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. 1970-2002*

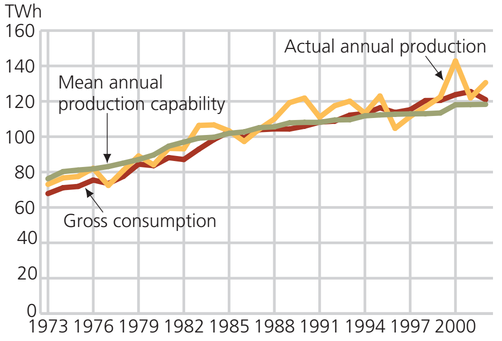


[1] Including services.
[2] Oil and gas only.
Source: National Accounts, Statistics Norway.

Crude oil and natural gas in an economic perspective

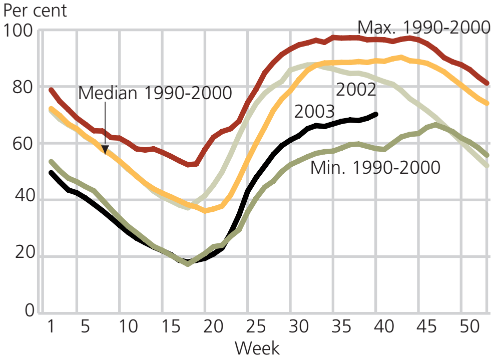
- Extraction of oil and gas is Norway's most important industry measured in terms of export revenue and value added (proportion of GDP). In 2002, oil and gas accounted for 42 per cent of the country's total exports. The volume of exports rose by 3.3 per cent from the year before, while the value dropped by 12 per cent.
- Value added in the petroleum sector corresponded to 22 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. 1973-2002



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

Figure 2.8. Degree of filling of Norway's reservoirs during the year, 2002 and 2003. Minimum, maximum and median values for the period 1990-2000. Percentages



Source: Energy statistics, Statistics Norway, based on figures from the Norwegian Water Resources and Energy Directorate.

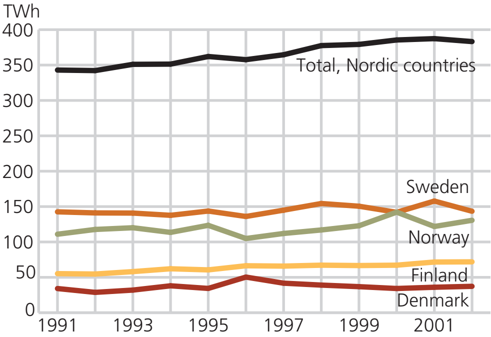
Electricity

- Electricity production in Norway in 2002 totalled 131 TWh, a rise of 7 per cent from the year before (see Appendix, table B8). This is the second-highest level of production ever recorded, only exceeded by the level in 2000, when high precipitation resulted in an extremely high level of production.
- Production was 12 TWh higher than the mean annual production capability (i.e. production in a year with normal precipitation). The mean annual production capability rose by only 0.12 TWh from the year before.
- Net exports of electricity totalled 9.7 TWh in 2002.

Degree of filling of the reservoirs

- Water inflow to the reservoirs 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.
- In January 2002, the total energy capability of Norway's reservoirs was about 84 TWh, or about 2/3 of annual mean production (Ministry of Petroleum and Energy 2002).
- The degree of filling of the reservoirs varies a great deal through the year, and is lowest in spring before the snow melts. It can also vary considerably from one year to another because of variations in precipitation and the demand for electricity. In winter 2002-2003, a dry autumn and high production resulted in particularly low water levels in the reservoirs. From January 2002 to January 2003, the degree of filling dropped by the equivalent of about 18 TWh.

Figure 2.9. Electricity production in the Nordic countries. 1991-2002

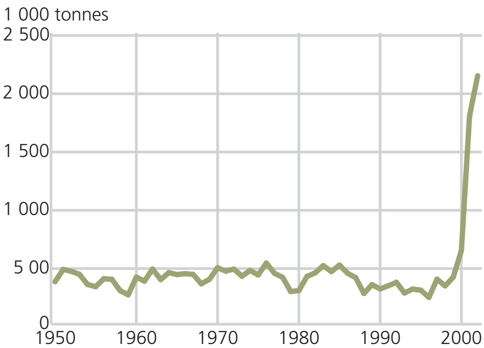


Source: Nordel's secretariat (various years).

Electricity production in the Nordic countries

- The energy balance in Norway influences electricity production in the other Nordic countries. Electricity production in Denmark, Finland and Sweden rose from 2000 to 2001, when Norway became a net importer instead of a net exporter. In 2002, production rose again in Norway and fell in Sweden, and Norway once again became a net exporter.
- The total net Norwegian export of 9.9 TWh in the Nordic region in 2002 consisted of 9.2 TWh to Sweden, 0.7 TWh to Denmark and a net import of 0.02 TWh from Finland.

Figure 2.10. Extraction of coal in Svalbard. 1950-2002



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

Norwegian extraction of coal in Svalbard

- Ordinary production at the Svea Nord mine in Svalbard began in 2002, after a decision by the Storting in December 2001 to continue Norwegian coal mining. The company responsible is Store Norske Spitsbergen Grubekompani. The company has made a profit during the first year of ordinary production, whereas Norwegian coal production has always previously been dependent on government support. Production has continued to rise, as it has for the last few years, and reached 2.1 million tonnes in 2002, five times more than in 1999. According to plan, mining at Svea Nord is to continue for about 25 years.
- Efforts to draw up a conservation plan for Svalbard have been hampered by serious conflict between Norwegian and Russian mining interests and conservation interests, and the issues involved have also been raised by the Russians at top political level.

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. 2001*. Percentages

Greenhouse gases	**26**
Carbon dioxide (CO_2)	32
Methane (CH_4)	11
Nitrous oxide (N_2O)	1
Acidifying substances	**20**
Sulphur dioxide (SO_2)	12
Nitrogen oxides (NO_X)	27
Ammonia (NH_3)	0
Heavy metals	
Lead (Pb)	6
Cadmium (Cd)	6
Mercury (Hg)	5
Arsenic (As)	3
Chromium (Cr)	3
Copper (Cu)	1
Total PAH	1
Dioxins	12
Other pollutants	
Non-methane volatile organic compounds (NMVOC)	68
Carbon monoxide (CO)	2
Particulate matter	1

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

Emissions to air

- 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 (see Chapter 6: Air pollution and climate change).
- The most important source of CO_2 and NOX emissions in the energy sectors is gas turbines on offshore installations. In the period 1990-2000, annual CO_2 emissions from this source were 5-7 million tonnes: however, in 2001 and 2002, they rose to more than 8 million tonnes. Annual emissions of NO_X from this source are about 30 000 tonnes.
- 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. In 2002, however, they dropped by more than 15 per cent because of a reduction in the quantity of oil loaded and a rise in the amount of oil loaded at facilities where oil vapour is recovered. In 2002, emissions totalled 185 000 tonnes.

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

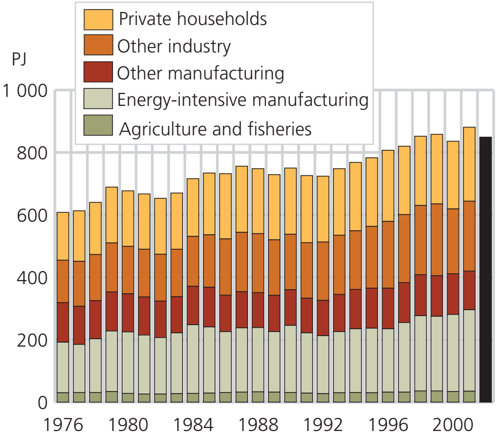
Emissions to air occur during the extraction, transport and use of oil and gas products. These can result in climate change, acidification, the formation of ground-level ozone and local air pollution (see Chapter 6: Air pollution and climate). Emissions to air from the energy sectors in 2001 are shown 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. Domestic energy use[1] by consumer group. 1976-2002*



[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 2002, Norway's total energy use (excluding international maritime transport) was 1 060 PJ, including 211 PJ in the energy sectors (see Appendix, tables B5 and B6).
- Consumption of energy commodities, excluding the energy sectors and international maritime transport, totalled 881 PJ in 2001 and 849 PJ in 2002 (preliminary figures).
- Energy use rose by an average of 1.5 per cent per year from 1976 to 2002. 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 1976-2001. Since these groups are dependent on cyclical changes, the rise has been uneven. Energy use by households has risen steadily, while energy use in agriculture and fisheries and in "other manufacturing" has remained almost unchanged.

Box 2.4. Welfare effects on households of a rise in electricity prices

In winter 2002-2003, there was a marked rise in electricity prices in Norway as a result of low precipitation and inflow into the reservoirs. Both politicians and the media expressed concern about the welfare effects of high electricity prices on low-income groups. This box presents an analysis of how the rise in electricity prices affects electricity expenditure and welfare for households in 10 different income groups.

In this analysis, the price of electricity was assumed to increase by NOK 0.20 per kWh including VAT from 2002 to 2003, for all households (Eika and Jørgensen 2003 and Halvorsen and Nesbakken 2003). Two different measures were used to estimate the effects on household welfare: i) the increase in electricity expenditure after a change in consumption and ii) the increase in household income necessary to maintain initial utility level after the price rise, that is the compensating variation. The analysis was based on data from Statistics Norway's survey of consumer expenditure.

Figure 1 shows that both the compensating variation and the rise in electricity expenditure increased with household income. This means that the welfare loss in monetary terms was greatest for high-income households, as measured both by higher electricity expenditure and by compensating variation. The compensating variation was higher than the increase in electricity expenditure, because the increase in income also had to compensate for the reduction in comfort due to reduced consumption.

Since a given rise in expenditure corresponds to a larger share of total household income for a low-income household than for one that is better off, both the compensating variation and the increase in electricity expenditure were calculated as a percentage of average income for each income group. Figure 2 shows that both the compensating variation and the rise in electricity expenditure expressed as percentages of household income decrease steadily with rising income. This indicates that even though high-income households generally experienced a larger increase in electricity expenditure, the increase had a more severe impact on the welfare of low-income households.

Figures 1 and 2 show mean values for each income group. However, electricity expenditure varied widely within each group. Even though there was a tendency for electricity expenditure to rise with income, figure 3 shows that electricity expenditure by some low-income households was high, while it was relatively low in some high-income households. For example, electricity consumption exceeded 25 000 kWh in 17 per cent of households in the lowest income group, even though mean electricity consumption for this group was 17 278 kWh a year. The increase in electricity prices resulted in a significant reduction in welfare for these households.

Read more in: Halvorsen, B. and R. Nesbakken (2002): *A conflict of interests in electricity taxation? A micro econometric analysis of household behaviour,* Discussion Papers No. 338, Statistics Norway.

Halvorsen, B. and R. Nesbakken (2003): *Hvem rammes av høye strømpriser? En fordelingsanalyse på mikrodata* (Who is affected by high electricity prices? A distributional analysis of microdata), Reports 2003/20, Statistics Norway.

Figure 1. Average welfare effects by income group of a rise in electricity prices. 2003 NOK

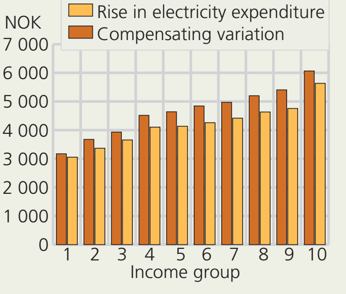


Figure 2. Average welfare effects by income group of a rise in electricity prices, per NOK of income. Percentages

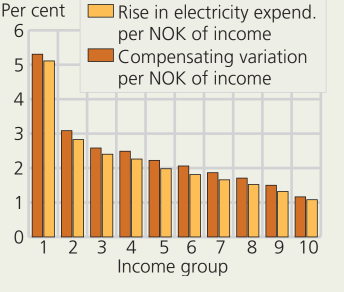
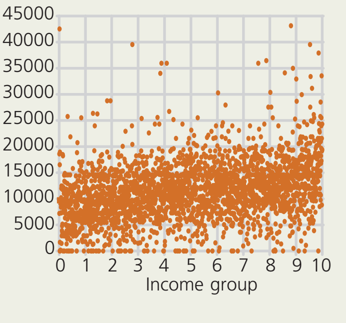


Figure 3. Household electricity expenditure by income group. 2003 NOK



Box 2.5. Profitability of a new electricity cable to the UK doubtful

Norway produces its electricity from hydropower, based largely on water stored in reservoirs (see figure 2.8), whereas electricity production in other European countries is based mainly on thermal power plants. In a hydropower-based system, it costs little to adjust production up or down at short notice, whereas this is expensive in a thermal power-based system. Since demand varies during the day, there are considerable price variations in a 24-hour period in countries with thermal power-based systems. These variations make it profitable to exchange power between countries: Norway can sell electricity during peak-load periods (day-time) and import during base-load periods (night-time and weekends).

In a year with normal inflow, Norway's current electricity generation system has too little production capacity to meet domestic consumption. The deficit must be made up through imports or by reservoir drawdown exceeding normal levels. The alternative would be for Norway to increase production capacity or reduce consumption.

The profitability of power exchange between countries depends primarily on investment costs and differences in electricity prices. Increasing transmission capacity between countries will result in smaller price differences.

Statistics Norway has drawn up projections for the power market up to the year 2020, including analyses of the social benefits of laying power cables to Germany and the UK and of bringing forward the construction of gas-fired power plants. The results, calculated as the present value in 2005, are shown in the table below.

Social benefits of various scenarios involving electricity cables to other countries and/or the development of gas-fired power plants, calculated on the basis of different assumptions concerning annual variations in water inflow. Present value in 2005, in million 2002 NOK

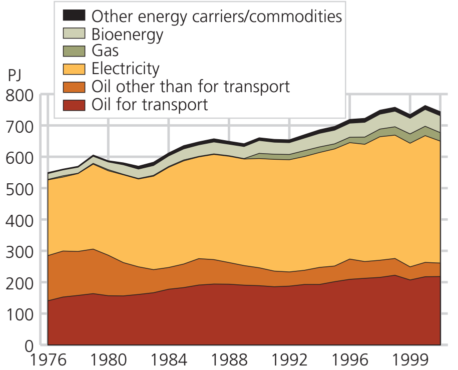
	Variations in inflow				
	Very small	Small	Medium	Large	Very large
KAB1 vs. REF	-3 923	-3 160	-2 425	-1 461	-247
KAB2 vs. REF	-7 715	-6 792	-5 864	-4 656	3 126
KAB3 vs. REF	-9 005	-7 869	-6 708	-5 208	-3 309
GASS1 vs. REF	43	415	913	1 657	2 679
GASS2 vs. REF	-156	202	731	1 1510	2 586
KAB3-B vs. REF-B	-7 721	-5 914	-3 762	-864	2 945

Abbreviations in left-hand column:
REF = Baseline scenario (expected developments): moderate development of gas-fired production capacity and CO_2 taxes from 2010
REF-B = Baseline scenario without gas-fired power plants and without CO_2 taxes from 2010
KAB1 = New 600 MW cable to Germany in 2005
KAB2 = Second new 600 MW to Germany in 2008
KAB3 = New 1200 MW cable to UK in 2005
KAB3-B = New 1200 MW cable to UK in 2005, no gas-fired power plants
GASS1 = 6 TWh gas-fired production capacity brought forward to 2005
GASS2 = A further 6 TWh gas-fired production capacity brought forward to 2008

The results suggest that investments in new cables are not very profitable, while bringing forward the construction of gas-fired power plants is more profitable. Both gas-fired power plants and new cables will have a restraining effect on prices in dry years. In wet years, the availability of electricity generated from gas will exert downward pressure on prices, while new cables will counteract any fall in prices. Laying a cable to the UK will be more profitable if no gas-fired power plants are built in Norway (scenario KAB3-B in the table). This is because the difference between prices in Norway and the UK will be larger without gas-fired power plants, particularly in very dry years in Norway. Profitability is also improved if there are large variations in actual precipitation (and thus inflow to the reservoirs) in Norway, because this results in greater fluctuations in price and thus larger differences between prices in the two countries. For the cable to give an acceptable level of profitability, the price difference between Norway and the UK needs to be almost NOK 0.10 per kWh (measured as the absolute values of the price differences in individual hours averaged over the whole year). However, Europe is becoming more and more integrated, and marginal power production in both Norway and the UK is increasingly based on natural gas from the same sources in the North Sea. This makes it difficult to envisage such a large average difference in electricity prices throughout the lifetime of a cable.

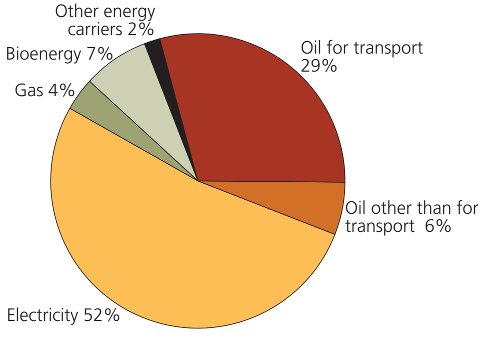
Based on: Aune, F. R. (2003): *Fremskrivninger for kraftmarkedet til 2020. Virkninger av utenlandskabler og fremskyndet gasskraftutbygging* (Projections for the electricity market up to 2020. Effects of transmission cables to other countries and of bringing forward the construction of gas-fired power plants), Reports 2003/11, Statistics Norway.

Figure 2.12. Energy[1] use by energy carrier. 1976-2002*



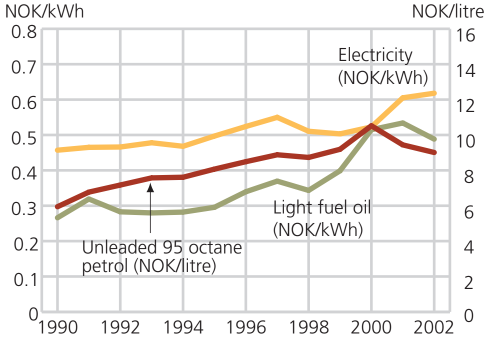
[1] Excluding energy carriers used as raw materials and in the energy sectors, and international maritime transport.
Source: Energy statistics, Statistics Norway and Norwegian Petroleum Industry Association.

Figure 2.13. Energy use by energy carrier. Percentages of total. 2002*



Sources: Energy statistics, Statistics Norway and Norwegian Petroleum Industry Association.

Figure 2.14. Price trends for electricity, petrol and fuel oil. 1990-2002. NOK per kWh and litre, current prices



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

Consumption by energy commodity

- Total oil consumption, excluding the energy sectors and international maritime transport, dropped by about 12 per cent in the period 1976–2002, despite a rise of 55 per cent in the consumption of oil for transport in the same period (see Appendix, table B5).

- Transport now accounts for almost 84 per cent of total oil consumption, as compared with 47 per cent in 1976. There has been a slight drop since 1999, due to a reduction in air traffic and maritime transport.
- Consumption of oil for stationary purposes had dropped to less than one third of the 1976 level by 1992. Since the mid-1990s, it has again shown a downward trend.
- Electricity consumption has risen from 241 PJ in 1976 to 389 PJ in 2002. This is a rise of more than 60 per cent, and the rise has been greatest for households and service industries, especially because there has been a changeover from oil to electricity for heating purposes. See Appendix, table B8.

Prices

- The listed prices of both heating kerosene and light fuel oil dropped from 2001 to 2002. This, combined with the substantial rise in electricity prices towards the end of 2002 (see box 2.8), resulted in a certain changeover from the use of electricity to kerosene and light fuel oil.
- Lower taxes have resulted in a drop in the price of petrol and autodiesel in the last couple of years.

Box 2.6. Various scenarios for a liberalised European gas market in 2010

A completely liberalised and deregulated European market for energy products in 2010 was simulated in this analysis. Several different scenarios were used for the overall supply of natural gas to the Western European market and possible effects on energy prices and natural gas trading patterns were analysed. The starting point was the ongoing efforts within the EU to ensure stable low prices and a reliable supply of gas through deregulation of the market. However, there are several elements of uncertainty as regards the gas supply in the medium term. Two of them are as follows:

1. In 2001, Russia exported a total of 74.2 billion m^3 (bcm) of natural gas to the EU, and will probably continue to be the most important supplier of gas to Europe for the foreseeable future. However, if the country is to maintain its leading position in the market and achieve its export goals, substantial investments will be needed in the improvement and development of Russian gas transport and production facilities. At the same time, stable political conditions are needed both within Russia and vis-à-vis important transit countries such as Ukraine, Belarus and, at a later date, Turkey.

2. The global supply of liquefied natural gas, LNG, has grown steeply in the past 10 years, partly as a result of large cost reductions and improvements in cooling technology, and a considerable drop in the price of new LNG vessels. A continuation of these trends is necessary if LNG is to be competitive in gas markets based on pipeline transport. This would open the way for gas from more distant regions such as the Middle East, Asia and western Africa. However, slow technological progress, political instability or a lack of investment by the multinational oil and gas companies could reduce the supply of LNG to the European market.

A numerical equilibrium model (LIBEMOD), see Aune et al. (2001), was used to simulate one scenario where the supply of both Russian gas and LNG was high, one where the supply from both sources was low, and two mid-range scenarios where the supply from one source was high and the supply from the other was low. The difference between the high-supply and low-supply scenarios was 64 bcm, which is about 12 per cent of the total market that was modelled for gas in 2010 in current EU member states. The production capacity for other gas supplied to the European market was kept constant in all the scenarios. However, the actual supply of gas from Norway, the UK and the Netherlands was determined using estimated supply curves, while Algeria was assumed to export pipeline gas up to the capacity limit.

In the high-supply scenario, the average price to the producer in purchasing countries was about USD 3.1 per Mbtu (million British thermal units) or USD 111.6 per thousand m^3. This was about 8 per cent lower than in the low-supply scenario. This drop in price was driven mainly by the fact that gas gradually outcompeted coal as the cheapest energy source for electricity production in many countries, and this resulted in greater price volatility than in a situation where coal set the floor price for gas for electricity production. The calculations also showed that there was generally little response to fluctuations in the price of gas in producer countries. Production in both Norway and the Netherlands remained more or less unchanged in the various scenarios, at around 100 and 70 bcm respectively. On the other hand, the UK, which has a higher cost profile, cut production more in response to a drop in price. The two mid-range scenarios resulted in very similar prices, but somewhat higher than in the high-supply scenario.

According to the model, the trading pattern for natural gas changed mainly in southern Europe, where Italy appeared to be the most important gas market in the future. In the high-supply scenario, both Russia and various producers of LNG channelled much of their new capacity to Italy, which meant that piped Algerian gas, in particular, went to the Spanish market at a lower price. From there, it was transported further northwards, with an increase in transit through Spain and France. Norway currently has excess capacity in its pipelines to the continent, particularly to Germany. This capacity will only be used if Norwegian exports rise, which in these scenarios meant that no new pipelines would be built from Norway to the UK before 2010. The large supplies of gas needed by the UK were thus met through imports of Algerian gas via Spain and France and Russian gas via Germany and Belgium in addition to imports of LNG.

Read more in: Aune, F.R., R. Golombek, S.A.C. Kittelsen and K.E. Rosendahl (2001): *Liberalising the Energy Markets of Western Europe – A Computable Equilibrium Model Approach,* Memorandum No. 14/2001, Department of Economics, University of Oslo.

Aune, F.R. and E.L. Sagen (2003): *Future Supply in a Liberalized European Natural Gas Market - A Numerical Model Approach,* to be published in the series Discussion Papers, Statistics Norway.

Box 2.7. Green certificates and learning effects

Many empirical studies show that production costs for new technologies tend to fall dramatically as cumulative production using the new technology rises. This relationship is often expressed in the form of learning or experience curves. For example, experience curves for wind power show that the price of wind power has dropped by 18 per cent for each doubling of cumulative production (IEA 2000). The hypothesis that it is cumulative production that results in the drop in costs, and not for example the number of years since production started, is based on the idea that only actual experience of production provides for learning that results in more efficient employees, more rational production techniques, product varieties that are simpler to produce, more highly-trained management, and so on.

At present, energy produced from new, greener sources cannot compete with energy from traditional sources such as coal- and gas-fired power plants. However, energy produced using green technologies is expected to become considerably cheaper in the future as cumulative production rises further. Many people therefore advocate support from the public authorities for the use of green energy technology as a way of speeding up the expected drop in costs. One form of support is the introduction of a green certificate scheme.

In a scheme of this kind, producers who generate electricity using green technologies receive green certificates for each unit of electricity generated. A market is then created for the certificates by requiring electricity distributors to buy certificates in proportion to their purchases of ordinary energy (alternatively, the requirement can apply to electricity generators). A producer of green energy is thus paid both for the energy generated and for the green certificate.

Do green certificates provide social benefits?
A green certificate scheme proves to be equivalent to a combination of a production subsidy for green electricity technologies and a tax on other sources of electricity (Bye et al. 2002).

It is difficult to justify a production subsidy for green energy purely on the grounds that the technologies involved have not yet advanced far along their experience curves, and that the costs of various types of green energy are highly likely to drop in future. As demonstrated by Spence (1984), a monopoly or an oligopoly may be profitable for the individual operator even if the technology follows an experience curve.

An experience curve functions as a barrier to market entry because new companies have to meet higher costs while in the start-up phase. It is possible for pioneer companies to survive negative results in the start-up phase because they can expect to make a profit at a later date as their costs drop. Pioneer companies will take this into account in pricing their products, and are thus able to move along the experience curve without any support from the public authorities. Even though a subsidy would speed up the price drop, the social benefits of doing this may be too small to justify the use of subsidies.

The situation is rather different if there are widespread spillover effects between companies, so that they do not take the effects of the experience curve into account when making decisions. The term spillover effects means that companies learn from each other, so that one company's productivity is influenced by what is happening in other companies. For example, experience gained in one company may be partly transferred to other companies, either because they observe each other's behaviour or because people move between companies (see Arrow 1962). This makes it difficult for pioneer companies to operate profitably even in the longer term, because other companies can make use of their experience and compete on equal terms with them at a later date. Stimulating production by means of a green certificate scheme will counteract this effect by making it cheaper for pioneer companies to become established. On the other hand, green certificate schemes may provide little stimulus for unknown and less mature green technologies. There is therefore a risk that very new technologies with a great deal of potential will be "locked-out" of the market unless certificate schemes are differentiated with respect to how novel the technology is or other forms of support are offered.

David (1997) discusses the risk of "lock-in" to the "wrong" type of technology in more depth. A well-know example of lock-in is the computer keyboards in use today. The arrangement of the letters was originally determined by the limitations of manual typewriter technology. The letters could later have been arranged in much more efficiently, but so many users have accumulated experience of the QWERTY lay-out that it is impossible for any one producer to succeed in introducing a more efficient keyboard arrangement.

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Green certificates – an imprecise policy instrument?

As mentioned above, green certificates are equivalent to a tax on electricity generated by conventional means (for example related to negative environmental effects) combined with a subsidy for green energy technologies (for example related to the spillover effect mentioned above). However, a green certificate scheme is a special case, because the sum of the tax revenues from ordinary electricity technologies and the expenditure on subsidising green energy technologies will always be exactly equal to zero. This is not a meaningful constraint. The tax on other energy sources should reflect their adverse environmental effects, and subsidies for green energy sources should reflect the positive spillover effects. Using a green certificate scheme reduces the number of policy instruments available from two to one in a situation where there are two possible and independent market imperfections to deal with.

Based on: Bye, T., M. Greaker and K.E. Rosendahl (2002): *Grønne sertifikater og læring* (Green energy certificates and learning), Reports 2002/27, Statistics Norway.

Box 2.8. Electricity prices still high in autumn 2003

In the third quarter 2003, the average electricity price for private households was NOK 0.271 per kWh, excluding taxes and the transmission charge. This is 70.5 per cent higher than in the third quarter 2002, but well under half the price in the first quarter 2003. Electricity prices have also been higher for service industries and the manufacturing sector.

The electricity price for households in the third quarter 2003 was the highest ever recorded for this quarter of the year. The average price of NOK 0.271 per kWh in the third quarter 2003, as compared with NOK 0.221 per kWh in the third quarter 2001. However, the price in the first quarter 2003 was NOK 0.624 per kWh. An important reason for the relatively high prices was that the degree of filling of the reservoirs was lower than normal for the time of year.

According to preliminary figures from the Norwegian Water Resources and Energy Directorate, the transmission charge for private households was NOK 0.238 per kWh in the third quarter 2003, excluding VAT. The price of the electricity itself varies considerably, but the transmission charge is normally much more stable. During the past year, the transmission charge has risen by NOK 0.019 per kWh excluding VAT. The total price of power, including the price of the electricity, the transmission charge and taxes, was NOK 0.73 per kWh in the third quarter 2003. This is a rise of 28.6 per cent from the third quarter 2002.

The quarterly statistics for electricity prices are based on information for a week in the middle of each quarter.

Read more in: Electricity statistics, Dagens Statistikk (Today's statistics) 1 October 2003: http://www.ssb.no/english/subjects/10/08/10/elkraftpris_en/

Figure 1. Electricity price, transmission charge and taxes for households. Fourth quarter 2002 to third quarter 2003. NOK/kWh

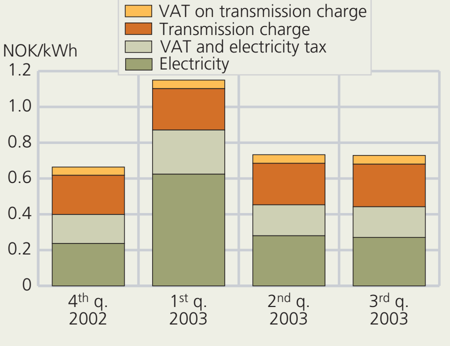
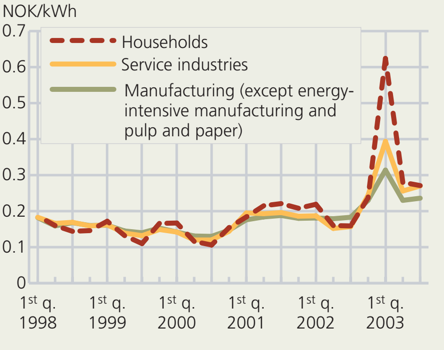


Figure 2. Average prices of electricity excluding taxes. All types of contracts. Fourth quarter 2002 to 3rd quarter 2003. NOK/kWh



More information: Lisbet Høgset, Trond Sandmo and Henning Høie.

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/
Norwegian Water Resources and Energy Directorate: http://www.nve.no/
Norwegian Petroleum Industry Association: http://www.np.no/
Ministry of Petroleum and Energy: http://www.odin.dep.no/oed/
Norwegian Petroleum Directorate: http://www.npd.no/
British Petroleum (World Energy Review):
International Energy Agency: http://www.iea.org/

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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 is declining, and when there have been major structural changes in farming. This has also affected the relationships 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 affected 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.

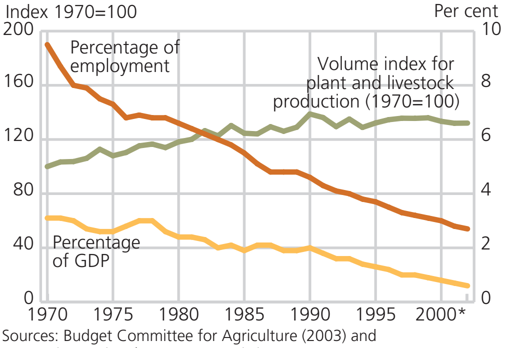
At the same time farming areas are also affected by outside environmental pressures such as pollution, including ozone and heavy metals, and pressures to convert farmland for development, resulting in conflicts over land use.

One of the most important objectives of farming is to safeguard the national food supply (Report No. 19 (1999-2000) to the Storting). Food production 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 farm products and thereby on human health, whether in the sense of the nutritional content of food, pesticide residues or animal diseases transmissible to humans, must also be taken into consideration in agricultural policy.

This chapter gives a brief summary of the economic importance of agriculture as an industry, followed by a closer look at the natural resource base (land resources) and activities in the agricultural sector that have an environmental impact in the form of changes in the landscape and emissions to water and air.

3.1. Main economic figures for agriculture

Figure 3.1. Trends in agricultural production volume (index 1970=100) and share of employment and GDP. 1970-2002*



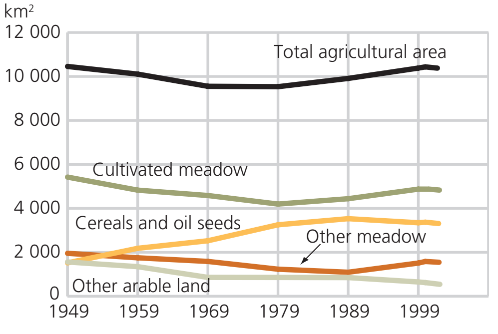
Sources: Budget Committee for Agriculture (2003) and Norwegian National Accounts, Statistics Norway.

Agriculture in an economic perspective

- From 1970 to 2002, employment fell by over 60 per cent (from over 140 000 to 53 600 normal full-time equivalents). In comparison, manufacturing employment fell by approximately 24 per cent.
- Agriculture's share of GDP fell from 3.1 to 0.6 per cent. In comparison, manufacturing declined from 19 to 9 per cent.
- Agricultural production has increased by about 32 per cent (Budget Committee for Agriculture 2003). However, production volume has not increased since 1990.

3.2. Land resources

Figure 3.2. Agricultural area in use. 1949-2002*

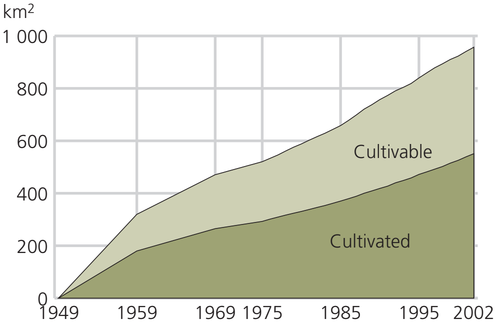


Source: Agricultural statistics, Statistics Norway.

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 increase in agricultural area over the last few years consists of surface cultivated meadow and fertilized pasture. This is 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]. 1949-2002*



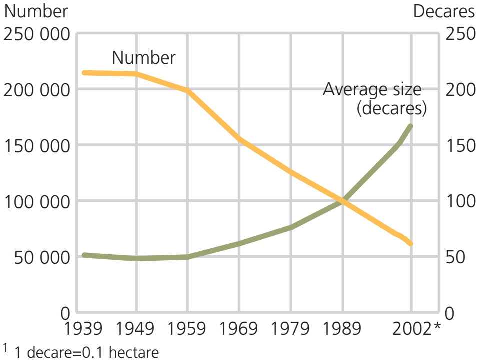
[1] For the period 1949-1975 data is only available for cultivated areas that were converted. The area of cultivable land converted in this period has been estimated on the basis of the ratio between cultivable and cultivated land converted 1976-1997.
Source: Agricultural censuses, Statistics Norway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

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 957 km², or about 4.9 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 grants ceased to apply 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 (decares[1]). 1939-2002*

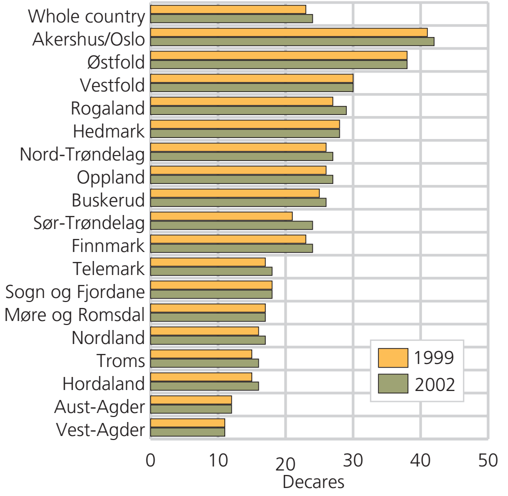


[1] 1 decare=0.1 hectare
Source: Agricultural Censuses, Statistics Norway.

Holdings - number and size

- The number of holdings in Norway has been reduced to nearly a third since 1960; this is equivalent to a loss of 9 holdings a day. Figures for the last 2-3 years indicate a rising rate of farm closures.
- The average size has more than tripled, 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 2001, 33 per cent of agricultural area in use was rented, an increase of 2 percentage points since 1999.

Figure 3.5. Average size of fields by county. 1999 and 2002

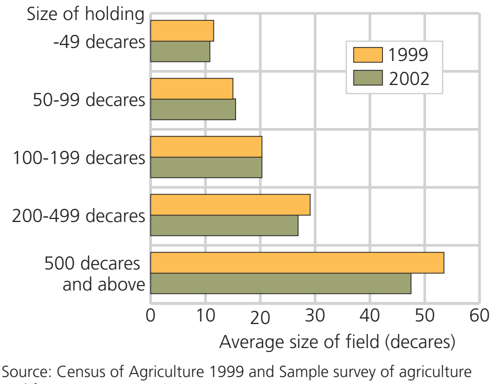


Source: Census of Agricultural 1999 and Sample survey of agriculture and forestry, 2002, Statistics Norway.

Field size

- On average, the counties around the Oslofjord have the largest fields, giving a more open agricultural landscape. In Akershus and Oslo, fields are on average almost 4 times larger than in the Agder counties, which on average have the smallest fields. In hilly areas such as Agder in southern Norway, most of western Norway and northern Norway, the size of fields is naturally delimited by the terrain.

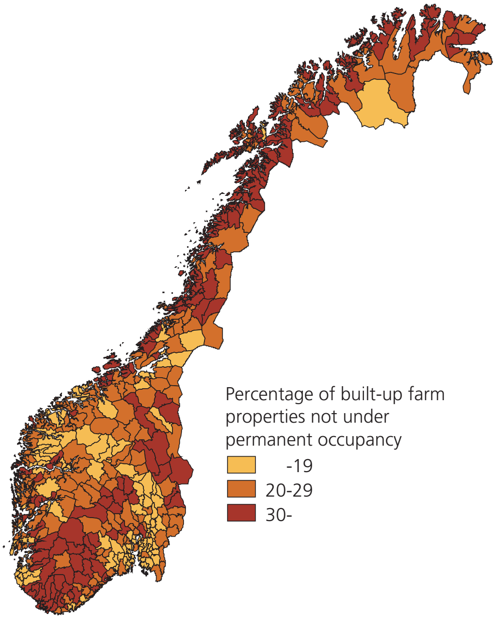
Figure 3.6. Average size of fields by size of holding. 1999 and 2002



Source: Census of Agriculture 1999 and Sample survey of agriculture and forestry, 2002, Statistics Norway.

- There is a clear connection between holding size and field size. The larger the holding, the larger the average field size. However, from 1999 up until 2002 a decrease was recorded in the average field size of holdings with at least 200 decares of agricultural land in use. A possible explanation is that the number of holdings in this size group is increasing, and that the increase in area is from rented land on smaller holdings, which have relatively small fields.
- For holdings in general, a modest increase in field size has been recorded. The decrease in average field size on the largest holdings is more than counterbalanced by closures among the smallest holdings.

Figure 3.7. Percentage of farm properties not under permanent occupancy. Municipalities. 2000



Source: Andersen et al. (2002).
Mapping data: Norwegian Mapping Authority.

Agricultural buildings and settlement

- There are buildings such as farmhouses, other farm buildings etc. on almost all the holdings. In 2000, there were a total of 547 000 buildings on holdings in operation, of which 23 percent were dwellings, 47 per cent farm buildings and 30 per cent other buildings, including unspecified buildings. About 21 per cent of the buildings were registered in the SEFRAK register, i.e. mainly built before 1900.
- In addition to the above buildings, there are buildings on farm properties no longer in operation as independent farms. In 2000, a total of 567 000 buildings were registered on these properties. In total, there are over 1 million buildings on farm properties in Norway.
- 11 per cent of holdings were not under permanent occupancy. For farm properties that were not in operation as independent farms and that included buildings, the corresponding percentage was 35.

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 (specialization at holding level)
- Production of important products is concentrated to a greater extent in certain regions (specialization 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, including buildings, which are an important part of Norway's cultural heritage.

Increased size of 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 will reduce the length of ecotones and result in less variation in the landscape within a given area. This will reduce biological diversity and give 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. 2001*

	Emissions from agriculture. 1 000 tonnes	Percentage of total emissions in Norway
Greenhouse gases	5 540[1]	10[1]
Carbon dioxide (CO_2)	563.3	1.4
Nitrous oxide (N_2O)	9.4	52
Methane (CH_4)	98.4	30
Acidifying substances	1.5[2]	21[2]
Ammonia (NH_3)	22.4	91
NO_X	6.1	3
SO_2	0.2	1

[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): use of commercial fertilizer and manure, livestock, biological nitrogen fixation, decomposition of plant material, cultivation of mires, deposition of ammonia and runoff. 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 fertilizer 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). Agriculture accounts for about 45 and 55 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 fertilizer 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.

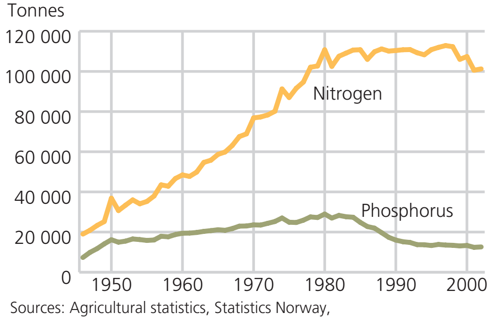
Farming also makes a substantial contribution to emissions to air, in the form of ammonia (NH_3) and greenhouse gases such as methane (CH_4) and nitrous oxide (N_2O) (see Appendix, tables F3-F5). Emissions of ammonia result in acid rain, while methane and nitrous oxide are greenhouse gases (see also Chapter 6). No measures have as yet been implemented to reduce emissions to air. The use of pesticides in farming also results in emissions of hazardous substances.

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 3.8. Sales of nitrogen and phosphorus in commercial fertilizers. 1946-2002

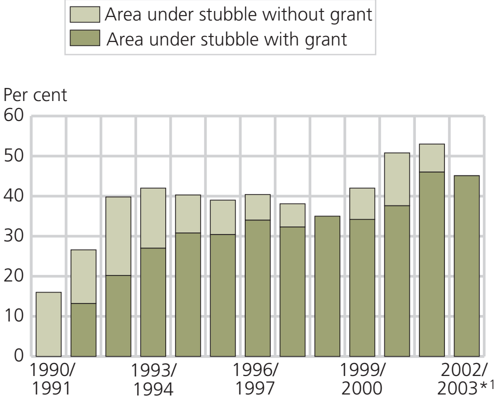


Sources: Agricultural statistics, Statistics Norway, and Norwegian Agricultural Inspection Service.

Application of commercial fertilizer

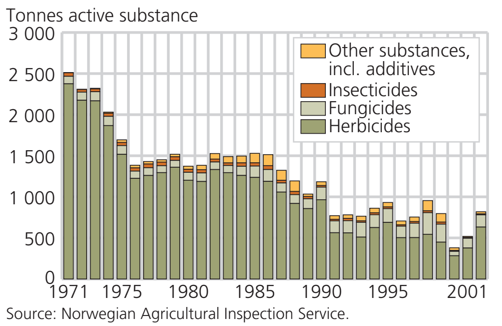
- Heavy application of fertilizer results as a rule in poor utilization of the nutrients and may therefore increase pollution in lakes and rivers. The amount of fertilizer applied is therefore increasingly determined on the basis of soil samples and recommended standards. As of 1998 a fertilization plan on holdings that apply for production grants is mandatory.
- Since the early 1980s, the use of phosphorus fertilizer has been halved. The use of nitrogen fertilizer has been reduced by 10 per cent since 1998.

Figure 3.9. Proportion of cereal acreage left under stubble[1] in autumn. 1990/1991-2002/2003*



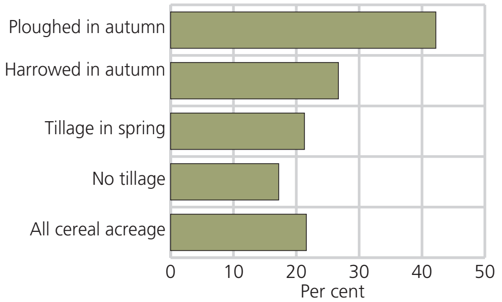
[1] Total area under stubble not recorded in 1998/99 and 2002/03.
Source: Agricultural statistics, Statistics Norway, and Ministry of Agriculture.

Figure 3.10.Sales of chemical plant protection products, measured in tonnes of active substance. 1971-2002



Source: Norwegian Agricultural Inspection Service.

Figure 3.11. Percentage of cereal acreage sprayed for couch grass after various forms of soil management. Average for the period 1992/93-2001/2002*



Source: Result Control Agriculture, Statistics Norway.

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. Then the area remained at about this level until 2000, but has since increased to 53 per cent.
- The same trend has been evident for the proportion of the area under stubble for which support is granted. The increase in 2000/01 and 2001/02 may perhaps have been caused by weather conditions, which provided fewer opportunities for tillage.

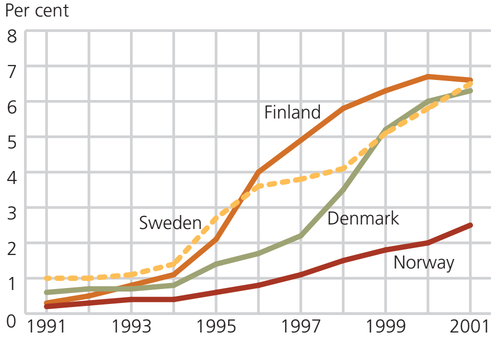
Use of plant protection products

- Sales trends over the last three years must be seen in the context of an increase in taxes on plant production products in 2000. This probably meant that stocks were built up before the year 2000, and that these stocks were subsequently used.
- In 2002, 632 tonnes of herbicides, 149 tonnes of fungicides, 11 tonnes of insecticides and 27 tonnes of other substances including additives were sold.

- There is a clear relationship between the soil management regime and spraying against perennial weeds. The more tillage of the soil is reduced or postponed, the larger the proportion of the area that is sprayed.
- With current agricultural practice, the environmental cost of reducing soil loss by limiting tillage is greater use of pesticides.

3.5. Ecological farming

Figure 3.12. Areas farmed ecologically or in the process of conversion in the Nordic countries. Percentage of total agricultural area. 1991-2001



Sources: Debio (Norway), KRAV (Sweden), Statistics Denmark (Denmark), KTTK 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 about 2.5 per cent, 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 shall be ecologically farmed by 2009.

Box 3.4. Ecological farming

Ecological farming is a collective term for various farming systems based on some common principles:

- No use of commercial fertilizer 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 the organization 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 and Ole Rognstad.

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/
Norwegian Agricultural Economics Research Institute: http://www.nilf.no/
Norwegian Crop Research Institute: http://www.planteforsk.no/
Norwegian Agricultural Inspection Service: http://www.landbrukstilsynet.no/
Norwegian Agricultural Authority: http://www.slf.dep.no/
Debio: http://www.debio.no/
Centre for Soil and Environmental Research: http://www.jordforsk.no/
Norwegian Institute for Land Inventory: http://www.nijos.no/

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Budget Committee for Agriculture (2003): *Volum- og prisindekser for jordbruket. Regnskapsåra 1959-2002* (Volume and price indices for agriculture. Accounting years 1959-2002). Norwegian Agricultural Economics Research Institute.

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

4. Forest and uncultivated land

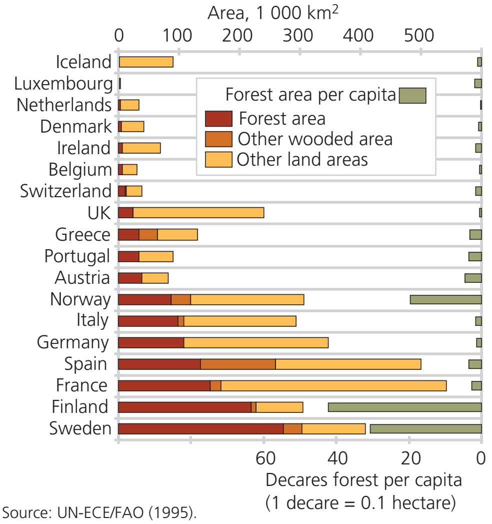
The Norwegian forest contains a wide variety of resources and environmental qualities. In terms of the economy, forests are primarily important as a source of raw materials for the sawmilling and pulp and paper industries. The forest, with its biological diversity, also has considerable intrinsic value 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 wood capital has resulted in an annual uptake of CO_2 by forest that is equivalent to about 45 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 for 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 forest 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.

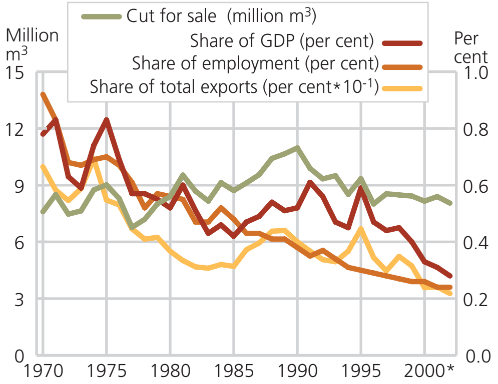
An estimated 22 000 plant and animal species are associated with forest in Norway, and about 900 of these are rare or endangered (Directorate for Nature Management 1997). Norway has ratified the Convention on Biological Diversity, which was adopted by the UN Conference on Environment and Development in 1992, and is therefore required to take steps to identify and monitor its biological diversity.

At the end of 2002, a total of 2 292 km² of forest in Norway was protected, of which 751 km² was productive forest. Included in this figure is 570 km² of productive coniferous forest or about 1 per cent of the total productive coniferous area. In addition, some broad-leaved and mixed forest is protected, and some forest areas will naturally be included in new national parks because of their location (Directorate for Nature Management 2003). The increase in protected forest area since 2001 has been 4 per cent for total forest and 12 per cent for productive forest.

By way of comparison, 3.6 per cent of the total area of productive forest in Sweden was protected in 1996. The corresponding figure for Finland was 4.1 per cent in 2002 (National Board of Forestry, Sweden 2000 and METLA 2002).

4.2. Forestry

Figure 4.2. Forestry: share of employment and GDP. Annual roundwood removals. 1970-2002*

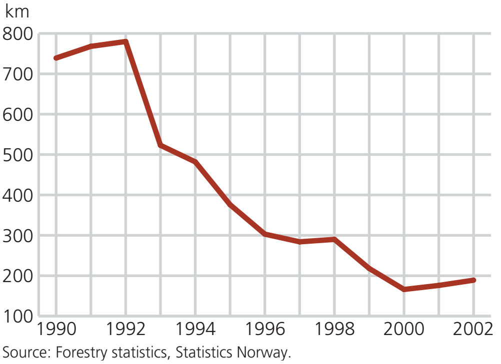


Sources: National accounts and forestry statistics, Statistics Norway.

Roundwood removals and economic importance

- In 2002, forestry's share of total employment was 0.24 per cent. This is equivalent to 4 700 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 2002. Forestry's share of GDP has declined less sharply than that of agriculture.
- The gross value of the roundwood removed for commercial purposes in 2002 was NOK 2.2 billion, and wood and wood processing products worth NOK 13.7 billion were exported from Norway.

Figure 4.3. Annual construction of new forest roads for year-round use. 1990-2002



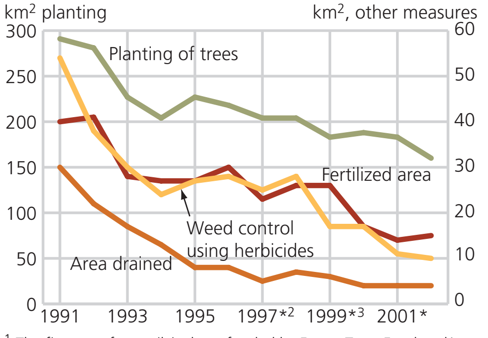
Source: Forestry statistics, Statistics Norway.

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 768 km forest roads for year-round use in 1991 to 189 km in 2002.
- A total of NOK 185 million was invested in forest roads in 2002, and NOK 69 million of this was in the form of public grants.

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. 1991-2002*



[1] The figures refer to silviculture funded by 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 all projects receiving public funding since the beginning of the 1990s. The planting of trees is the largest single silviculture investment. A total of NOK 121 million was invested in planting in 2002, and 160 km² 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 and reductions in grants.
- The county of Nord-Trøndelag accounted for 60 per cent of all forest drainage in 2002.

Box 4.2. Registration of biodiversity in forests

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 registration 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) 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 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 two seasons about 12 million decares had been registered. An annual government grant in the region of NOK 30-40 million is provided for forestry planning.

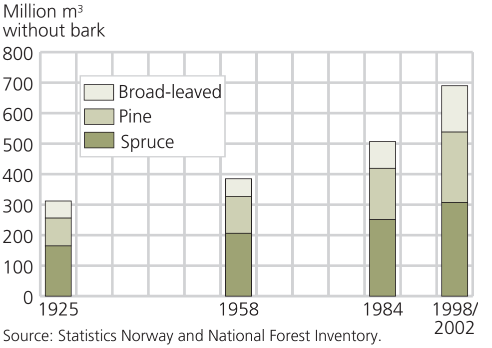
A booklet is available describing the registration method and courses have been held for forestry planners and other users.

The registration is based on identifying the areas of most importance for biodiversity and obtaining qualitative information at population level for species that are not concentrated in specific areas. Localities are identified using 12 defined environmental elements, such as the quantity of dead wood on the ground or the number of old trees. These environmental elements are also classified into 29 different habitats on the basis of nutrient status and moisture. The localities are ranked in relation to each other, with the most important qualifying for possible action. The methodology is being continuously improved.

The work carried out under the project can be expected to provide new knowledge that will be of value to the forestry industry in the environmental adjustments made in compliance with government policy and in relation to the Living Forests Standards. The project's work is also relevant to the development of a national programme to survey and monitor biological diversity (Ministry of Agriculture 2003).

4.3. Increment and uptake of CO_2 by forest

Figure 4.5. Volume of the growing stock. 1925, 1958, 1984 and 1998/2002

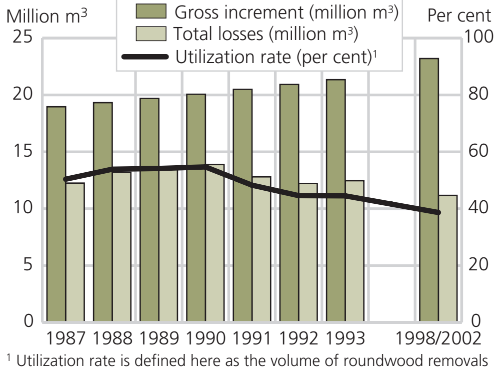


Source: Statistics Norway and National Forest Inventory.

Total growing stock

- Data from inventories carried out by the Norwegian Institute for Land Inventory and calculations carried out by Statistics Norway show that in the period 1998/2002 the volume of the growing stock in Norway was 689 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]. 1987-1998/2002



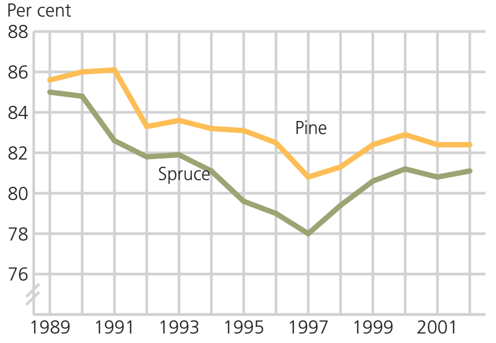
[1] Utilization rate is defined here as the volume of roundwood removals in relation to gross increment.
Source: Forestry statistics, Statistics Norway.

Increment and utilization rate of the growing stock

- In 2001, the net increment (annual increment minus roundwood removals and calculated natural losses) in the growing stock was 12.4 million m^3, or 1.8 per cent of the total volume (see Appendix, table D1).
- The increase in the biomass (branches and roots included) of forests in 2001 resulted in an uptake of CO_2 by forest that corresponded to about 45 per cent of the total anthropogenic CO_2 emissions in Norway.

4.4. Forest damage

Figure 4.7. Mean crown condition for spruce and pine. 1989-2002



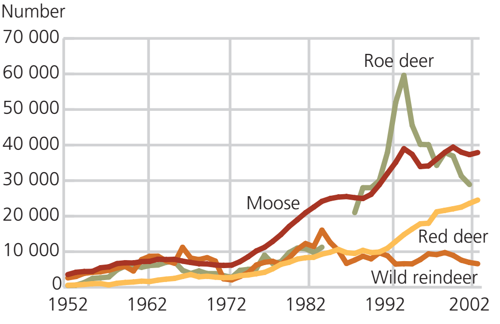
Source: Norwegian Institute for Land Inventory (2003).

Forest damage in Norway

- Crown condition is an indicator of the forest's state of health. The crown condition for both spruce and pine improved in the period from 1997 to 2000.
- A slight decline was recorded for both species in 2001. In 2002 there was a small increase for spruce, and no change for pine. Mean crown condition for spruce was 81.1 per cent and 82.4 per cent for pine.
- The crown colour of both spruce and pine was greener in 2002 compared with the year before. An increase in discolouring was recorded for birch.

4.5. Game species

Figure 4.8. Number of moose, red deer, wild reindeer and roe deer killed. 1952-2002

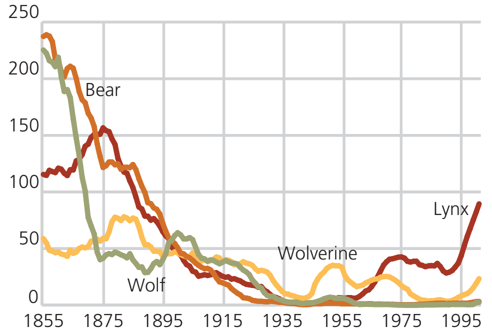


Source: Hunting statistics, Statistics Norway.

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 2001 was 4 932 tonnes of moose meat, 1 378 tonnes of venison and 230 tonnes of wild reindeer meat (see also Appendix, table D3).

Figure 4.9. . Number[1] of predators killed. 1885-2001



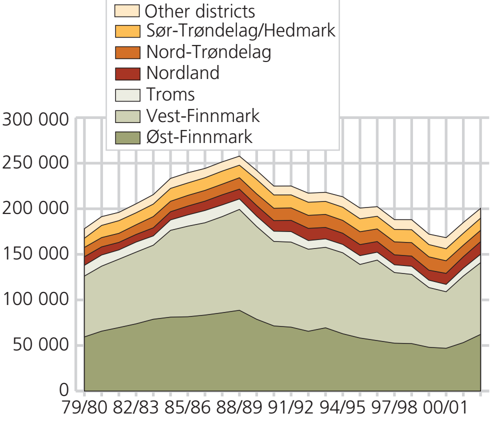
[1] Average number past ten years.
Source: Hunting statistics, Statistics Norway

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).

4.6. Reindeer husbandry

Figure 4.10. Trends in the size of the spring herd. 1979/80-2002/03*

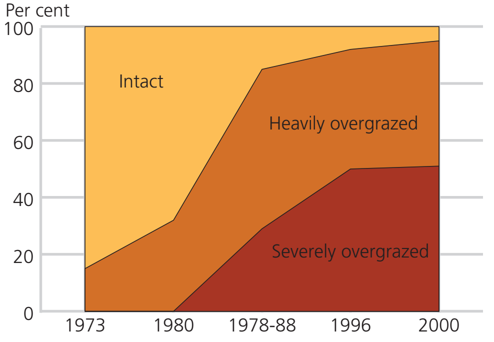


Source: Norwegian Reindeer Husbandry Association.

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 two 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. Approval of applications for motor traffic in uncultivated areas, according to number of applications in municipality. 2002. Per cent

Number of applications processed by municipality	Number of munici-palities	Share ap-proved	Share of area in these munici-palities	Share of pop. in these munici-palities
All applications				
whole country	434	93	100	100
300-1140	14	94	15	2
100-299	23	95	12	4
50-99	19	98	8	2
20-49	56	91	17	7
5-19	85	84	21	22
1-4	93	83	11	19
None	101	.	9	38
No response	43	.	7	6

Source: Statistics Norway 2003.

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, 93 per cent of all applications for exemption were granted in 2002. The number of applications processed was unevenly distributed among the municipalities, but this had little effect on the share of exemptions granted.
- See also Chapter 9, Land use, where municipal land use management and building activity in the coastal zone (100-metre belt) is described.

More information: Ketil Flugsrud (forest balance), Astri Kløvstad (forest and game), Svein Homstvedt (reindeer), and Henning Høie (management of uncultivated areas).

Useful websites

Directorate for Nature Management: http://english.dirnat.no/
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/
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/
The Living Forests Project: http://www.levendeskog.no/Engelsk_Default.asp

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UN/ECE-EC (2000): *Forest Condition in Europe. 1999 Executive Report, Federal Research Centre for Forestry and Forest Products*, United Nations/Economic Commission for Europe and the European Commission.

UN-ECE/FAO (1995): *Forest Resource Assessment 1990*. Rome: Global synthesis, United Nations Economic Commission for Europe / Food and Agriculture Organization of the United Nations.

5. Fisheries, sealing, whaling and fish farming

The fisheries are based on conditionally renewable natural resources. Sound management of fish stocks is therefore of crucial importance for a high, stable long-term yield. Stocks of several important fish species in the North Sea are now low. This is particularly the case for stocks of demersal species such as cod and whiting. In the Norwegian and Barents Seas, the situation is less uniform. The capelin stock has continued to drop since last year. The spawning stock of Norwegian spring-spawning herring is now at a relatively high level. The spawning stock of Northeast Arctic cod has increased in the past year, and is now considered to be within safe biological limits.

In its report *Marine Resources 2003* (Michalsen 2003), the Institute of Marine Research states that there is still a need to exercise considerable caution in the harvesting of a number of Norway's important fish species. This particularly applies to demersal species, while the pelagic stocks are in a better state.

The same report refers to three basic principles that must be followed to ensure that catches remain high and as stable as possible despite substantial natural fluctuations in fish stocks:

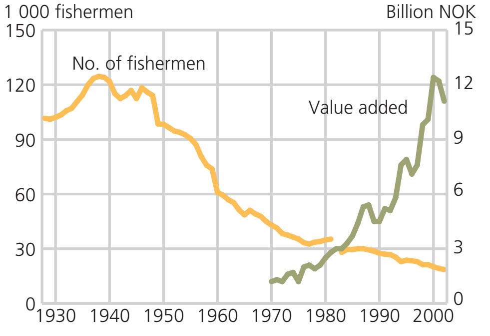
- Spawning stocks must be sufficiently large to safeguard future recruitment.
- The natural growth of individual fish must be exploited.
- Buffer stocks must be established that can be fished in years when recruitment is low, i.e. some extra "capital" should be set aside.

The fisheries and fish farming industry is one of Norway's key export industries and is very important to commercial activity and settlement along the coast. The value of Norwegian exports of fish and fish products continued to fall in 2002, even though the volume of exports increased. This applied both to traditional fish and fish products and to farmed fish.

The total world catch from marine fisheries was 86 million tonnes in 2000. According to the FAO, about 47 per cent of major fish stocks for which data is available are fully exploited, while 18 per cent are overexploited. It is estimated that 10 per cent of the fish stocks have been substantially depleted. The remaining 25 per cent are regarded as moderately exploited or underexploited, and this is where there is a potential for the expansion of marine fisheries.

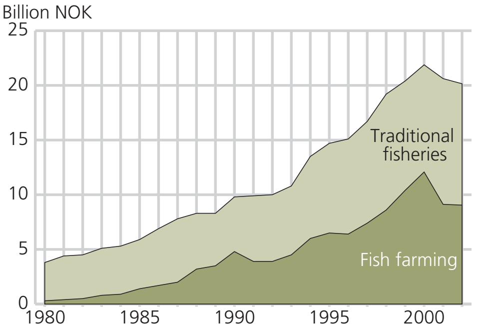
5.1. Principal economic figures for the fisheries

Figure 5.1. Value added in the fishing, sealing and whaling industry 1970-2002, and number of fishermen 1926-2002



Source: Directorate of Fisheries and National Accounts, Statistics Norway.

Figure 5.2. First-hand values in traditional fisheries and fish farming. 1980-2002



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

GDP and employment

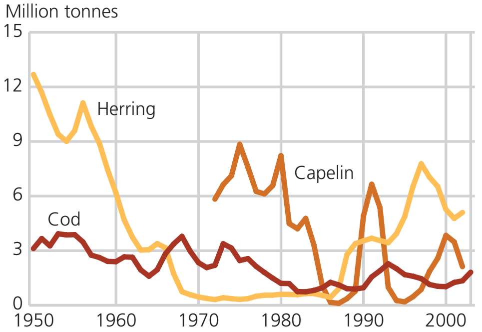
- According to the Norwegian National Accounts, fishing, sealing, whaling and fish farming contributed NOK 11.0 billion, or 0.7 per cent, to Norway's gross domestic product (GDP) in 2002.
- The fishing industry accounted for 0.7 per cent of total employment in 2002. At the end of 2002, 18 648 fishermen were registered in Norway. The number of fishermen has dropped by about 85 per cent since the late 1930s. The fish farming industry employs about 4 000 people.

Production and prices

- After a year of approximately zero growth from 2000 to 2001, total production in the fishing, sealing, whaling and fish farming industries has picked up. Production in 2002 was close to 10 per cent higher than in the previous year (Statistics Norway 2003a).
- Overall, prices fell somewhat more than production rose, resulting in a decline in the value of production. Prices fell in both the traditional fisheries and the fish farming industry.
- In 2002, the first-hand value of catches in the traditional fisheries declined by 3 per cent, whereas it fell by about 1 per cent in the fish farming industry (salmon and trout).

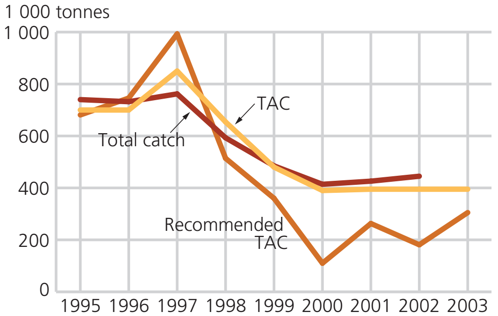
5.2. Trends in stocks

Figure 5.3. Trends for stocks of Northeast Arctic cod[1], Norwegian spring-spawning herring[2] and Barents Sea capelin[3]. 1950-2003



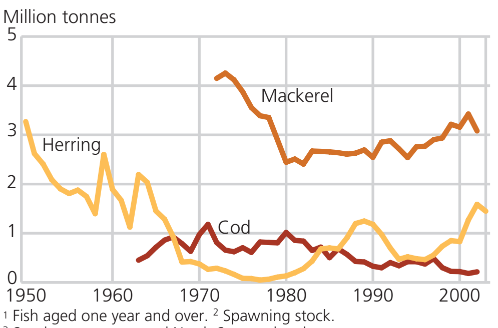
[1] Fish aged three years and over. [2] Spawning stock.
[3] Fish aged one year and over.
Sources: The International Council for the Exploration of the Sea (ICES) and the Institute of Marine Research, Bergen.

Figure 5.4. Recommended TACs, TACs actually set and catches of Northeast Arctic cod. 1995-2003



Source: 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]. 1950-2003



[1] Fish aged one year and over. [2] Spawning stock.
[3] Southern, western and North Sea mackerel.
Sources: The International Council for the Exploration of the Sea (ICES) and the Institute of Marine Research, Bergen.

Barents Sea-Norwegian Sea

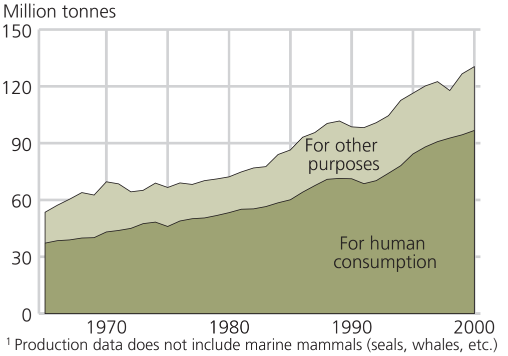
- The spawning stock of Norwegian spring-spawning herring in 2002 is estimated to be over 5 million tonnes. Even though the stock is still within safe biological limits, it has declined considerably from the high level in 1997.
- The total stock of capelin in the Barents Sea in autumn 2002 was estimated to be 2.1 million tonnes. This clear decline is a result of weaker recruitment and lower mean weights for some year classes.
- The total stock of Northeast Arctic cod was estimated to be a little over 1.8 million tonnes in 2003, about 200 000 tonnes higher than the year before.
- Since 1998, the TAC (total allowable catch) for Northeast Arctic cod has been considerably higher than the level recommended by marine scientists. The recorded catches correspond fairly closely to the TACs.
- The Norwegian-Russian Fisheries Commission has set an annual TAC of 395 000 tonnes for three years from 2001.
- The quota for 2003 is 90 000 tonnes higher than the level recommended by ICES.

North Sea

- In recent years, the North Sea herring stock has developed satisfactorily. The spawning stock in 2003 was calculated to be about 1.4 million tonnes.
- The cod stock is still low. The total stock is calculated to be about 200 000 tonnes.
- The total spawning stock of mackerel has developed satisfactorily in recent years. It is now estimated to be over 3 million tonnes.

5.3. Fisheries

Figure 5.6. World fisheries production[1], by main uses. 1965-2000



[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 130 million tonnes in 2000.
- The proportion used for human consumption in 2000 was 74 per cent. Table 5.1 shows production split by type.
- The species with the highest catch figures in 2000 was Peruvian anchovy (*Engraulis ringens*) at 11.3 million tonnes.

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, it is considered to be outside safe biological limits, and 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 2001. The reference points for Northeast Arctic cod were revised this year, and the table shows the new values.

Stock	B_{lim} (critical reference point) 1 000 tonnes	B_{pa} (precautionary reference point) 1 000 tonnes	Estimated spawning stock 2002 1 000 tonnes
Northeast Arctic cod	220	460	505
Northeast Arctic saithe	89	150	447
Norwegian spring-spawning herring	2 500	5 000	5 098
North Sea herring	800	1 300	1 590
North Sea cod	70	150	38
North Sea saithe	106	200	298
Whiting	225	315	210[1]
Mackerel (total stock)	No biological basis for definition of limit	2 300	3 080

[1] Whiting in North Sea; spawning stock in 2001.
Source: Institute of Marine Research and ICES.

Table 5.1. World fisheries production. 2000

	1 000 tonnes	Per cent
Total production	130 434	100
Marine fisheries	86 048	66.0
Freshwater fisheries	8 801	6.7
Aquaculture (fish, crustaceans, etc.) in marine waters	14 954	11.5
Aquaculture (fish, crustaceans, etc.) in inland waters	20 632	15.8

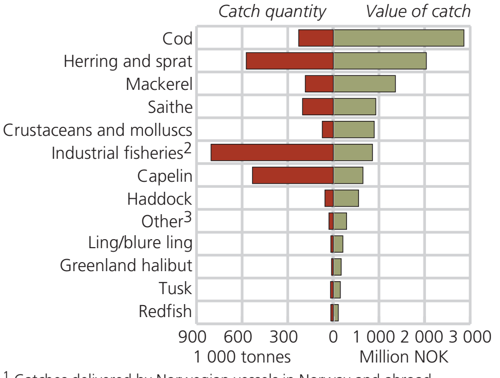
Sources: FAO (2002a, 2002b, 2002c).

Box 5.2. More about stock trends

- In 2003, the stock of Norwegian spring-spawning herring was somewhat above the precautionary level defined by marine scientists. The stock is well above the critical level of 2.5 million tonnes. Recruitment from the 1998 year class contributed to an increase in the spawning stock in 2003.
- The decline in the total stock of Barents Sea capelin from 2001 to 2002 is due to weak recruitment and a lower mean weight in some age groups. How long the stock will continue to decline depends on recruitment in 2003 and on growth and survival rates in all the age groups. The development of the stock seems to be somewhat uncertain.
- The spawning stock of Northeast Arctic cod - around 650 000 tonnes in 2003 - is now well above the precautionary level. One important reason for the increase in spawning biomass after 2002 is earlier maturation. The future development of the stock will depend not only on catches in the fisheries, but also on interactions between the key species herring, capelin and cod in the ecosystem in the Barents Sea and on conditions in the marine environment. Since the Barents Sea capelin stock has been reasonably strong in recent years, cod cannibalism has declined sharply.
- The stock of coastal cod is declining. The size of the stock has dropped from 297 000 tonnes in 1994 to 90 000 tonnes in 2002. Unless harvesting is reduced considerably over the next few years, the total stock and the spawning stock are both expected to decline further.
- After remaining at a low level for many years, the stock of North Sea herring rose steadily from 1980 onwards. However, from 1990 to 1996, the spawning stock dropped to considerably less than the 800 000 tonnes that is regarded as the critical level for this stock. The poor state of the stock in 1990s was a result of years of overfishing. There have been positive developments in recent years due to higher recruitment and strict management. The current spawning stock is well above the precautionary level.
- Several of the stocks of demersal fish in the North Sea have remained low for many years. However, more recently the saithe and haddock stocks have shown a positive trend. The cod stock in the North Sea has been heavily fished, and the spawning stock is about 40 000 tonnes, which is an all-time low. The spawning stock of whiting is also outside safe biological limits. The Advisory Committee for Fisheries Management (ACFM) has recommended closure of the cod fishery. Since the cod fishery is multi-species, including haddock and whiting, the ICES has also recommended closure of the haddock and whiting fisheries.
- 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 one stock (North East 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. Both the southern and western components are currently at a high level. On the other hand, the level of the North Sea component, the smallest of the three, is still low, although for the first time for 25 years there are signs of growth.

Source: *Marine Resources 2003* (Michalsen 2003). See also Box 5.1 and Appendix, table E1.

Figure 5.7. Norwegian catches[1], by groups of fish species, molluscs and crustaceans. 2002



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

Norwegian catches

- In 2002 the total catch in Norwegian fisheries (including crustaceans, molluscs and seaweed) was 2.92 million tonnes, and the value of the catch was NOK 11.1 billion. The total catch was about 60 000 tonnes higher than in 2001, but the value was about NOK 350 million 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 2002. The catch of blue whiting totalled 558 000 tonnes.

Box 5.3. World catches and Norwegian catches

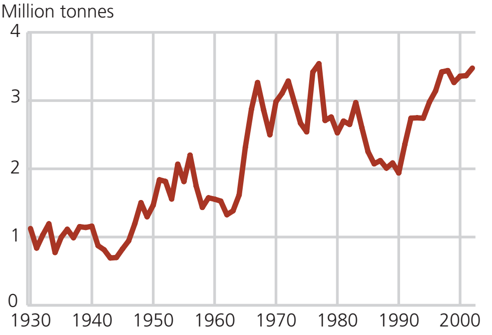
Catches in the world's marine fisheries rose by 1.3 million tonnes (1.6 per cent) from 1999 to 2000, while inland fisheries rose by about 300 000 tonnes (3.6 per cent). The rise in the yield from marine fisheries is explained by the fact that several stocks in the Southeast Pacific have increased again after being affected by the atmospheric phenomenon El Niño in 1997-1998. Total landings of anchoveta and Chilean jack mackerel rose from 3.8 million tonnes in 1998 to 12.8 million tonnes in 2000. In 2000, catches of these two species corresponded to almost 5 times the total catch in Norwegian fisheries. There were no dramatic changes in catches in other marine areas. According to FAO (2003) 47 per cent of major fish stocks for which data is available are fully exploited, while 18 per cent are overexploited. It is estimated that 10 per cent of the fish stocks have been depleted or are recovering from depletion. World aquaculture production (excluding plants) rose by about 2 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 2.7 million tonnes in 2000. At the head of the list are China (17.0 million tonnes), Peru (10.7 million tonnes), Japan (5.0 million tonnes), the USA (4.7 million tonnes) and Chile (4.3 million tonnes). See also Appendix, tables E7 and E8. According to the FAO yearbook of fisheries statistics (FAO 2002b), 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 was about the same in 2002 as the year before. The value of the catch dropped by about NOK 200 million to NOK 2.0 billion. The catch of cod was about 20 000 tonnes higher than in 2001, while the value of the catch dropped by about NOK 40 million to below NOK 2.9 billion. The mackerel catch rose by about 4 000 tonnes and its value was NOK 1.4 billion. The catch of capelin rose from 483 000 tonnes to 532 000 tonnes with a value of NOK 650 million. The shrimp catch was 67 000 tonnes and its value was NOK 790 million.

See also figure 5.8 and Appendix, table E2.

Figure 5.8. Total production[1] in Norwegian fisheries. 1930-2002

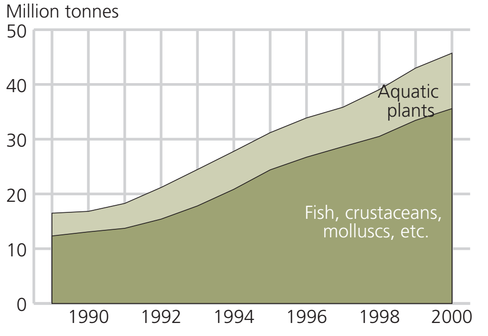


[1] Fish farming production is included.
Sources: Directorate of Fisheries and fisheries statistics, Statistics Norway.

- The total catch in Norwegian fisheries is now 2-3 times higher than in the 1930s.
- Total production in the fisheries and fish farming in 2002 was about 3.5 million tonnes, of which 2.9 million tonnes was in traditional fisheries.
- The highest level of catches in the traditional fisheries in the period since 1930 was 3.5 million tonnes in 1977. In the same year, more than 2 million tonnes capelin was caught.

5.4. Aquaculture

Figure 5.9. World aquaculture production. 1989-2000

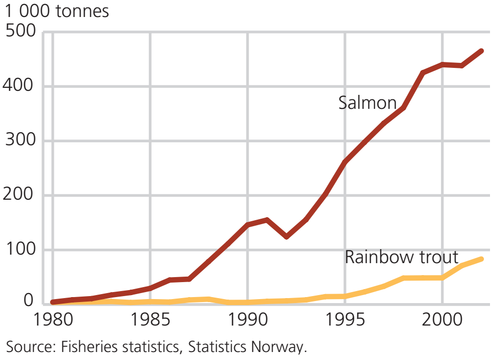


Source: FAO.

World aquaculture production

- In 2000, world aquaculture production totalled 35.6 million tonnes fish, crustaceans, molluscs, etc. corresponding to about 38 per cent of the total catch in marine and inland fisheries for that year.
- Production of aquatic plants totalled 10.1 million tonnes in 2000.
- World aquaculture production has almost trebled since 1989.

Figure 5.10. Fish farming. Volume of salmon and rainbow trout sold. 1980-2002



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 2002, salmon production (sold quantity) totalled 465 000 tonnes. The first-hand value was NOK 7.7 billion; the lowest since 1998. Prices were generally poor in 2002.
- Sales of trout rose to about 83 000 tonnes in 2002, with a first-hand value of NOK 1.4 billion.
- Norwegian production of Atlantic salmon in 2000 accounted for about half the total global production of this species (883 000 tonnes). Over 80 per cent of farmed salmon is exported.

Box 5.4. More about aquaculture production

Globally, freshwater production accounted for 58 per cent of the total aquaculture production of fish, crustaceans, molluscs, etc. of over 35 million tonnes in 2000 (see also table 5.1). 10.1 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 2000. The species farmed in the largest volume was the Pacific oyster (3.9 million tonnes), followed by a number of species of carp. On a list of 29 farmed species of which over 100 000 tonnes were produced in 2000, Atlantic salmon ranked tenth and mussels seventeenth (FAO 2002a).

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: annual production rose to 2 660 tonnes in 2002. 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. In 2000, 460 000 tonnes of mussels were produced on a global basis (FAO 2002a). Other bivalve species of interest to Norwegian aquaculture are scallops and oysters (European oyster (*Ostrea edulis*) and Pacific oyster (*Crassostrea gigas*)), but production of these species has been modest so far.

Other species of fish, such as cod, halibut, turbot, wolf-fish and Arctic char, will probably become increasingly important to the aquaculture industry in the years ahead. However, production of these species for human consumption is still relatively modest in volume. In 2002, 320 tonnes of farmed Arctic char, 1 250 tonnes of cod and 420 tonnes of halibut were sold in Norway (Statistics Norway 2003b).

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

The information on the incidence of disease in salmon farming in 2002 is based on figures in A*nnual Report on Aquaculture 2003* (Ervik et al. 2003). Serious diseases include the following:

- Furunculosis, caused by the bacterium *Aeromonas salmonicida* (no new cases registered in 2002).
- Bacterial kidney disease (BKD), caused by the bacterium *Renibacterium salmoninarum* (new cases registered in 2002: 1 fish farm).
- Infectious salmon anaemia (ISA), a virus disease (new cases registered in 2002: 12 fish farms)
- Infectious pancreatic necrosis (IPN), a virus disease, (new cases registered in 2002: 174 fish farms, of which 70 were hatcheries).
- Winter ulcers, a common disease caused by bacteria, but no figures are available on its incidence. Moderate mortality, but causes considerable losses by reducing the quality of slaughtered salmon.

New diseases also emerge, such as heart and skeletal muscle inflammation in salmon. This disease was first diagnosed in 1999, and there have been around 12-15 outbreaks per year. In 2002, the number of cases diagnosed rose to 24.

The *salmon louse* (a parasitic crustacean which lives in salt water and drops off the salmon after a short period in fresh water) is still the most important cause of losses in the salmon farming industry. Annual losses can be as high as NOK 500 million (Kristiansen 1999). The parasite is controlled by chemical means using delousing preparations, by means of medicated feed, or biologically, using wrasses (gold-sinny, corkwing, ballan wrasse and rock cook are species commonly used). The use of wrasses seems to be declining. Salmon lice can cause poor growth, injury to salmon and secondary infections followed by outbreaks of disease. The parasite can also be a threat to wild salmon and sea trout stocks. It is particularly dangerous to smolt (young salmon) as they migrate from the rivers into the fjords.

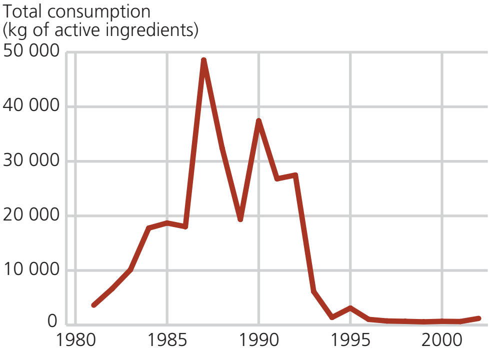
The parasite *Gyrodactylus salaris* was found in salmon in three hatcheries in 2002.

According to fisheries statistics (Statistics Norway 2003b), sea-water rearing units lost 10 million fish (9 million salmon and 1 million trout) to disease in 2002. Total losses were 34 million fish (29.4 million salmon and 4.5 million trout). In 2002 about 629 000 farmed salmon and trout were reported escaped (475 000 salmon and 155 000 trout). Other reasons for losses include injury, predators, discards due to wounds or defects, theft, etc.

Even though the fish farming industry does have its problems - escapes, salmon lice, various diseases and related environmental problems - and there is a debate in progress on the resources used to produce feedstuffs, Ervik et al. 2003 argue that:

- Farming of salmonids is the most resource-efficient method of meat and fish production in Norway. The production of 1 kg salmon requires only about 50 per cent of the amount of feed necessary for the production of 1 kg of pork or poultry.
- No other form of meat or fish production has so little impact on the area used for production.
- No other form of meat production uses a smaller amount of antibacterial agent per kg meat produced.

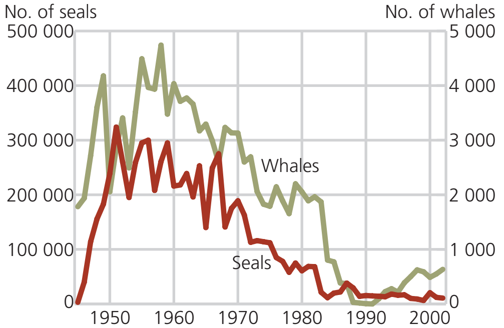
Figure 5.11. Consumption of medicines[1] (antibacterial agents) in fish farming. 1982-2002



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

5.5. Sealing and whaling

Figure 5.12. Norwegian sealing and whaling[1]. 1945-2002



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

Fish health in salmon farming

- There has been a considerable improvement in the salmon health situation, and the use of medicines has been dramatically reduced (see Appendix, table E3). New vaccines and improved operational procedures are probably the main reasons for these improvements.
- The consumption of antibacterial agents was highest in 1987, when it reached 49 tonnes. Consumption in 2002 was 1 219 kg; this is almost a doubling of the figure in 2001, but consumption is still low (about 0.002 g per kg slaughtered fish).
- According to preliminary figures for 2002, the total catch was 10 771 animals (1 580 harp seals and 7 191 hooded seals). The catch in the West Ice includes both hooded seals and harp seals (1 232), whereas in the East Ice it consists entirely of harp seals (2 348). The value of the catch in 2002 was NOK 4.1 million.
- The quota for the small whale hunt in 2002 was 671 animals, and the catch was 634 animals. The quota for 2003 was set at 711 animals. The value of the small whale catch in 2002 was about NOK 28 million.

Box 5.6. Sealing and whaling

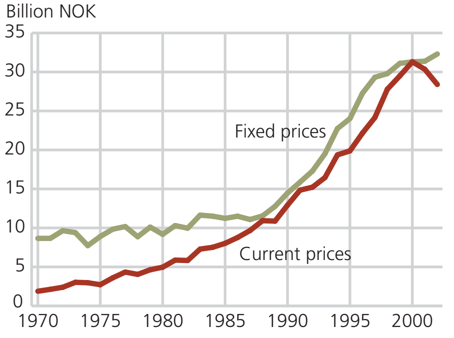
Norwegian *sealing* has essentially been based on two species, harp seals and hooded seals, and has taken place in the Newfoundland area (until 1983), the West Ice (off Jan Mayen) and the East Ice (drift ice areas at the entrance to the White Sea). The most recent estimates for stocks of harp seals are 360 000 year-old and older animals in the West Ice and about 1.7 million in the East Ice. The stock of hooded seals in the West Ice is about 100 000 animals (Michalsen 2003). 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 calculated to be 112 000 animals. *The Central Atlantic minke whale stock* (Central Atlantic, Iceland, Jan Mayen) is calculated to be 72 000 animals, 12 000 of which are in the Jan Mayen area (Michalsen 2003).

5.6. Exports

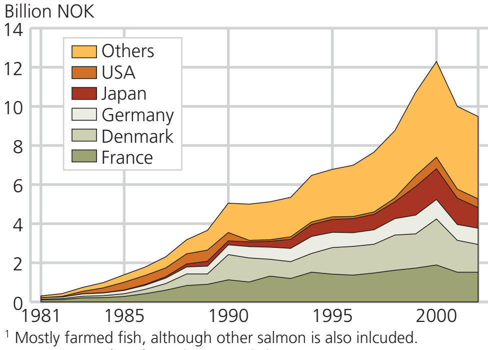
Figure 5.13. Value of Norwegian fish exports. Current and fixed prices (2000-NOK). 1970-2002



Source: National accounts, Statistics Norway.

- In 2002, Norway exported about 2.1 million tonnes of fish and fish products to a value of NOK 28.7 billion (see Appendix, tables E4 and E5). Exports to EU countries accounted for 54 per cent of the total.
- According to the FAO, Norway was in 2000 the world's third largest exporter of fish in terms of value behind Thailand and China, and ahead of the United States, Canada and Denmark. 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. 1981-2002. Current prices



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

- Salmon exports totalled NOK 9.5 billion in 2002. This is a drop of NOK 0.45 billion from 2002 (see Appendix, table E6).
- Denmark and France have for a number of years been the most important importers of farmed salmon. Exports to Denmark (NOK 1.4 billion) declined again considerably in 2002, while there was little change in the value of exports to France (NOK 1.5 billion).
- China is a new, interesting market for salmon, although the value of exports in 2002 was only NOK 62 million.

More information: Frode Brunvoll.

Useful websites

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

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Report No. 20 (2002-2003) to the Storting: *Strukturtiltak i kystfiskeflåten* (Structural measures for the coastal fishing fleet). Ministry of Fisheries.

6. Air pollution and climate change

Norwegian emissions of greenhouse gases, acidifying 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. Norway is a party to a number of multilateral environmental agreements, and under these has agreed to reduce its emissions of the most important pollutants. Norwegian greenhouse gas emissions have risen by 5 per cent since 1990.

Many substances that are emitted to air can contribute to environmental problems or be harmful to health. Emissions may have effects locally where they occur, but may also have effects across national borders (see boxes 6.2 and 6.3). 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. One of them is the Convention on Long-range Transboundary Air Pollution (LRTAP). There are eight protocols under the convention, one of which is the Gothenburg Protocol. This 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) and NMVOCs (non-methane volatile organic compounds). Climate change and depletion of the ozone layer are serious global environmental problems. The Montreal Protocol has helped to bring about substantial reductions in the use of ozone-depleting substances in the industrial countries. The Kyoto Protocol (see boxes 6.5, 6.6 and 6.7) may be a first step on the way to reducing global emissions of greenhouse gases. Norway has ratified the Kyoto Protocol, but before it can enter into force, the protocol must be ratified by industrialised countries that accounted for at least 55 per cent of the world's CO_2 emissions in 1990. The Storting has also decided that until the Kyoto Protocol enters into force, emissions are to be limited by means of a combination of a domestic emissions trading system, to be introduced in 2005, and a continuation of the current CO_2 tax.

Under multilateral environmental agreements, Norway has undertaken commitments to limit or reduce emissions of most of the pollutants listed in box 6.2. Air quality guidelines have been drawn up for pollutants that have local effects on health, and the local authorities are responsible for ensuring that these are respected. An emission inventory (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.

Greenhouse gas emissions in Norway dropped by 2.5 per cent from 2001 to 2002. This was mainly the result of lower production and the closure of plants in the ferro-alloy and magnesium industry. There has been a substantial reduction in flaring of surplus gas offshore, but this has been counterbalanced by a rise in emissions from gas turbines on offshore installations. Total emissions of nitrous oxide (N_2O) and carbon dioxide (CO_2) from road traffic are continuing to rise.

SO_2, NO_x and NH_3 contribute to acid rain, and NMVOCs and NO_x are involved in the formation of ground-level ozone. Emissions of NMVOCs and NO_x must be substantially reduced by 2010 if Norway is to meet its commitments under the Gothenburg Protocol.

Through the LRTAP Convention, Norway has also undertaken to reduce emissions of selected persistent organic pollutants (POPs) from their 1990 levels. So far, Norway has committed itself to reductions in emissions of lead, cadmium, mercury, polycyclic aromatic hydrocarbons (PAHs) and dioxins. Emissions of persistent organic pollutants (POPs) and heavy metals to air were lower in 2001 than in 1990. There has been a particularly large reduction in emissions of lead as leaded petrol has been phased out of the market. Emissions of dioxins in Norway were also considerably reduced in the period 1990-2001, mainly because stricter emission standards brought about cuts in industrial emissions, and a few enterprises where emissions were high were closed down.

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 several persistent organic pollutants (POPs) and heavy metals. The inventory covers only anthropogenic emissions, not natural emissions for example from oceans and forests.

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. 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 2003, national emission figures for 2002 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 2001 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 2001, which are being published now, and the final figures, which will be published in 2004.

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 Flugsrud et al. (2000): The Norwegian Emission Inventory. Reports 2000/1, Statistics Norway and Norwegian Pollution Control Authority.

Box 6.2. Harmful effects of air pollutants

Component	Important sources[1]	Effects
Ammonia (NH_3)	Agriculture	Contributes to acidification of water and soils.
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.
Carbon dioxide (CO_2)	Combustion of fossil fuels, changes in land use and deforestation	Enhances the greenhouse effect.
Carbon monoxide (CO)	Combustion (fuelwood, road traffic)	Increases risk of heart problems in people people with cardiovascular diseases.
Chlorofluorocarbons (CFCs)	Cooling fluids	Deplete the ozone layer.
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.
Copper (Cu)	Road traffic and process industry	Liable to bioaccumulate. Some copper compounds are acutely toxic or irritant in mammals.
Dioxins	Metal production, pulp and paper industry, fuelwood use, shipping and waste incineration	Becomes concentrated in organisms and food chains. Carcinogenic.
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
Hydrochlorofluorocarbons (HCFCs)	Cooling fluids	Deplete the ozone layer.
Hydrofluorocarbons (HFCs)	Cooling fluids	Enhance the greenhouse effect.
Lead (Pb)	Road traffic, 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	Becomes concentrated in organisms and food chains. Causes kidney damage and harms nervous system. May cause cellular changes.
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.
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.
Particulate matter ($PM_{2,5}$ and PM_{10})	Road traffic and fuelwood use	PM_{10}: particles measuring less than 10 µm in diameter, $PM_{2,5}$: particles measuring less than 2.5 µm in diameter. Increase the risk of respiratory complaints.
Perfluorocarbons (PFCs: CF_4 and C_2F_6)	Aluminium production	Enhance the greenhouse effect.
Polycyclic aromatic hydrocarbons (PAH)	All incomplete combustion of organicmaterial and fossil fuels, solvents, aluminium production	Several are carcinogenic.
Sulphur dioxide (SO_2)	Combustion, metal production	Increases the risk of respiratory complaints. Acidifies soil and water and causes corrosion.
Sulphur hexafluoride (SF_6)	Magnesium production	Enhances the greenhouse effect.

[1] The table indicates important anthropogenic sources. There are also major natural sources for several of these pollutants.

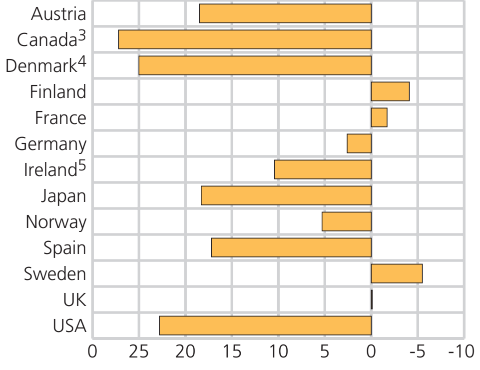
Box 6.3. Environmental problems caused by air pollution

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 fluorine-containing 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 direct 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.
Depletion of the ozone layer	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/m³. The number of pollution episodes[1] was higher in 2002 (19) than in 2001 (4). The highest hourly mean concentration in 2002 was 151 µg/m³ (Norwegian Institute for Air Research 2003a). No measuring station recorded above 160 mg/m³, which is the Norwegian Pollution Control Authority's population warning threshold.
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/m³ or several measuring stations record an hourly mean concentration of more than 120 µg/m³.
Sources: IPCC (2001) and Norwegian Pollution Control Authority/Directorate for Nature Management (1999).

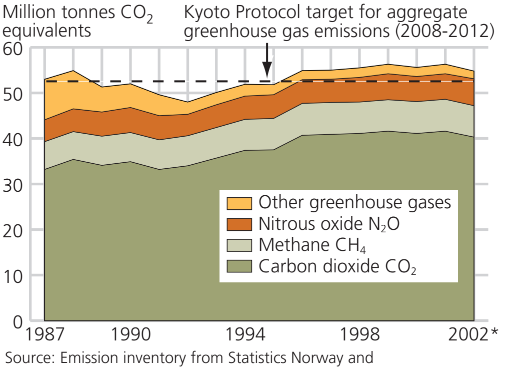
6.1. Greenhouse gases

Figure 6.1. "Distance-to-target" for greenhouse gas[1] emissions in 2000 (deviation of actual emissions from Kyoto[2] targets)



[1] Greenhouse gases are CO_2, CH_4, N_2O, SF_6, PFCs og HFCs.
[2] The USA has not ratified the Kyoto Protocol.
[3] HFCs for 1990 not included.
[4] HFCs and PFCs for 1990 not included.
[5] HFCs, PFCs and SF_6 for 1990 not included.
Sources: UNFCCC (2003), EEA (2003).

Figure 6.2. Total emissions of greenhouse gases in Norway. 1987-2002*



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

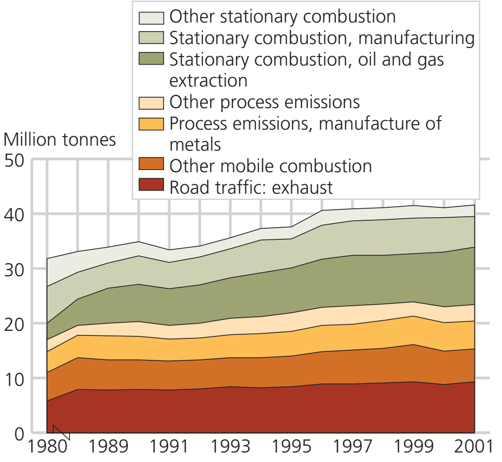
Greenhouse gas emissions in other countries

- Aggregate greenhouse gas emissions rose by 1 per cent from 2000 to 2001. The EU member states must reduce their overall emissions of greenhouse gases 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 2000, its emissions totalled 991 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 35, 25 and 14 per cent respectively in the period 1990-2000. 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.

Aggregate greenhouse gas emissions in Norway

- Greenhouse gas emissions in Norway dropped by 2.5 per cent from 2001 to 2002. The overall rise since 1990, the base year for the Kyoto Protocol, is 5 per cent.
- The overall reduction in 2002 was mainly due to lower emissions of CO_2 and SF_6 (see Appendix, table F1). The drop in CO_2 emissions was partly explained by lower production and the closure of plants in the ferro-alloy industry.
- Emissions of nitrous oxide and CO_2 from road traffic continued to rise in 2002.

Figure 6.3. Emissions of CO_2 by source. 1980-2001*



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

Carbon dioxide (CO_2)

- In 2002, CO_2 emissions totalled 40.3 million tonnes: this is a drop of 3 per cent from the year before. The overall rise since 1990 is somewhat more than 15 per cent.
- The most important sources of CO_2 emissions are road traffic, oil and gas extraction, combustion in manufacturing industries and process emissions from metal production.
- In 2002, CO_2 accounted for three quarters of Norway's aggregate greenhouse gas emissions. This proportion has been stable since 1996.

Box 6.4. Greenhouse gases and global warming potential

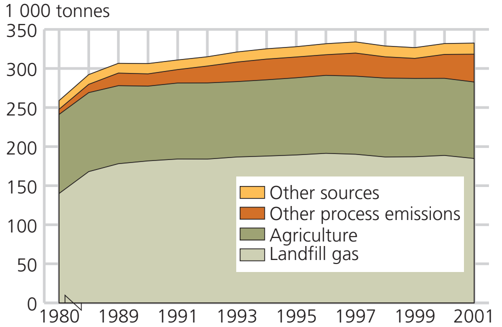
The three most important greenhouse gases are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Anthropogenic emissions of CO_2 are mainly associated with the combustion of fossil fuels, but are also generated by various chemical processes in manufacturing industries. Methane is formed 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
Perfluorkarboner (PFK)	
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 (see box 6.5 and box 6.6). In addition to CO_2, CH_4 and N_2O, the Protocol applies to sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Figure 6.4. Emissions of CH_4 by source. 1980-2001*

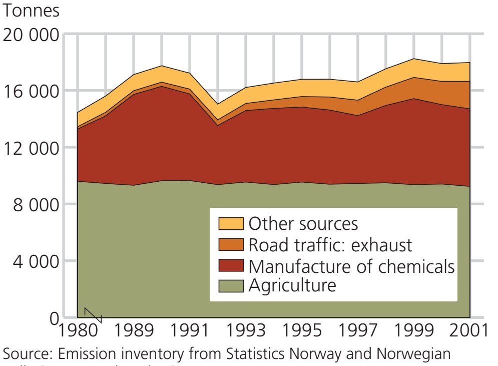


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Methane (CH_4)

- In 2002, CH_4 emissions totalled 329 500 tonnes, which is 1 per cent less than the year before. There has been a 7 per cent rise in emissions since 1990.
- The most important sources of CH_4 emissions are landfills, which account for more than half of Norwegian emissions, and agriculture (livestock and manure).
- Other process emissions include methane emissions from oil and gas extraction. These emissions have risen by more than 240 per cent since 1990.
- In 2002, CH_4 accounted for 13 per cent of Norway's aggregate greenhouse gas emissions.

Figure 6.5. Emissions of N_2O by source. 1980-2001*

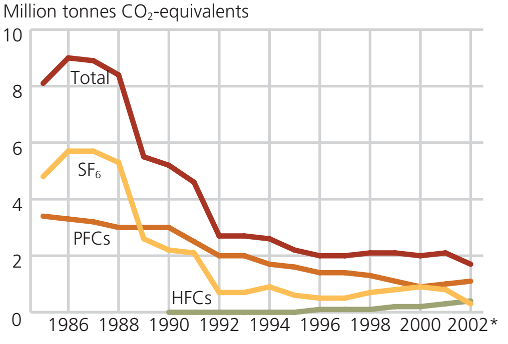


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Nitrous oxide (N_2O)

- In 2002, N_2O emissions totalled 18 900 tonnes, which is a rise of 5 per cent from 2001.
- 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 of nitrous oxide from fertiliser manufacturing rose in 2002, partly because of operational problems. Emissions from road traffic continued to rise because of the growing volume of traffic, particularly diesel vehicles, and the fact that nitrous oxide emissions are higher from cars with catalytic converters than from those without.
- In 2002, N_2O accounted for 11 per cent of Norway's aggregate greenhouse gas emissions.

Figure 6.6. Total emissions of other greenhouse gases (HFCs, PFCs and SF_6). 1985-2002*



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

Other greenhouse gases

- In 2002, emissions of sulphur hexafluoride (SF_6) totalled 10.8 tonnes, which is a drop of 66 per cent from the year before. The large cut in emissions is explained by discontinuation of primary production of magnesium. Emissions of perfluorocarbons (PFCs) from aluminium production rose by 7 per cent to 167 tonnes, but without a corresponding rise in production. Emissions of hydrofluorocarbons (HFCs) totalled 176 tonnes, a rise of 22 per cent from the year before.
- 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.
- Measured in CO_2 equivalents, these pollutants together accounted for 3 per cent of Norway's aggregate greenhouse gas emissions in 2002.

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.

Emissions trading
Countries that have undertaken commitments may trade emissions credits among themselves. A country that can reduce emissions to below the target set out in the Protocol at relatively low cost may sell credits to countries where the cost of achieving the target is relatively high. Countries that sell credits 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.

Box 6.6. The Kyoto Protocol. Ratification and international emissions trading

The Protocol sets out an emissions target for each industrialised country, in effect an annual quota. This also entitles each country to issue the corresponding number of tradable emissions permits. If a country wishes to emit more than its quota, it can buy emissions permits from another country (this is known as emissions trading). In addition, industrialised countries can acquire further permits by funding approved emission reduction projects in developing countries. Finally, emission permits can be obtained from projects to enhance carbon sinks in forests.

Norway ratified the Kyoto Protocol on 30 May 2002. The Protocol will enter into force when it has been ratified by industrialised countries that accounted for at least 55 per cent of total emissions from the industrialised countries in 1990. Now that the Protocol has been ratified by parties including the EU, Japan and several Eastern European countries, only ratification by Russia is needed for it to enter into force. The US President has declared that the USA will not ratify the Protocol.

Now that the USA has withdrawn from the Kyoto Protocol, it seems unlikely that the quantitative commitments set out in it will have a significant effect on overall emissions. This is because Russia, Ukraine and other countries in Eastern Europe and the former Soviet Union have experienced a sharp drop in energy use, and therefore in greenhouse gas emissions, since the collapse of Communism. However, the emission ceilings these countries were assigned for the first commitment period (2008-2012) were not correspondingly reduced. For Russia and Ukraine, for example, the Kyoto commitment is the same as their 1990 emissions. These countries will therefore be able to sell a large number of emission permits without having to make any emissions reductions themselves. Most emission projections, including those from the IEA and the US Department of Energy, show that the surplus credits available on the market will be enough to make up the shortfall in the EU, Japan and Norway. If all the emission permits issued are placed on the market, there will be so many permits available that no countries need to reduce their emissions.

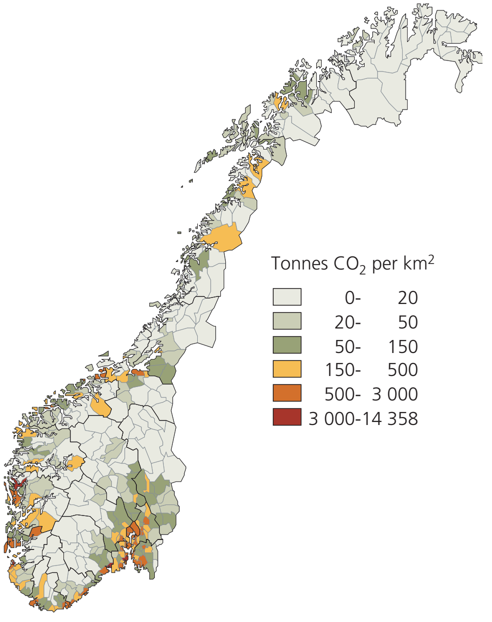
Despite the expected surplus of emission permits, it is unlikely that the price will approach zero, for two reasons. Firstly, Russia will be a large, dominant supplier, and will be able to withhold permits to force the price upwards and thus increase the country's revenues from the sale of permits. Secondly, the Kyoto Protocol allows countries to bank permits for the next commitment period. Thus, countries that have permits to sell will not accept a price that is lower than their discounted permit price for the next commitment period. This will result in a limit for how far permit prices can fall.

However, Russia, which is a major supplier of both natural gas and oil, may find that exercising its market power in the market for emission permits has unwelcome repercussions. A high permit price will cause the end-user price for fossil fuels to rise, thus reducing demand and the price received by fuel producers. This suggests that Russia is likely to show some caution in using market power to force permit prices upwards. Holtsmark (2003) assumes that Russia will safeguard its own interests in the best possible way, both as a supplier of emission permits and as a supplier of oil and gas. Given this assumption, the permit price is estimated to be NOK 20 per tonne CO_2.

Norway has an annual emission allowance of 52.5 million tonnes CO_2 equivalents. According to Report No. 54 (2000-2001) to the Storting, Norway's annual emissions in the period 2008-2012 may in fact be as much as about 63.5 million tonnes CO_2 equivalents. Instead of taking steps to reduce domestic emissions, Norway has the option of buying emission permits for 11 million tonnes CO_2 equivalents. Since the price of emission permits is difficult to predict, the cost of doing this is uncertain. Using the permit price estimated by Holtsmark (2003), it would cost the Norwegian authorities roughly NOK 220 million per year to meet Norway's entire Kyoto commitment through the purchase of emission permits.

Read more in: Holtsmark, B. (2003): Strategic behaviour in the market for permits under the Kyoto Protocol. To be published in Climate Policy 3 (4), Elsevier Science.

Figure 6.7. Emissions of CO_2 in 2000, by municipality



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

Greenhouse gas emissions at local level

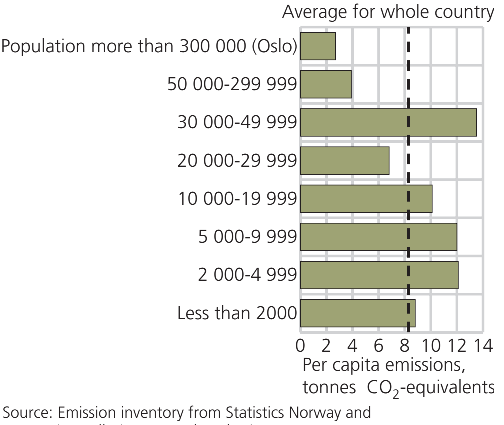
- CO_2 is the most important component of greenhouse gas emissions in all counties.
- Manufacturing, road traffic, agriculture and landfills are the largest sources of greenhouse gas emissions in most municipalities.
- Emissions of the three most important greenhouse gases, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) have risen by 13 per cent in Norwegian municipalities from 1991 to 2000. Most of the overall rise in emissions is explained by rising emissions from manufacturing and road traffic.
- About 40 per cent of Norway's CO_2 emissions take place at sea and in its airspace, and are generated mainly by the oil and gas industry, shipping and air traffic.

Box 6.7. Domestic emissions trading scheme for Norway

The Storting has decided that Norway is to reduce its greenhouse gas emissions by means of a combination of a domestic emissions trading system for some branches of industry from 2005, a continuation of the current CO_2 tax, and a number of measures targeted at specific branches and sectors. The domestic emissions trading system is to include emissions of CO_2 and other greenhouse gases from energy- and emissions-intensive industries and possibly other entities. Together, these account for about 30 per cent of total Norwegian emissions. The emissions trading system will initially apply to emission sources to which the CO_2 tax does not apply. The overall ceiling for quotas is to be based on a reduction of total emissions by 20 per cent from 1990. If the Kyoto Protocol enters into force, the Norwegian emissions trading system can be linked to an international market. It would also be possible to link the Norwegian system to the proposed EU emissions trading scheme from 2005.

Sources: http://www.cicero.uio.no/(30-07-02), and the Standing Committee on Energy and the Environment (2002).

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



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

- Per capita greenhouse gas emissions average 3.4 tonnes in the ten municipalities with a population of more than 50 000, and 13.5 tonnes CO_2 equivalents in municipalities with a population of 30 000 - 50 000. Per capita emissions for mainland Norway as a whole average 8.5 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. Another factor of some importance is road traffic. 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.

Box 6.8. Local climate and energy plans

Local or regional climate and energy plans have been drawn up by about 40 municipalities and a few counties. One plan involves cooperation between three county authorities. The level of ambition in local plans is generally similar to that of Norway's national climate policy. Some municipalities have not included quantified goals in their plans, while a few larger towns are pursuing a more ambitious policy than the central government.

Bergen, Trondheim, Stavanger and Oslo have all drawn up local climate and energy action plans. In Oslo's case, a climate and energy strategy has been drawn up for the Oslo region and adopted by the three counties involved, i.e. Akershus, Buskerud and Oslo. This states that in 2010, the region's greenhouse gas emissions shall be no more than 1 per cent above the 1990 level. Greenhouse gas emissions in Oslo have risen by 6 per cent in the period 1991-2000. Overall emissions were at the same level in 1995 as in 1991. However, since 1995, emissions have risen as a result of an increase in road traffic and a rise in emissions from landfills.

Bergen has adopted the most ambitious local target for climate: a 30 per cent reduction of aggregate greenhouse gas emissions from 1991 to 2005, measured as CO_2 equivalents. The city registered a drop of 1 per cent in total greenhouse gas emissions from 1991 to 2000. Emissions of methane from landfills have been reduced by 21 per cent in this period, as have emissions from combustion in households and other sectors. Greenhouse gas emissions from road traffic have risen by 15 per cent from 1991 to 2000.

In 1997, Trondheim City Council adopted the target of a 20 per cent reduction in CO_2 emissions, with 1990 as the base year. The objective is to reach this target during the commitment period for the Kyoto Protocol, 2008-2012. Greenhouse gas emissions in Trondheim have risen by 5 per cent from 1991 to 2000. This is because of a rise in process emissions from manufacturing and rising emissions of landfill gas.

Stavanger's climate and energy plan states that in 2010, the city's emissions are not to exceed 316 000 tonnes CO_2 equivalents from road traffic, landfills, agriculture, manufacturing, and combustion in households and other sectors. Stavanger's emissions (CO_2 equivalents) fell by 5 per cent from 1991 to 2000. This was a result of a drop in emissions from manufacturing and from combustion in households and other sectors. Greenhouse gas emissions from road traffic rose by 3 per cent in the same period.

Based on: Aasestad, K. and G. Haakonsen (2003): Klimagassutslipp og miljøplaner. Mindre klimagassutslipp per innbygger i storbyene enn på landet. (Per capita greenhouse gas emissions lower in large towns than in rural areas) http://www.ssb.no/valgaktuelt

Box 6.9. Acidification: a brief explanation of causes and effects

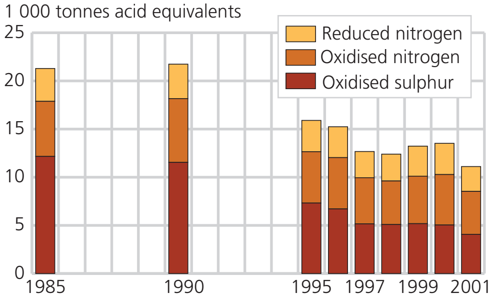
The term acid rain means inputs of pollutants that have acidifying effects in the environment with rain and snow. Such pollutants can also be deposited directly in the form of gases or particles (dry deposition), and direct deposition is normally also included in the definition of acid rain. Acid rain 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.

6.2. Acidification

Figure 6.9. Deposition of acidifying substances in Norway. 1985-2001



Sources: Norwegian Meteorological Institute and EMEP.

Deposition of acidifying substances in Norway

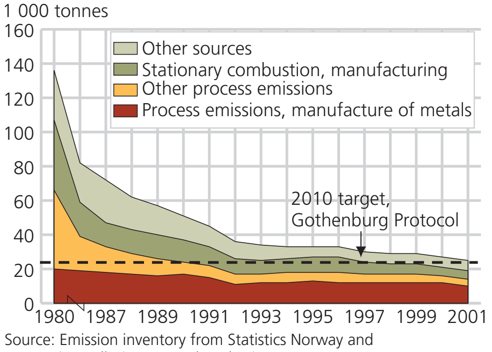
- Acidification of the Norwegian environment is being reduced. Sulphur emissions have been cut elsewhere in Europe, thus reducing the deposition of pollutants over Norway. Reductions in nitrogen emissions have been much smaller, so that the relative importance of nitrogen deposition is increasing.
- 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 (Norwegian Meteorological Institute 2001). A substantial proportion of Norwegian emissions is also deposited in Sweden.
- The UK, Germany and Russia 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. 1 000 tonnes

	SO_2			NO_X		
	Emissions		Target	Emissions		Target
Country:	1990	2000	2010	1990	2000	2010
UK	3 721	1 165	625	2 763	1 512	1 181
Germany	5 321	831	550	2 706	1 637	1 081
Russian Federation[1]	4 671	1 997	2 343	3 600	2 357	2 653
Sweden	111	58	67	349	247	148
Denmark	181	27	50	277	207	127
Norway	53	26	22	226	223	156

[1] The figures apply to the European part, within the EMEP area.
Sources: EMEP/MSC-W (2002) and UN/ECE (1999).

Figure 6.10. Emissions of SO_2 by source. 1980-2001*

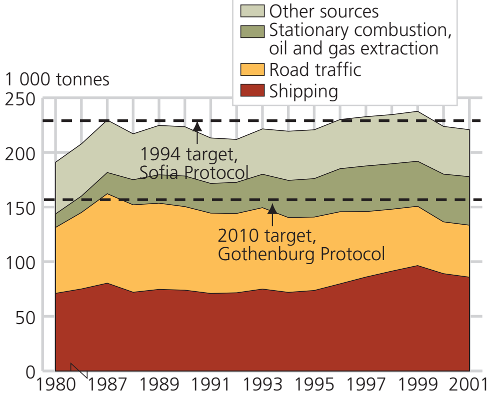


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Sulphur dioxide (SO_2)

- In 2002, SO_2 emissions totalled 22 600 tonnes, a drop of 9 per cent from the previous year. SO_2 emissions have been more than halved since 1990. Under the Gothenburg Protocol, Norway has undertaken to ensure that its emissions do not exceed 22 000 tonnes in 2010.
- The drop in emissions from 2001 to 2002 was not mainly due to environmental measures, but to a reduction in activity in some manufacturing industries. If production rises again, emissions may also rise unless measures are taken to counteract this.

Figure 6.11. Emissions of NO_x by source. 1980-2001*

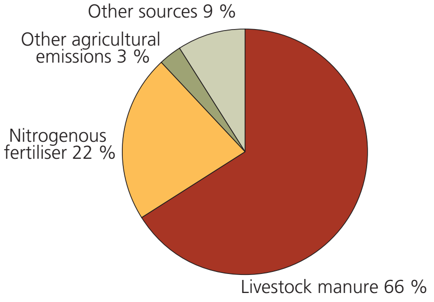


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Nitrogen oxides (NO_x)

- In 2002, NO_x emissions totalled 214 000 tonnes, which is a drop of 3 per cent since 2001. The reasons for this were the rise in the number of cars with catalytic converters, which reduce NO_x emissions, less flaring of gas on the continental shelf and a lower level of activity in parts of the process industry.
- The largest sources of NO_x emissions are shipping (39 per cent), road traffic (22 per cent) and stationary combustion in the oil and gas industry (20 per cent).
- Total emissions must be reduced to 156 000 tonnes if Norway is to meet its commitment under the Gothenburg Protocol. Norway exceeded its emission ceiling under the Sofia Protocol in the period 1997-1999.

Figure 6.12. Emissions of ammonia by source. 2001*

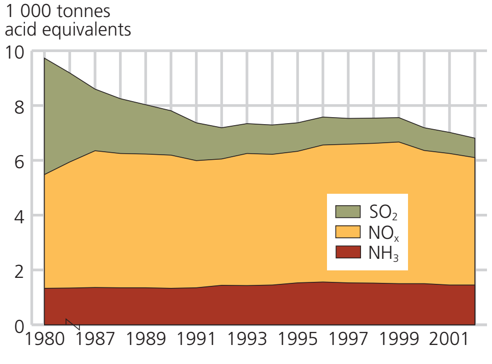


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Ammonia (NH_3)

- In 2002, NH_3 emissions were unchanged from the year before at 24 700 tonnes. The level of emissions has been relatively stable in the last few years.
- Agriculture generated more than 90 per cent of Norwegian emissions of ammonia in 2002. 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.
- Under the Gothenburg Protocol, Norway has undertaken to meet an emission ceiling of 23 000 tonnes NH_3 in 2010.

Figure 6.13. Emissions of acidifying substances in Norway. 1980-2002*



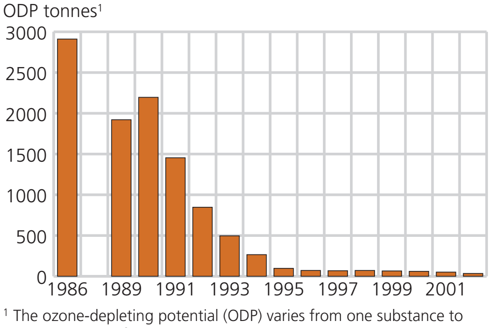
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Aggregate emissions of acidifying substances

- In 2002, Norway's aggregate emissions of acidifying substances, expressed as acid equivalents, amounted to 6 800 tonnes. NO_X accounts for almost 70 per cent of the total.
- The level of emissions expressed as acid equivalents was 3 per cent lower than in 2001.
- 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. 1986-2002



[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 34 ODP tonnes ozone-depleting substances in 2002. This is a drop of 33 per cent since 2001.
- Various HCFCs still dominate imports of ozone-depleting substances to Norway, and accounted for 89 per cent of the total (expressed as ODP tonnes) in 2002.
- It has been calculated that the thickness of the ozone layer above Oslo has been reduced by an average of 0.25 per cent per year since 1979.

Box 6.10. 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.

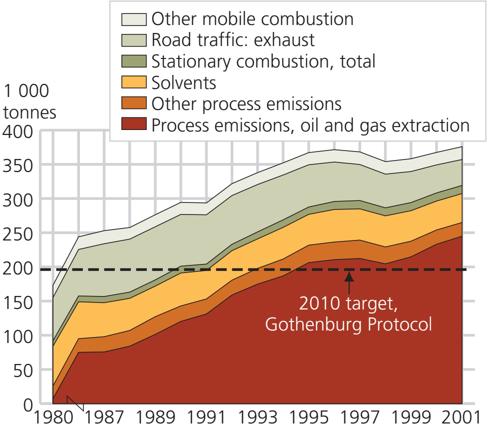
In accordance with the Montreal Protocol, the consumption of ozone-depleting substances in Norway has dropped steeply since the mid-1980s. Emissions take place largely during use of equipment containing these gases, not during production, and only small amounts are collected and destroyed. In accordance with the revised Montreal Protocol, Norway has eliminated imports of newly-produced halons and CFCs, and there is a general prohibition against imports of CFCs (small quantities of CFCs, ca. 3 tonnes per year, are imported for necessary purposes such as laboratory analysis). 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, particularly in September and October each year. 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 and the ozone layer regenerates until the next cycle starts. This phenomenon was first registered in the 1980s (Norwegian Pollution Control Authority 2003).

An analysis for the period 1979-2002 based on measurements at ground level in Oslo shows a reduction of 0.25 per cent per year in the thickness of the ozone layer (Norwegian Institute for Air Research 2003b). In winter 2001-2002, no large reduction of the ozone concentration over the Arctic was recorded. This was because temperatures in the stratosphere remained relatively high for much of the winter and spring. Significant ozone depletion only occurs when the temperature is low.

6.4. Formation of ground-level ozone

Figure 6.15. Emissions of NMVOCs by source. 1980-2001*



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

NMVOC

- In 2002, Norway's NMVOC emissions totalled 334 000 tonnes, which is a reduction of 11 per cent from 2001. This is explained by a reduction in the quantity of oil loaded offshore. In addition, more of the oil was loaded at facilities where oil vapour is recovered.
- The most important source is process emissions from oil and gas activities (65 per cent), primarily evaporation during loading of crude oil offshore. Other important sources are emissions from solvents (11 per cent) and road traffic (10 per cent).
- 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 42 per cent from the current level.

Box 6.11. Ozone precursors

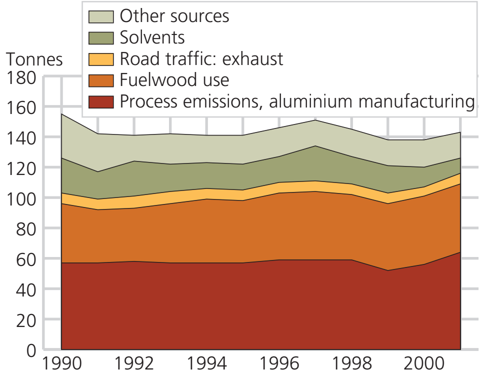
Ground-level or tropospheric ozone is formed by the oxidation of CH_4, CO, NO_X and NMVOCs in the presence of sunlight. A weighting factor is defined for each of these precursors according to how much ground-level ozone it forms during a specific period of time. These are known as TOFP (Tropospheric Ozone-Forming Potentials) 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 1 per cent in the period 1990-2002.

6.5. Persistent organic pollutants (POPs) and heavy metals

Figure 6.16. Emissions of total PAH to air by source. 1990-2001*

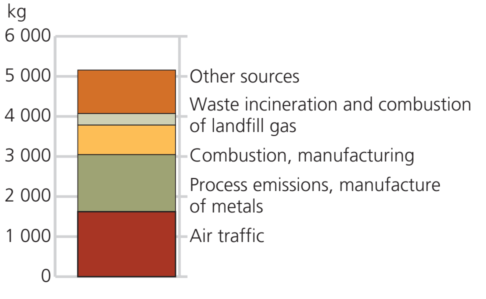


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

PAHs

- In 2001, Norway's emissions of "total PAH" were 143 tonnes (PAH-4, which is the component regulated by the POPs Protocol under the LRTAP Convention, accounted for 14.9 tonnes of this). PAH emissions have shown small variations with no clear trend since 1990.
- The largest sources of PAH emissions are fuelwood use in households and process emissions from aluminium production. These two sources accounted for 32 and 45 per cent respectively of the total in 2001. Process emissions from aluminium production accounted for 65 per cent of total PAH-4 emissions.
- PAH emissions from aluminium production rose by 15 per cent from 2000 to 2001.

Figure 6.17. Emissions of lead to air by source. 2001*

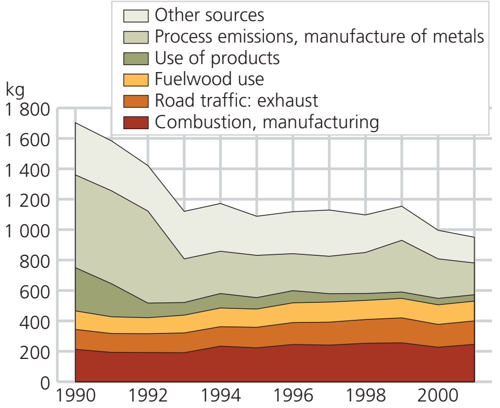


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Lead (Pb)

- Lead emissions were reduced by 97 per cent in the period 1990 to 2001. This was mainly a result of the changeover to unleaded petrol.
- In 2001, emissions totalled 5.2 tonnes, 15 per cent below the year before.
- 31 per cent of the total is generated by domestic air transport, and 28 per cent by the manufacture of metals.

Figure 6.18. Emissions of mercury to air by source. 1990-2001*

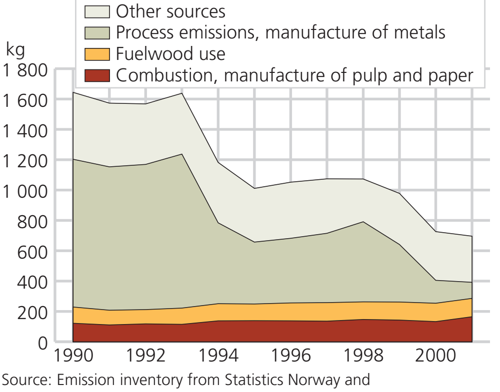


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority..

Mercury (Hg)

- In 2001, mercury emissions totalled 950 kg, a drop of 5 per cent from the year before.
- The largest sources of mercury emissions to air today are process emissions from the manufacture of iron, steel and ferro-alloys, combustion in manufacturing industries and fuelwood use in households.
- 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. In addition, there has been a changeover to raw materials with a lower mercury content.

Figure 6.19. Emissions of cadmium to air by source. 1990-2001*

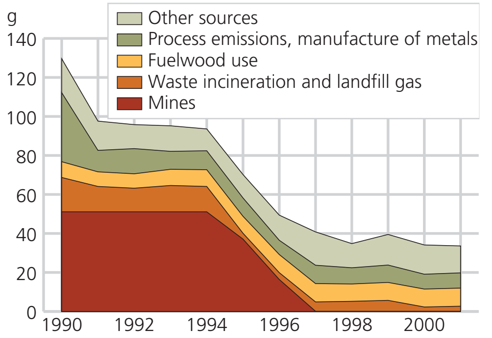


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Cadmium (Cd)

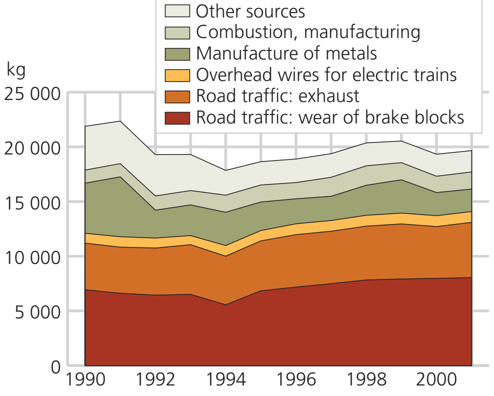
- In 2001, cadmium emissions totalled 696 kg, a drop of 4 per cent from the year before.
- The most important sources of cadmium emissions today are combustion of wood waste in manufacturing industries, fuelwood use by households and process emissions from metal production and the chemical industry.

Figure 6.20. Emissions of dioxins to air by source. 1990-2001*



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

Figure 6.21. Emissions of copper to air by source. 1990-2001*



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

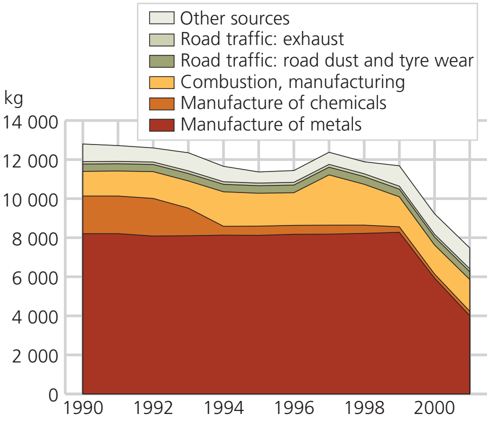
Dioxins

- In 2001, emissions of dioxins totalled 34 g, the same as in 2000. This is 74 per cent lower than in 1990. The large reduction is mainly explained by the closure of an ore production plant in Syd-Varanger in Finnmark and the reduction of emissions from magnesium production.
- Various combustion sources now account for 60 per cent of all dioxin emissions to air, and dioxin emissions from fuelwood use by households account for 46 per cent of this. Another important source is combustion in the pulp and paper industry. Emissions from shipping are the largest mobile combustion source.

Copper (Cu)

- In 2001, emissions of copper to air totalled 19.7 tonnes. Road traffic is by far the largest source of emissions. Wear of brake blocks accounted for more than 40 per cent of copper emissions in 2001, and exhaust emissions from petrol and diesel vehicles for 26 per cent. Emissions of copper from road traffic (exhaust) have risen by 18 per cent from 1990 to 2001.
- Other sources of copper emissions in 2001 were process emissions from manufacturing and mining (13 per cent of the total) and emissions from overhead wires for electric trains (5 per cent). Copper emissions have been reduced by 10 per cent since 1990. The largest cuts have been in process industries, particularly chemical and metallurgical industry, as a result of the reorganisation of production processes and the installation of equipment to control emissions.

Figure 6.22. Emissions of chromium to air by source. 1990-2001*



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

Chromium (Cr)

- In 2001, emissions of chromium to air totalled 7 tonnes. These emissions have been reduced by 45 per cent since 1990 and 37 per cent since 1999. 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 ferro-chromium plant. There has been little change in emissions at ground level.
- The ferro-alloy industry generates more than half of all chromium emissions. Other important sources are combustion in manufacturing industries (23 per cent) and road traffic (8 per cent). Road traffic includes road dust and wear and tear of tyres in addition to exhaust emissions.

Box 6.12. Emissions of copper, chromium and arsenic to air

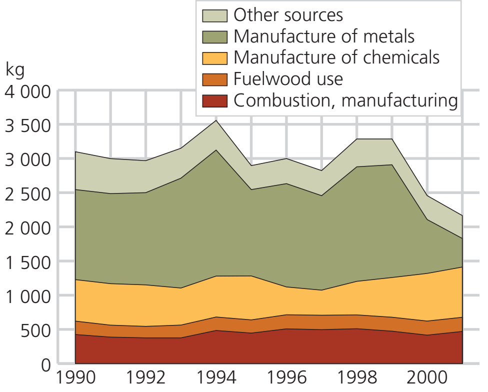
Since 1998, heavy metals and POPs have been covered by the Convention on Long-range Transboundary Air Pollution (LRTAP). So far, the protocols under the convention include specific obligations for reductions in emissions of the heavy metals lead, cadmium and mercury. There are no specific requirements for copper, chromium and arsenic, but the convention includes requirements to report on emissions of these substances.

Emissions of copper, chromium and arsenic have not previously been included in Norway's official statistics. In 2002, Statistics Norway was commissioned by the Norwegian Pollution Control Authority to compile a complete inventory of emissions of these substances in Norway from 1990 to 2001. The figures are based on emissions reported directly by large enterprises and incineration plants to the Norwegian Pollution Control Authority, and on calculations based on activity data and emission factors for other sources. The figures are generally very uncertain because many emission sources are poorly surveyed, the results of measurements vary widely, and the weighting factors are uncertain. The uncertainty level is higher for 1990 than for later years.

Copper, chromium and arsenic are now included in the ordinary statistics for emissions to air.

Based on: Finstad, A. and K. Rypdal (2003): *Utslipp til luft av kobber, krom og arsen i Norge. Dokumentasjon av metode og resultater.* (Emissions of copper, chromium and arsenic to air in Norway: documentation of a method and results). Reports 2003/7. Statistics Norway.

Figure 6.23. Emissions of arsenic to air by source. 1990-2001*



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

Arsenic (As)

- In 2001, arsenic emissions totalled 2.2 tonnes, which is a drop of 30 per cent since 1990.
- Process emissions from carbide production are the most important source of emissions in Norway today, and made up 34 per cent of the total in 2001. Before 2000, emissions from the ferro-alloy industry dominated. Emissions from this source dropped by more than 80 per cent from 1999 to 2001 because one sintering plant was closed for most of this period. In 2001, they made up only 12 per cent of total emissions, as compared with 45 per cent in 1999.
- Other important sources of arsenic emissions are combustion in the pulp and paper industry and fuelwood use by households. Together, these accounted for 23 per cent of total emissions in 2001.

Box 6.13. Emissions of particulate matter to air

Statistics Norway has been commissioned by the Norwegian Pollution Control Authority to compile the first complete inventory of emissions of particulate matter in Norway. Until now, the Norwegian emission inventory has only included emissions of PM_{10} from combustion and road traffic. Now, the inventory distinguishes between three fractions: TSP (total suspended particles), PM_{10} and $PM_{2.5}$. This has been done because the LRTAP Convention applies to all three fractions, and Norway is required to report emissions under the convention.

The new emission figures are more than 25 per cent higher than earlier calculations indicated. This is because several important emission sources were not previously included in the national inventory. The most important source of emissions that has now been included is process emissions from manufacturing industries. Other important sources that have also been included are burning of straw, house fires, wear of brake blocks and tyres, and emissions from construction activities and extraction of sand.

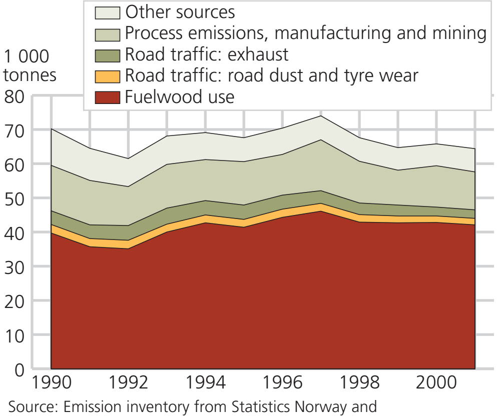
The data are based on emissions reported directly to the Norwegian Pollution Control Authority by larger enterprises and incineration plants, and calculations based on activity data and emission factors.

Based on: Finstad, A. et al. (2003): *Utslipp av partikler i Norge - Dokumentasjon av metode og resultater*. (Emissions of particulate matter in Norway: documentation of a method and results). Reports 2003/15, Statistics Norway.

6.6. Emissions of substances that particularly affect local air quality

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

Figure 6.24. Emissions of particulate matter (PM_{10}) to air by source in Norway. 1990-2001*

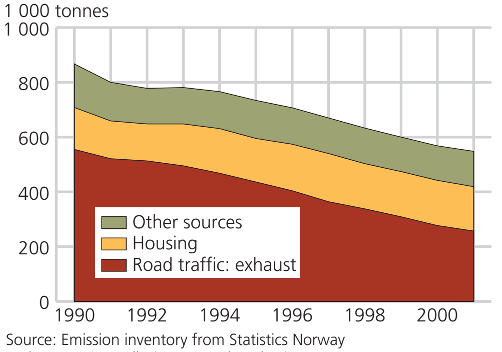


Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Particulate matter

- Three different fractions of particulate matter are distinguished: TSP (total suspended particles), PM_{10}, with a diameter of less than 10 mm and $PM_{2.5}$, with a diameter of less than 2.5 mm. Total emissions of the three fractions in 2001 were 79 900 tonnes, 64 400 tonnes and 54 400 tonnes respectively.
- Emissions from fuelwood use are the largest source of particulate matter, and accounted for 65 and 70 per cent respectively of emissions of PM_{10} and $PM_{2.5}$ in 2001. For these two fractions, the next most important source of emissions is metal production.

Figure 6.25. Emissions of carbon monoxide in Norway. 1990-2001*



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

Carbon monoxide

- In 2001, emissions of carbon monoxide to air totalled 548 000 tonnes.
- The largest sources of CO emissions are road traffic and heating of housing, especially with fuelwood, and these account for 47 and 30 per cent respectively of the total.
- Since 1990, emissions of CO have been reduced by 37 per cent. The main reason is reduced emissions from road traffic due to catalytic converters in cars.

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 a little more than half of all emissions of particulate matter in Oslo in 2000 were generated by fuelwood use. The other main source is road traffic. 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 six times as much particulate matter as new stoves.

In autumn 2002, Statistics Norway carried out a comprehensive survey of fuelwood use in Oslo. This showed that 8000 households in Oslo had replaced old, polluting wood-burning stoves with new, less polluting stoves since 1998. This has reduced emissions of particulate matter by 70 tonnes since 2000. Nevertheless, a larger proportion of the wood was burnt in old, polluting stoves in 2002 than in 2000. This was because old stoves that were not in use in 2000 were being used again two years later in response to higher electricity prices. This effect was probably even more marked in winter 2002-2003, when electricity prices climbed rapidly, probably encouraging even more people to use fuelwood for heating.

There is still room for large reductions in emissions in Oslo. If all the old wood-burning stoves were replaced, Oslo's emissions of particulate matter from this source would be reduced by a further 70 per cent or 270 tonnes, provided that fuelwood consumption remained constant and the proportions burned in stoves and open fireplaces remained unchanged.

Fuelwood use in wood-burning stoves and open fireplaces has been calculated by means of a questionnaire-based survey. The calculations combine figures for fuelwood consumption with emission factors for Norwegian wood-burning stoves and open fireplaces. The Oslo survey will be used to improve the model-based calculations that are used to monitor progress towards the authorities' target for local air quality. A thorough analysis of the material will therefore be made in two projects financed by the Norwegian Pollution Control Authority.

Based on: 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, and Haakonsen, G. (2003): Vedfyring og utslipp til luft. Oslo. 2002. Nye vedovner ga 70 tonn mindre støv i Oslo (New wood-burning stoves reduced dust in Oslo by 70 tonnes). Statistical Magazine. http://www.ssb.no/magasinet/miljo/

Box 6.15. Will future economic growth reduce emissions to air?

Historical data show an inverted U-shaped relationship between income and a number of environmental problems. When income levels are low, emissions rise with rising production. But when a sufficiently high income level is reached, a number of mechanisms begin to counteract the effects of production growth, and tend to lower emissions. These mechanisms can be summarised as greener production and consumption patterns, technological advances and a stronger focus on environmental issues, which in turn result in a stricter environmental policy. A question that arises in connection with studies of this relationship is whether we can expect environmental problems to be solved automatically in the future as a result of economic growth. To suggest possible scenarios, we have analysed the relationship between economic growth and emissions to air using a forward-looking macroeconomic model.

The results of the analysis suggest that the same mechanisms will continue to counteract growth in emissions in future. In particular, more efficient use of energy and intermediates may tend to reduce emissions. However, it is not certain that the effect of these mechanisms will be stronger than that of rising production and consumption. The model suggests that the emission-reducing mechanisms will dominate in the case of most local and regional pollutants. However, emission reductions cannot be expected for greenhouse gases and some of the local pollutants generated by transport. This is because it is expected that both the use of electricity generated from gas and transport activity will rise.

Read more in: Bruvoll, A., T. Fæhn and B. Strøm (2003): Quantifying central hypotheses on environmental Kuznets curves for a rich economy: A computable general equilibrium study, *The Scottish Journal of Political Economy* 50 (2), 149-173.

More information: Gisle Haakonsen, Ketil Flugsrud, Anne Finstad and Kristin Aasestad.

Useful websites

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/
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/

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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. However, hazardous waste that is not dealt with through the proper channels is still considered to be a substantial problem.

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, greenhouse gas emissions, health problems, littering and locally, unpleasant smells (see box 7.1). 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 seepage 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 (see box 7.7). 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 2001 almost 7 per cent of the hazardous waste generated was dealt with outside the proper channels.

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. In 2002, about 8.7 million tonnes of waste was generated in Norway, including 700 000 tonnes of hazardous waste. About 47 per cent of the non-hazardous waste was utilised by means of material recovery, energy recovery or biological treatment within the country. The Government's objective is to increase this proportion to 75 per cent by 2010. 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 354 kg of household waste in 2002.

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, and also littering, have direct impacts in the form of varying quantities 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. Some of the impacts of waste and waste management on the environment and natural resources are discussed below.

If organic waste is landfilled, it generates emissions of the greenhouse gas methane (IPCC 1996). Methane emissions from landfills account for 7 per cent of Norway's greenhouse gas emissions (measured as CO_2 equivalents) and contributes to global warming (see table 7.1). Old landfills generate seepage 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 seepage. Locally, landfills can give rise to problems related to unpleasant smells and vermin.

Composting is an environmentally sound method of treatment for wet organic waste, including park and garden waste, provided that it is successful. The main emissions are water vapour and CO_2. If the process is unsuccessful, on the other hand, anaerobic conditions may develop in the compost, giving rise to unpleasant smells (for example from hydrogen sulphide) and seepage. 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, even for the closest neighbours (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, 73 per cent of the heat generated by Norwegian incineration plants was utilised in 1999. This reduces the 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 examples are discussed below.

PCBs (polychlorinated biphenyls) 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. Their acute toxicity is not very high, but chronic exposure to PCBs, even at relatively low concentrations, can impair reproduction, disturb behavioural patterns, weaken the immune system and cause cancer (Thorsen 2000). 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.

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.

Cont.

7.1. Some environmental problems related to waste management

Table 7.1. Emissions from waste incineration and landfills. Percentages of total Norwegian emissions in 2001 and change since 1990

	Percentage of total Norwegian emissions	Percentage change since1990
Incineration plants:		
Quantity of waste incinerated	.	+ 52
Sulphur dioxide	0.6	- 56
Nitrogen dioxide	0.4	- 7
Carbon dioxide	0.4	+ 51
Particulate matter, PM_{10}	0.0	- 98
Lead	5.6	- 84
Cadmium	3.9	- 69
Mercury	7.2	- 59
Arsenic	0.5	-92
Chromium	1.2	-72
Copper	0.3	-74
Total PAH	0.6	- 45
Dioxins	7.8	- 85
NMVOCs	0.1	+ 47
Landfills:		
Methane (greenhouse gas)[1]	6.9	+2
Seepage: heavy metals[2]	1	..
Seepage: nitrogen[2]	2	..
Seepage: 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 (seepage).

Environmental problems

- Emissions of heavy metals, PAHs and dioxins from waste incineration have dropped steeply since 1990, even though 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).
- Emissions of methane (a greenhouse gas) from rotting waste in landfills make a substantial contribution to Norway's total emissions. In 2001, methane emissions totalled 332 460 tonnes, and landfills accounted for 55.6 per cent of this, or about 7 per cent of Norway's aggregate greenhouse gas emissions.
- Seepage from landfills may contain heavy metals, organic material and plant nutrients such as nitrates and phosphates. These discharges may cause local pollution, but are small compared with those from other sources.

Cont.

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 POPs. 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 increasingly being used for various purposes, for example in electronic circuit boards, curtain textiles and fittings for vehicles. 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 200 000 tonnes (National Institute of Public Health 2002). 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 2003.

Box 7.2. Waste and waste statistics - terminology 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. The Norwegian General Standardizing Body has drawn up a new standard for waste classification, NS 9431 (NAS 2000). The objective is to encourage uniform use of categories when registering and reporting waste quantities.

In the Pollution Control Act, waste has until now been divided into three categories: consumer waste, production waste and special waste (including hazardous waste). In April 2003, the Act was amended and the terms production waste and consumer waste were replaced by industrial waste and household waste. These amendments will enter into force on 1 July 2004. According to the Pollution Control Act, the municipalities are responsible for collection and management of consumer waste, whereas after the amendment they will be responsible for household waste. In addition, the term municipal waste has been used for waste actually treated or administered in the municipal system. Until now, industrial waste has made up a little over half of all municipal waste. Once the amendments enter into force, it is likely that more of this waste will be dealt with by non-municipal actors.

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 products, etc.). Both material fractions and product types may belong to any of the above-mentioned categories.

Consumer waste: Ordinary waste, including large items such as fittings and furnishings from private households, shops, offices, etc.

Production waste: Waste from commercial activities and services which is significantly different in type or amount from consumer waste. Includes all waste that is not classified as consumer waste or hazardous waste.

Household waste: Waste from normal activities in private households.

Industrial waste: Waste generated by economic activities, both private and public. 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.

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 above) 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.

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 (see box 7.5).

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 and cooling equipment containing CFCs are not included in this definition.

Wet organic waste: Readily degradable organic waste, e.g. food waste and slaughterhouse waste. Park and garden waste is included in wet organic waste in the waste accounts unless otherwise specified.

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.

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.

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.

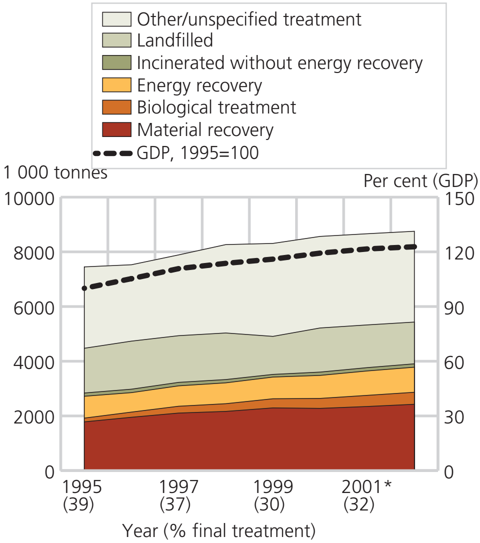
Energy recovery: Use of the energy released by waste incineration, for example to heat buildings.

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

Landfilling: Final disposal of waste at an approved landfill.

7.2. Waste accounts for Norway

Figure 7.1. Waste quantities in Norway 1995-2002* according to method of recovery or disposal (1 000 tonnes) and GDP 1995-2002 (percentage change, 1995=100)



Source: Waste accounts and national accounts, Statistics Norway.

Waste quantities and form of treatment/disposal

- From 1995 to 2002, annual waste generation rose from less than 7.5 to more than 8.7 million tonnes, a rise of 17.5 per cent. In the same period, GDP grew by 22.8 per cent. The rise in waste generation was considerably larger than population growth, which was 4.1 per cent in the same period.
- The quantity of waste delivered for final disposal dropped from 39 to 30 per cent of the waste for which we have information on the form of treatment or disposal. In 2002, treatment/disposal was unknown for 38 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 7.3. Waste accounts

The waste accounts are being developed on the basis of traditional principles for natural resource accounting, 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 a few selected characteristics of the waste. These are:

- material type
- product type
- source
- form of treatment/disposal

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.

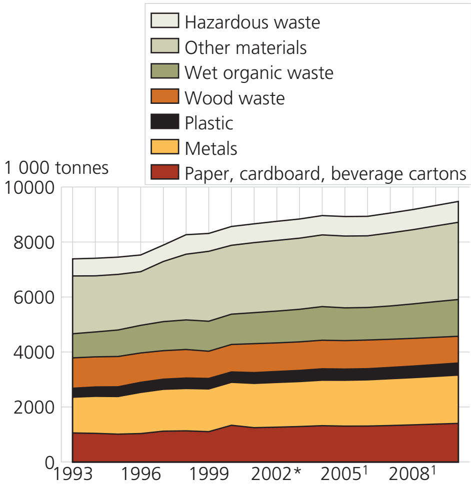
Two different methods have been used to estimate waste quantities. One is called the "supply of goods method", and is a theoretical method of estimating waste quantities. It is based on the assumption that waste quantities are equal to the supply of goods after correction for the lifetime of the products. 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 use different points in the waste stream as their starting points. 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.

The calculation methods will be further developed in the years ahead, and time series and already published figures may be revised.

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

Figure 7.2. Waste quantities in Norway, 1993-2002*. Projections for 2003-2010. By material. 1 000 tonnes

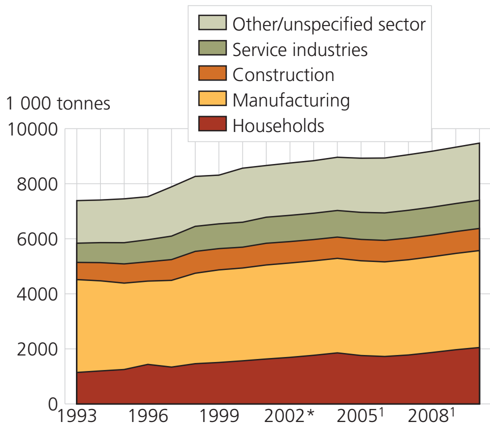


[1] Projections.
Source: Waste statistics, Statistics Norway.

Materials in waste

- Waste quantities are rising each year. The most rapidly-growing fractions are paper, wet organic waste and textiles, which are largely found in household waste.
- If this trend continues, total waste generation will exceed 9 million tonnes in 2007, but waste generation will grow less than Statistics Norway's prognoses for GDP up to 2005.
- The only waste fractions specified in the waste accounts that have shown a drop in the last ten years are wood and glass waste. For wood waste, this is probably explained by lower activity in the wood and wood products industry.
- "Other materials" include organic and inorganic sludge, slag, rubber, glass, china and ceramics, and dust, but not soil, gravel, etc.

Figure 7.3. Waste quantities in Norway, 1993-2002*. Projections 2003-2010. By source. 1 000 tonnes

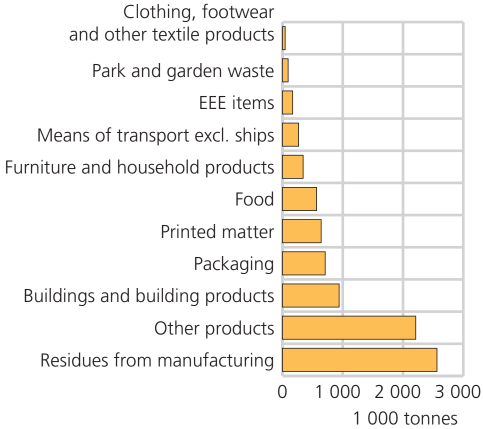


[1] Projections.
Source: Waste statistics, Statistics Norway.

Sources of waste

- Waste generation by households is rising. The quantity of household waste has grown at about the same pace as GDP, and in 2002 accounted for about 19 per cent of the total quantity of waste. If this trend seen in 1995-2000 is continuing, calculations show that household waste would have accounted for 20 per cent of the total in 2002 and will rise to almost 22 per cent in 2010.
- For other branches, the relationship between waste generation and GDP is less clear or uncertain.
- Manufacturing waste accounted for 39 per cent of the total in 2002. Of this, more than 80 per cent was production waste.

Figure 7.4. Waste by product type. 2000



Source: Waste statistics, Statistics Norway.

Product types

- The quantities of all fractions of waste by product type rose from 1995 to 2000.
- The product types park and garden waste, packaging, means of transport and printed matter rose most steeply from 1995 to 2000. For park and garden waste, only the proportion delivered is included. Ships of gross tonnage exceeding 100 t and large constructions are not included in the statistics.
- The category other products include large quantities of hazardous waste and 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.

Box 7.4. 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, using the macroeconomic model MODAG (Statistics Norway 2002) and waste statistics from the waste accounts (http://www.ssb.no/english/subjects/01/05/40/avfregno_en/). These projections have since been expanded to include all types of waste. The figures were calculated by linear regression analysis, using the quantity of waste of a given material as the dependent variable and gross production as the independent variable. The formula for projection of the quantity of waste of a given material m from source n in the year t is:

$$\text{Waste}(m,n,t) = \text{production}(n,t) * a + b,$$

where a is the slope of the regression line for an xy plot of waste (m,n) against production (n) for the period 1993-2000, and b is the y-intercept of the regression line in the same plot. For service industries, factor inputs were used as the dependent variable instead of production, and for households, consumption was used.

The results show that we can expect waste quantities to grow by about 8 per cent from 2002 to 2010. Household waste will account for about half of this growth, whereas the quantity of waste from manufacturing will hardly rise at all. Of material types, the organic fractions textiles, wet organic waste and paper are likely to increase most. 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 (taxes, statutory requirements, prohibitions, etc.) have not been taken into account in the calculations.

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

7.3. Hazardous waste

Box 7.5. New regulations relating to hazardous waste

On 1 January 2003, new Regulations relating to hazardous waste entered into force in Norway. At the same time, the EU amended its list of hazardous wastes, expanding it from 236 to 403 waste types. This list forms an appendix to the Norwegian regulations.

Because of their hazardous properties, many of the waste types that were added to the EU list already met the criteria for hazardous waste set out in appendix 3 to the Norwegian regulations. This meant that in many cases, the expansion of the list of hazardous wastes made the Norwegian legislation clearer rather than widening its scope.

However, in certain cases the legislation had not previously been enforced, and waste that in fact met the criteria set out in appendix 3 of the Hazardous Waste Regulations was treated as ordinary waste. One example was wood treated with preservatives. In the new regulations, wood waste containing dangerous substances is explicitly listed as a type of hazardous waste, and the authorities now require this type of waste to be dealt with according to the rules for hazardous waste.

The changes to the EU list of hazardous waste also triggered a critical review of waste types to find out whether waste previously considered to be non-hazardous in fact had dangerous properties. This revealed that certain types of waste, for example car seats, contain such large quantities of brominated flame retardants that they must be treated as hazardous waste.

On the basis of its own calculations and calculations made by the Norwegian Institute of Wood Technology, Statistics Norway estimates that with the new regulations, an additional 50 000 to 60 000 tonnes of the waste generated in Norway each year will be classified as hazardous waste. Wood treated with preservatives accounts for more than half of this. The authorities are seeking to establish a waste collection and recovery scheme for wood treated with preservatives in the course of autumn 2003.

Box 7.6. Hazardous waste management in Norway

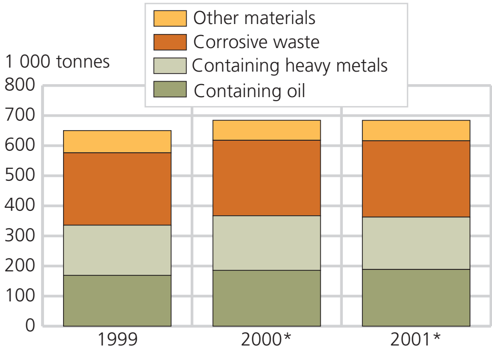
Normally, anyone who has hazardous waste is required to deliver it to an approved municipal facility. Waste is collected from such facilities by hazardous waste transport firms, and transferred to a firm that specialises in preliminary treatment, or directly to a firm that can carry out final treatment. 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, and the arrangements apply to almost 20 per cent of all hazardous waste that is generated.

Some companies hold permits to export hazardous waste. In 2001, just over 10 per cent of all hazardous waste was exported, about half of it directly from the enterprise where it was generated. Waste is most commonly exported directly by companies in the petroleum extraction and manufacturing sectors.

Hazardous waste that is dealt with without being reported to the authorities is considered to be dealt with outside the proper channels. In 2001, this applied to about 46 000 tonnes of hazardous waste. Some of this was probably in fact handled at approved facilities, but not reported to the authorities as required, while the rest was treated and/or disposed of illegally.

Figure 7.5. Hazardous waste by material. 1999-2001*

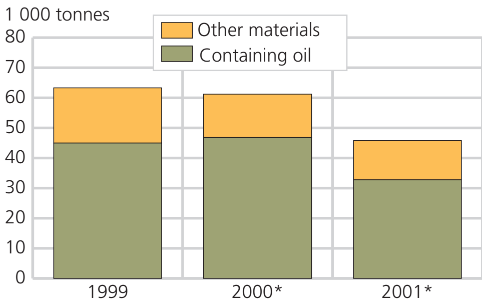


Source: Waste statistics, Statistics Norway.

Origin and materials

- Of the total quantity of 684 000 tonnes of hazardous waste, 638 000 tonnes was dealt with through the proper registered channels in 2001.
- About 2/3 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.
- In 2001, 10 per cent of Norway's hazardous waste was exported.

Figure 7.6. Hazardous waste dealt with outside the proper channels, by material. 1999-2001*



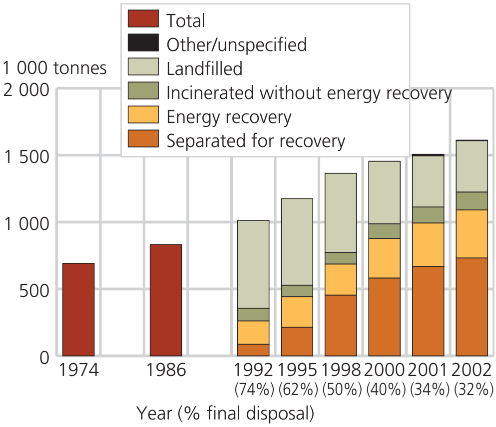
Source: Waste statistics, Statistics Norway.

Unknown treatment/disposal method

- About 46 000 tonnes of hazardous waste – 7 per cent of the total – was dealt with outside the proper channels in 2001, and may in the worst case have been dumped in the environment.
- The quantity of oil-contaminated waste dealt with outside the proper channels dropped from 47 000 tonnes in 2000 to 33 000 tonnes in 2001.
- Waste containing PCBs that is not dealt with through the proper channels is a serious environmental problem. About 6 000 tonnes of such waste was dealt with outside the proper channels each year in the period 1999-2001. Most of this consisted of insulating windows from the 1960s and 1970s.

7.4. Household waste

Figure 7.7. Household waste by method of recovery or disposal. 1974-2002



Source: Waste statistics, Statistics Norway.

Quantities and methods of disposal

- In 2002, per capita generation of household waste was 354 kg, 120 kg more than in 1992 and 19 kg more than in 2001. The 7 per cent rise from 2001 to 2002 is higher than the trend for the past ten years.
- In 2002, 732 000 tonnes of household waste, or 45 per cent of the total, was separated for recovery.
- After several years when the quantity of waste landfilled dropped, there was a small rise (1 856 tonnes) in 2002, and the quantity landfilled was 384 000 tonnes.

Box 7.7. 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 March 1998 No. 0197 relating to scrapped electrical and electronic products

Regulations of 10 December 1996 No. 1310 relating to scrapped refrigeration and freezing equipment containing CFCs

Regulations of 17 July 1990 No. 0616 relating to environmentally harmful batteries

Regulations of 26 June 2002 No. 0750 relating to end-of-life vehicles

Regulations of 25 March 1994 No. 0246 Regulations relating to the disposal, collection and recycling of discarded tyres

Regulations of 10 December 1993 No. 1182 relating to return schemes for packaging for beverages

Regulations of 3 January 2000 No. 0001 relating to refunding of a tax on trichloroethene (TRI)

Regulations of 20 December 2002 No. 1817 relating to hazardous waste

Regulations of 21 March 2002 No. 0375 relating to landfilling of waste

Regulations of 20 December 2002 No. 1816 relating to waste incineration

Regulations of 20 June 1997 No. 0627 relating to the incineration of hazardous waste

Regulations of 24 May 1995 No. 0508 relating to the incineration of municipal waste

Regulations of 20 May 1995 No. 0498 relating to the incineration of waste oil

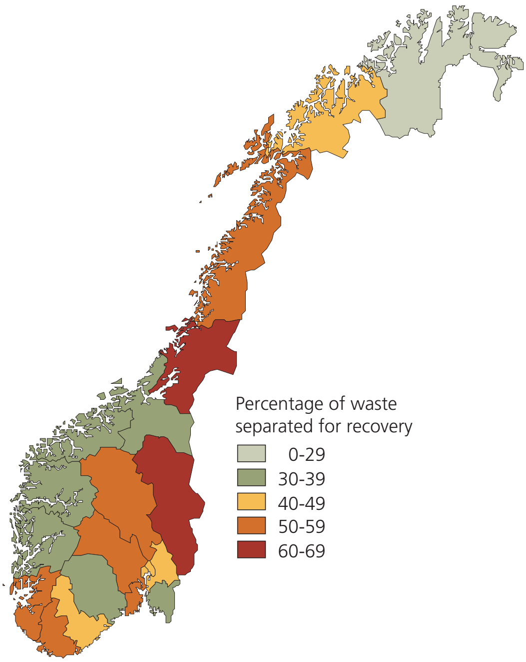
Regulations of 30 December 1994 No. 1231 relating to transboundary movements of waste

Regulations of 23 September 1994 No. 0902 relating to waste water contaminated with amalgam and waste from dental clinics and dental surgeries

Regulations of 13 December 2002 No. 1236 on fees for the declaration of hazardous waste

In addition, there is separate legislation governing animal waste, infectious waste, explosive waste and radioactive waste.

Figure 7.8. Percentage of household waste separated, by county. 2002



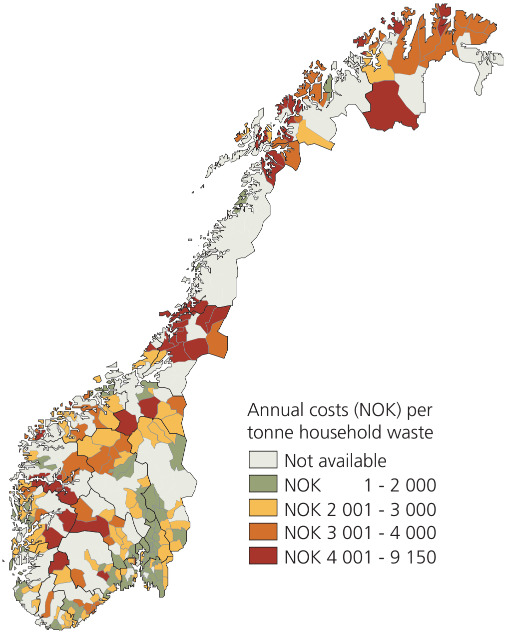
Source: Waste statistics, Statistics Norway.

Waste recovery

- In 2002, each person in Norway separated 161 kg of household waste for recovery, 13 kg more than in 2001. The proportion of household waste delivered for final disposal (incineration without energy recovery and landfilling) in 2002 was 32 per cent.
- The highest proportions of household waste were separated in Hedmark and Nord-Trøndelag counties, 68 and 65 per cent respectively. The lowest proportion, 15 per cent, was in Finnmark.
- In 2002, the largest fractions of separated waste were paper and board and wet organic waste (food waste). These materials accounted for 34 and 19 per cent respectively of the total sorted. Plastic accounted for only 1 per cent of the total. However, new technology has made it possible to separate different types of plastic automatically.
- More and more municipalities are introducing collection schemes for separated waste. In 2002, 393 municipalities had collection schemes for paper and 307 for wet organic waste. Only 5 per cent of the population lived in areas with no collection scheme for separated waste in 2002. In these areas, only the residual waste is collected, and people must deliver separated waste to collection points themselves.

7.5. Financial situation in the municipal waste management system

Figure 7.9. Annual costs per tonne of household waste, by municipality. 2002



Waste management costs not fully covered by fees

- On average, the annual costs per tonne of household waste collected in 2002 were NOK 1 867.
- The overall costs incurred by the municipalities in managing consumer waste in 2002 were NOK 3.0 billion.
- In the same year, the municipalities charged a total of NOK 2.8 billion in waste management fees.
- This means that 92 per cent of the costs were covered by fees (see Appendix, table G9).
- The average annual fee per subscriber for household waste was NOK 1 718 in 2003.
- 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. However, in most cases the municipalities collect the fees. Since the municipalities to a large extent purchase waste management services externally, there is little investment in the municipal waste management sector.
- In 2002, the municipalities invested NOK 170 million in the municipal waste management sector. This is only about 1/10 of what is invested in the municipal waste water sector.

More information: Øystein Skullerud, Håkon Skullerud and Tone Smith (financial data).

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 over-exploitation and degradation, it is important to monitor developments. 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.

At present a large number of water works still do not meet the requirements of the drinking water regulations. Estimates from 2002 indicate that only 20 per cent have been approved. There are many reasons for this. Even though the regulations require that all water from surface water sources shall be disinfected, many 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. Many smaller water works must therefore at regular intervals issue recommendations to their users to boil the water they supply. However, most people in Norway are supplied with drinking water of good quality (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.

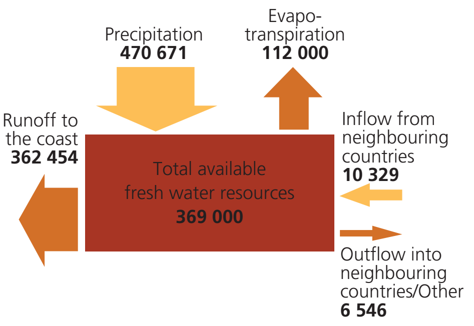
Discharges of phosphorus and nitrogen from the waste water treatment sector have been a matter of concern for many years, because these plant nutrients play an important role in the eutrophication of rivers, lakes and coastal areas. Eutrophication causes excessive growth of algae and oxygen depletion. Agriculture and aquaculture 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 waste water directive and the nitrate directive), 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. Million m³

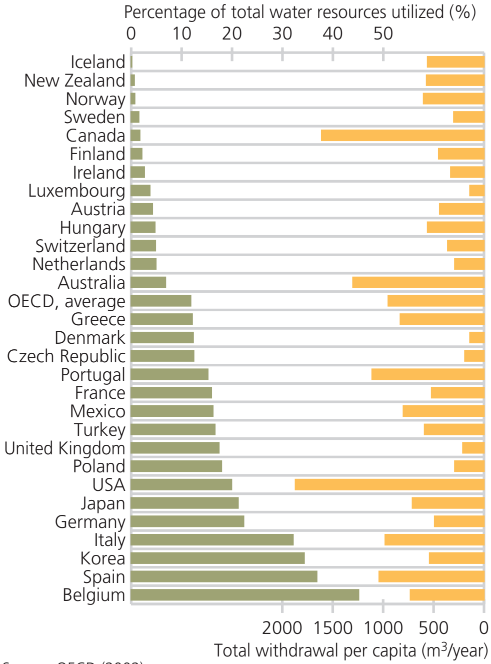


Source: Based on data from the Norwegian Institute for Water Research.

Available water resources

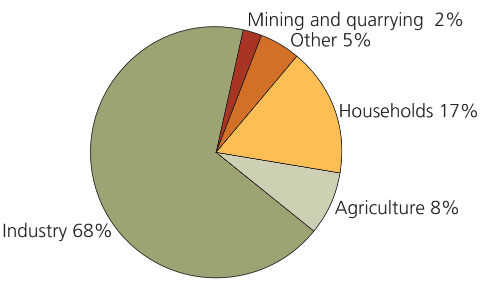
- Renewable water resources in Norway in a normal year total about 369 billion m^3.
- 98 per cent of the annual input of water resources is in the form of precipitation, while the remainder is in the form of incoming water flows via rivers from our three neighbouring countries.
- About 77 per cent of 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 end of the 1990s



Source: OECD (2002).

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



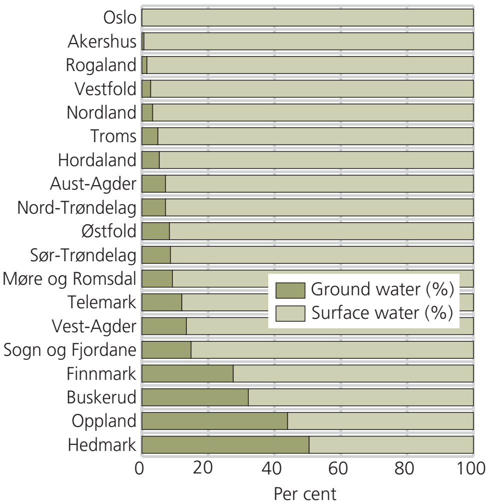
Source: Provisional figures from Statistics Norway.

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 (98 per cent) or via rivers to neighbouring countries (2 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 600 m^3 of water is withdrawn annually per inhabitant in Norway. This is well below the average for the OECD countries (950 m^3). The average American uses 1 870 m^3, while an inhabitant of Denmark uses 140 m^3.
- A total of about 2 400 million m^3 of water is used annually in Norway. The largest share, just under 1 700 million m^3, is used by manufacturing industries. The sectors that utilize most are the wood processing industry, the food processing industry and the petrochemical industry.
- Over 400 million m^3 is used by households. Approximately 90 per cent of this amount is supplied by public water works. Industry and agriculture largely meet their water needs from their own sources.

8.2. Public water supplies

Figure 8.4. Percentage of population connected to public water works using various sources of drinking water[1]. 2002. By county

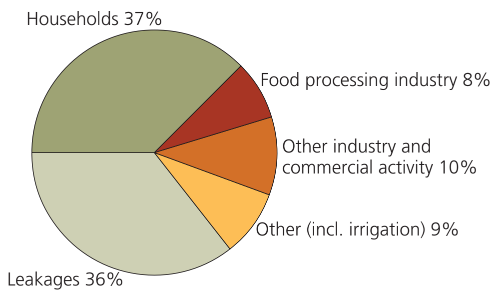


[1] The figure is based solely on public water works that have reported their water source for 2002 and the overall picture may therefore be distorted.
Source: National Institute of Public Health.

Water sources

- In 2002, water was supplied to about 90 per cent of Norway's population by about 1 700 water works 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 2002, 66 per cent of Norway's water works used surface water as their source of water, while the remainder used groundwater.
- The counties that in 2002 had the highest percentage of the population connected to water works using groundwater as their source were Hedmark and Oppland.

Figure 8.5. Percentage of public water supplies used by various sectors[1]. 2002

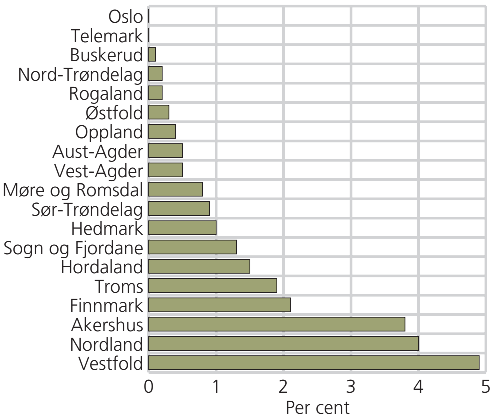


[1] The figure is based on 2002-data for 323 water works. These water works supplied 1.8 million persons. The figures are uncertain.
Source: National Institute of Public Health.

Consumption of water

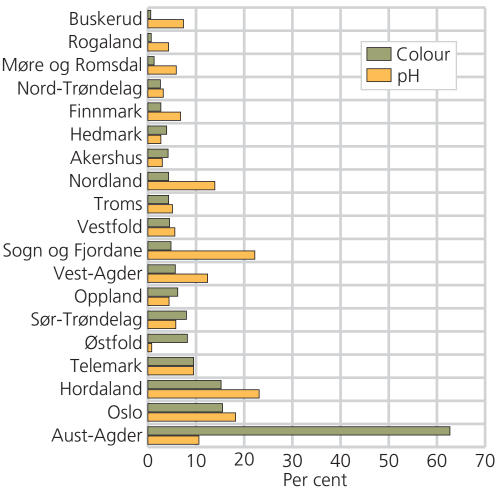
- In 2002, water production at Norwegian water works was calculated to be 789 million m^3, with households using 37 per cent of this total.
- About a third of the water produced was lost due to leakages from pipelines and joints.
- Average household consumption is estimated at 193 litres per person per day.
- There is substantial uncertainty associated with these figures as they are largely based on estimates from the water works.

Figure 8.6. Percentage of samples from municipal water works that do not satisfy the requirements with respect to content of thermo-tolerant intestinal bacteria. By county. 2002



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

Figure 8.7. Percentage of samples from municipal water works that do not satisfy the requirements with respect to pH and colour. By county. 2002



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

Water quality

- It is important to ensure that drinking water is not infected by intestinal 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 and membrane filtration.
- A number of water works using surface water as their source are finding it hard to satisfy the requirements with respect to thermo-tolerant intestinal bacteria. In 2002, the highest percentages of unsatisfactory samples were recorded in the counties of Vestfold, Akershus and the three northernmost counties.
- 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 sewers. Chlorination of water containing humus may result in the formation of organic chlorine compounds, with potential effects on odour, taste and health.
- A number of water works in densely populated areas in Eastern Norway are finding it difficult to meet the acidity and colour requirements.
- 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 brown-coloured water is mainly due to humus and organic material deposited in water sources during rainfall and minor flooding.

Box 8.1. Concepts related to nutrient inputs to coastal areas and inland waters

North Sea Agreements
The North Sea Agreements/OSPAR convention 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.

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 8.2. Terms, municipal waste water treatment

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 incorporate 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 micro-organisms. 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 similar facilities, micro-organisms decompose the organic material in the waste water and plants utilise the nutrients.

The number of **population equivalents (PE)** 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.

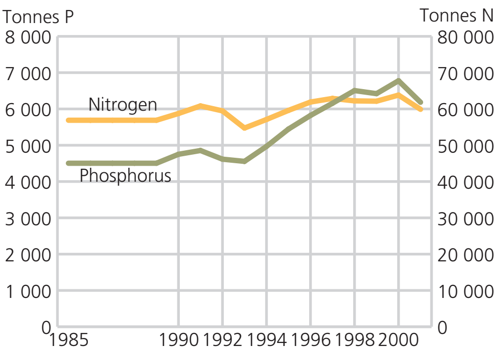
The hydraulic capacity of a treatment plant is the amount of waste water it is designed to treat.

The hydraulic load is the amount of waste water a treatment plant actually treats.

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

8.3. Inputs of nutrients to coastal areas

Figure 8.8. Inputs of phosphorus and nitrogen to the Norwegian coast. 1985-2001

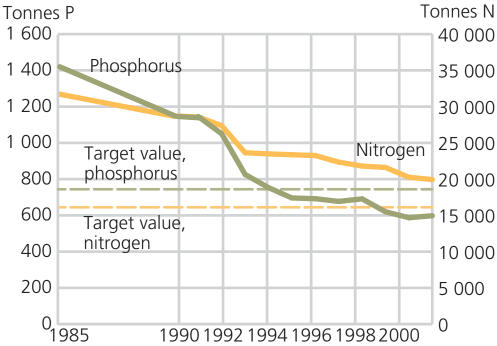


Source: Norwegian Institute for Water Research.

The Norwegian coast

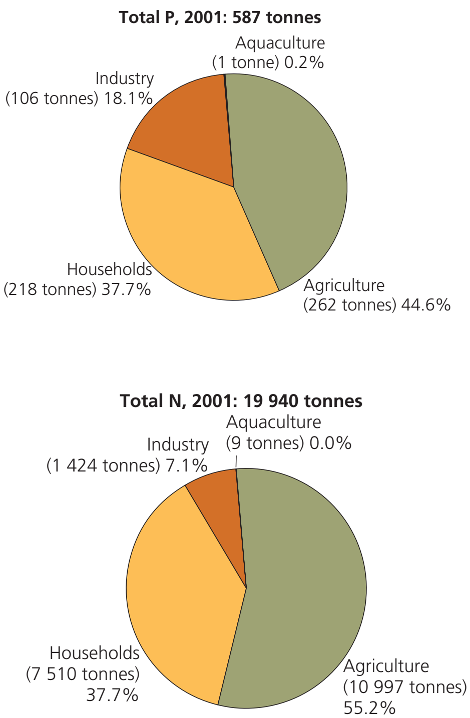
- Although total anthropogenic inputs of phosphorus and nitrogen to the coast were higher in 2001 than in 1985, by 37 and 5 per cent respectively, discharges from all sectors, with the exception of fish farming, have declined. The 2001 figures for fish farming also show a declining trend.
- Due to the 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 2001, phosphorus discharges were 3 866 tonnes higher and nitrogen discharges 18 508 tonnes higher than in 1985. Today, this industry accounts for 68 per cent of phosphorus inputs and 34 per cent of nitrogen inputs to coastal areas.

Figure 8.9. Inputs of phosphorus and nitrogen to the North Sea region. 1985-2001



Source: Norwegian Institute for Water Research.

Figure 8.10. Inputs of phosphorus and nitrogen to the North Sea region by sector. 2001



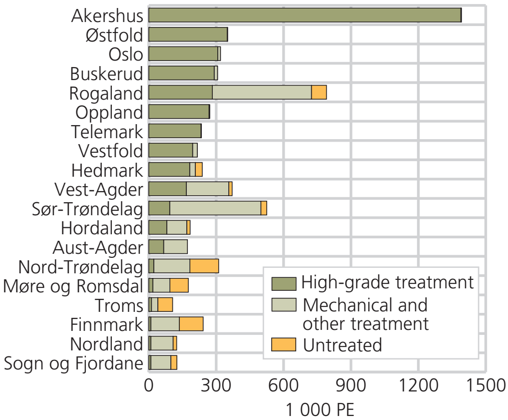
Source: Norwegian Institute for Water Research.

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 aquaculture sector.
- Phosphorus and nitrogen inputs to the sensitive North Sea region (from the border with Sweden to Lindesnes) have been reduced by 60 and 38 per cent respectively from 1985 to 2001.
- This means that the target set for phosphorus in the North Sea Agreements has already been achieved, but that there is some way to go before the nitrogen target is reached (see box 8.1).
- Phosphorus inputs from municipal waste water treatment plants (households) have been reduced by 710 tonnes (76 per cent) since 1985 and nitrogen inputs by 4 419 tonnes (37 per cent).
- Phosphorus inputs from agriculture have been reduced by around 35 per cent and nitrogen inputs by 25 per cent since 1985.
- Phosphorus and nitrogen inputs from manufacturing industry have been reduced by 21 and 75 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.

8.4. Municipal waste water treatment

Figure 8.11. Hydraulic capacity of waste water treatment plants[1], by treatment method. By county. 2001



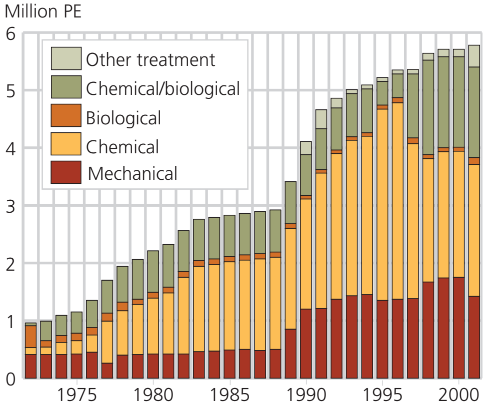
[1] Facilities with a capacity of more than 50 PE.
Source: Waste water statistics, Statistics Norway.

Treatment capacity at waste water treatment facilities

- In 2001, total waste water treatment capacity in Norway was 5.77 million population equivalents (PE), 68.8 per cent of which was high-grade capacity. In addition, systems with direct discharges of untreated sewage had a total capacity of 0.55 million PE.
- High-grade treatment methods account for 94.6 per cent of treatment capacity in the North Sea counties, but only 30 per cent of the total in the rest of the country.
- High-grade treatment capacity in the North Sea region totals 1.5 PE per inhabitant, while the equivalent figure for the rest of the country is 0.46 PE. This is a marked increase from 2000 for both areas, caused mainly by upgrading of existing plants.

- 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. See figure 8.12, p. 154.
- 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.

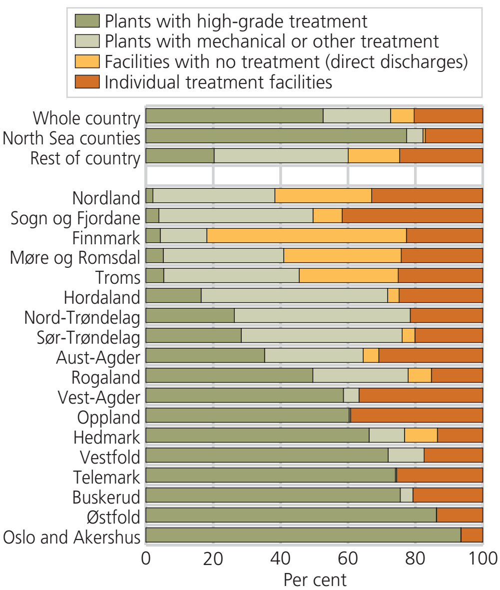
Figure 8.12. Trend in treatment capacity[1]. Whole country. 1972-2001



[1] Facilities with a capacity of more than 50 P.E.
Source: Waste water statistics, Statistics Norway.

- Increased use of natural purification processes may explain the increased capacity in the category "Other treatment" in 2001. In this year, municipalities were given responsibility for issuing discharge permits up to 1 000 PE, and many new treatment techniques based on natural purification were introduced in the market.
- Upgrading of older mechanical plants may explain the decrease in capacity of this category in 2001.

Figure 8.13. Percentage of population connected to various types of treatment plants. By county. 2001



Source: Waste water statistics, Statistics Norway.

Connection to waste water treatment plants

- In 2001, 80 per cent of the population of Norway were connected to waste water treatment plants with a capacity greater than 50 PE and to municipal sewerage systems. The remaining 20 per cent were connected to smaller, individual treatment facilities.
- Over 50 per cent of the population were connected to high-grade treatment plants in 2001. In the North Sea counties, this proportion was 77 per cent, while the figure for the rest of the country was 20 per cent.

Discharges of plant nutrients from waste water treatment plants

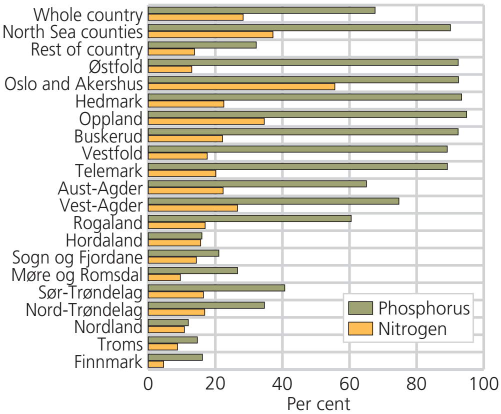
- Discharges of phosphorus and nitrogen from the waste water treatment sector in 2001 totalled 1 280 and 16 723 tonnes respectively. This includes leakages from sewers and discharges from individual treatment facilities.
- Plants in the North Sea counties accounted for 29 per cent of the phosphorus discharges and 54 per cent of the nitrogen discharges. This corresponds to a discharge of 0.15 kg phosphorus and 3.5 kg nitrogen per inhabitant per year. The equivalent figures for the rest of the country were 0.45 kg phosphorus and 3.9 kg nitrogen.

Table 8.1. Total discharges of phosphorus and nitrogen from sewerage systems 2000 and 2001. By county. 2001

	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	**1 295.7**	**825.4**	**124.4**	**345.9**	**0.29**	**17 373.8**	**13 191.4**	**912.4**	**3 270**	**3.88**
Total 2001	**1 280.1**	**794.8**	**123.2**	**362.1**	**0.28**	**16 722.8**	**12 302.9**	**859.8**	**3 560.1**	**3.71**
North Sea counties	367.9	148.9	75.1	143.9	0.15	8 778.9	6 685.0	530.4	1 563.6	3.54
Other counties	912.3	645.9	48.1	218.2	0.45	7 943.9	5 617.9	329.4	1 996.6	3.93
Østfold	31.9	11.7	7.7	12.4	0.13	1 087.3	914.3	52.5	120.5	4.33
Akershus and Oslo	107.9	51.3	34.1	22.6	0.11	2 646.7	2 161.5	242.0	243.2	2.70
Hedmark	31.8	6.1	4.7	21.0	0.17	802.1	507.0	32.7	262.4	4.27
Oppland	28.0	4.8	4.7	18.5	0.15	721.1	430.0	32.9	258.2	3.93
Buskerud	34.1	10.0	6.6	17.5	0.14	916.5	692.8	44.5	179.2	3.84
Vestfold	39.6	13.3	6.1	20.1	0.18	935.5	725.6	44.0	165.9	4.35
Telemark	28.9	8.2	3.8	16.8	0.17	644.4	453.7	28.4	162.3	3.89
Aust-Agder	32.7	21.5	3.1	8.1	0.32	396.7	290.8	18.7	87.2	3.86
Vest-Agder	33.0	21.9	4.3	6.8	0.21	628.6	509.4	34.7	84.5	4.01
Rogaland	110.4	77.3	9.9	23.2	0.29	1 498.2	1 131.4	68.9	297.8	3.99
Hordaland	176.9	123.6	7.5	45.9	0.40	1 645.7	1 157.2	69.5	419.1	3.75
Sogn og Fjordane	51.4	31.8	2.0	17.6	0.48	426.7	240.2	14.2	172.2	3.97
Møre og Romsdal	126.8	90.4	6.3	30.2	0.52	1 028.5	732.7	41.3	254.5	4.22
Sør-Trøndelag	140.8	110.6	9.3	20.9	0.53	932.1	705.3	42.2	184.7	3.52
Nord-Trøndelag	59.5	37.7	2.9	18.8	0.47	512.1	337.2	20.3	154.6	4.02
Nordland	119.3	78.1	4.6	36.6	0.50	948.0	609.8	35.1	303.1	3.98
Troms	84.1	62.8	3.7	17.7	0.55	613.2	443.6	24.3	145.2	4.04
Finnmark	43.0	33.6	2.0	7.3	0.58	339.5	260.5	13.7	65.3	4.58

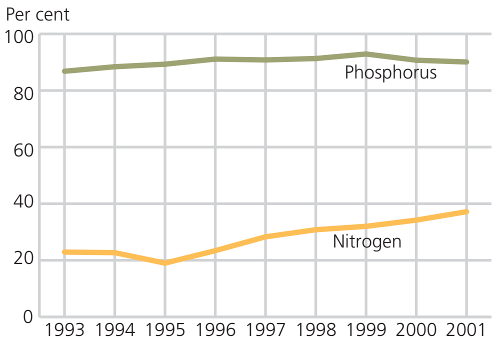
[1] Estimated at 5 per cent of the content of phosphorus and nitrogen in waste water before treatment.
Source: Waste water statistics, Statistics Norway.

Figure 8.14. Estimated treatment effect for phosphorus and nitrogen. By county. 2001



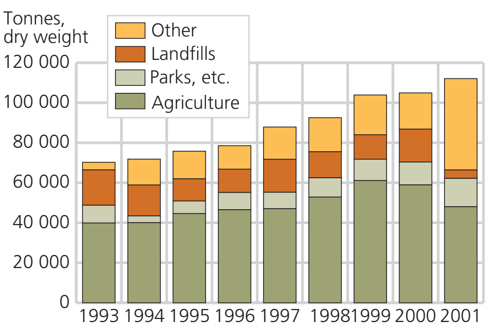
Source: Waste water statistics, Statistics Norway.

Figure 8.15. Trend in treatment effect for phosphorus and nitrogen in the North Sea region. 1993-2001



Source: Waste water statistics, Statistics Norway.

Figure 8.16. Quantities of sewage sludge used for different purposes. Whole country. 1993-2001



Source: Waste water statistics, Statistics Norway.

Treatment efficiency

- In 2001, waste water treatment plants in the North Sea counties removed on average 90 per cent of the phosphorus and 37 per cent of the nitrogen load processed by the plants. In the rest of the country, treatment efficiency for these nutrients was 32 and 14 per cent respectively.
- In the North Sea region, a decrease of 1 per cent in treatment efficiency for phosphorus was registered from 1999 to 2000. An increase of 3 per cent was registered for nitrogen. 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 by more than 18 percentage points due to the construction of nitrogen removal plants in the Oslofjord area.

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 2001, 112 096 tonnes of sludge, expressed as dry weight, was used for various purposes, an increase of 6.7 per cent compared with 2000. Since 1993 there has been a 59 per cent increase.

- If the content of heavy metals exceeds the limit values, the sludge cannot be used in integrated plant nutrient management.
- Lower mean values for the content of most heavy metals were registered in 2001 than in the previous year. This has been the trend over the past few years.
- 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).

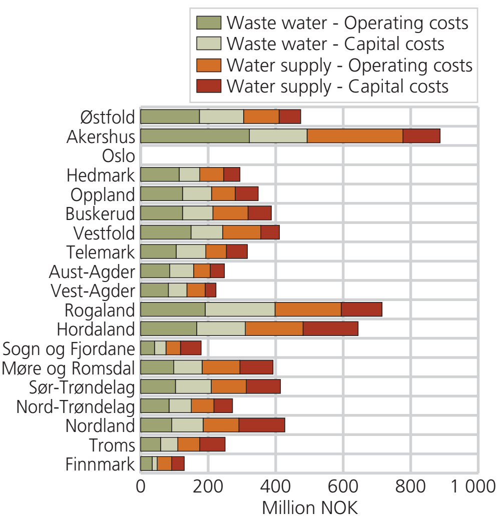
Table 8.2. Content of heavy metals in sludge. 2001

Heavy metals	Mean value	Maximum value	Limit value agriculture	Limit value parks etc.	Change in mean value 2000-2001
	Milligrams per kg expressed as dry weight				Per cent
Cadmium (Cd)	1.0	5.9	2	5	0.0
Chromium (Cr)	24.5	552.0	100	150	-0.3
Copper (Cu)	227.0	2 200.0	650	1 000	-17.1
Mercury (Hg)	0.8	41.0	3	5	-0.1
Nickel (Ni)	12.7	912.0	50	80	-1.8
Lead (Pb)	16.4	130.0	80	200	-4.2
Zinc (Zn)	302.8	1 720.0	800	1 500	-14.6

Source: Waste water statistics, Statistics Norway.

8.5. Financial situation in the municipal water and waste water sectors

Figure 8.17. Annual costs in the water supply and waste water sectors, by type. By county[1]. 2002

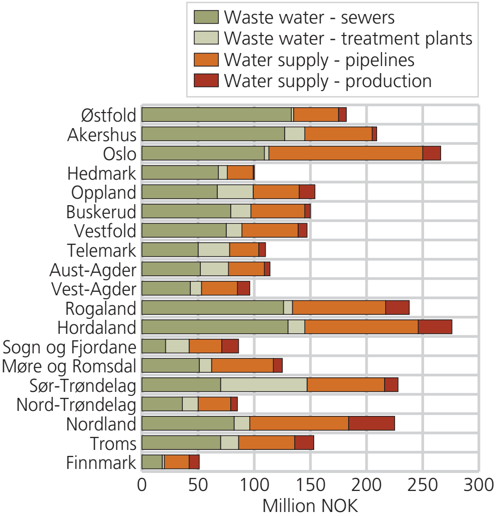


[1] Oslo did not report figures for annual costs in 2002. National figures have been estimated.
Source: Environmental protection expenditure statistics, Statistics Norway.

Costs

- In 2002, annual costs in the municipal water and waste water sectors totalled NOK 7.7 billion. Of this, the water supply accounted for NOK 3.5 billion and waste water for NOK 4.2 billion.
- In most counties, operating costs are higher than capital costs. At the national level, operating costs constitute 57 per cent of the total annual costs of the waste water sector. The corresponding figure for the water supply sector was 55 per cent. However, the potential for improvements in efficiency lies in the operating costs.
- Municipalities in Norway are not allowed to charge more through fees than they need to cover the costs of the service. In 2002, revenues from fees totalled 96 per cent of the annual costs of the waste water sector. The corresponding figure for the water sector was 92 per cent.

Figure 8.18. Investments in the water supply and waste water sectors, by type. By county. 2002

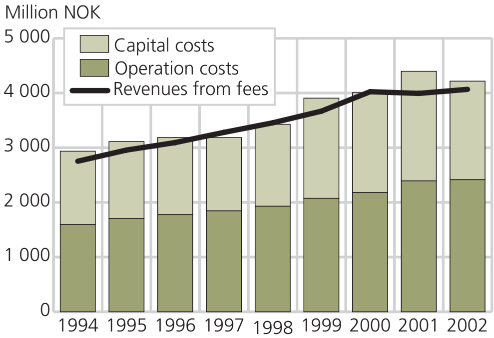


Source: Environmental protection expenditure statistics, Statistics Norway.

Investments

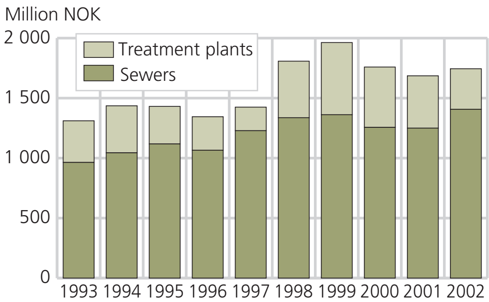
- Investments in the municipal water supply sector in 2002 totalled NOK 1 250 million. The corresponding figure for the waste water sector was NOK 1 745 million.
- The share of total investments in distribution systems (sewage and water pipelines) in 2002 was the same for both the waste water and the water supply sector, i.e. 81 per cent of total investments.
- Investments vary widely across municipalities and counties. This is partly related to the number of inhabitants and settlement structure. For the waste water sector it also depends on whether counties are included in the North Sea Agreements or not.
- Due to stricter requirements in the forthcoming waste water regulations, upgrading will be required in a number of treatment plants in Western Norway and northwards. The Pollution Control Authority estimates the need for investments at NOK 1-1.5 billon up to the end of 2006 (Norwegian Pollution Control Authority 2003).

Figure 8.19. Costs and revenues from fees in the waste water sector, by type. Whole country. 1994-2002



Source: Environmental protection expenditure statistics, Statistics Norway.

Figure 8.20. Investments in the waste water sector, by type. Whole country. 1993-2002



Source: Environmental protection expenditure statistics, Statistics Norway.

Decrease in costs in waste water sector

- In 2002, the annual costs in the waste water sector totalled NOK 4 216 million, a decrease of 4.1 per cent compared to the year before. For the first time since 1994, annual costs have decreased.
- For the country as a whole, the ratio between annual costs and revenues from fees has been relatively constant over the period from 1994. The ratio has varied far more at municipal level, however. An increasing number of municipalities have decided on a 100 per cent cost coverage for this sector.

Varying investments in the waste water sector

- In 2002, investments in the municipal waste water sector totalled NOK 1 745 million, an increase of 3.5 per cent compared with 2001.
- Investments in the sewage system increased by 12.6 per cent from 2001 to 2002. Investments in waste water treatment plants have, on the other hand, continued to decrease.

More information: Tone Smith (financial data) and Jørn Kristian Undelstvedt.

Useful websites

Norwegian Institute of Public Health: http://www.fhi.no/english/
State of the Environment Norway: http://www.environment.no/
Norwegian Institute for Water Research: http://www.niva.no/engelsk/welcome.htm
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/

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Ministry of Health (2001): *Drikkevannsforskriften - Forskrift om vannforsyning og drikkevann* (Regulations relating to water supplies and drinking water). FOR 2001-12-04, no. 1372

Norwegian Food Control Authority (2003): Article on the Authority's web-site: http://www.snt.no/dokumentasjon/maten/2002/drikkevann.htm (In Norwegian only).

Norwegian Pollution Control Authority (2003): Public consultation on proposal for two general pollution regulations concerning products and pollution. Letter of consultation of 22 July 2003.

OECD (2002): *OECD Environmental Data. Compendium 2002*. Organisation for Economic Co-operation and Development. Paris.

9. Land use

With a land area of 306 252 km² and 4.5 million inhabitants, Norway has the second lowest population density in Europe after Iceland. 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.

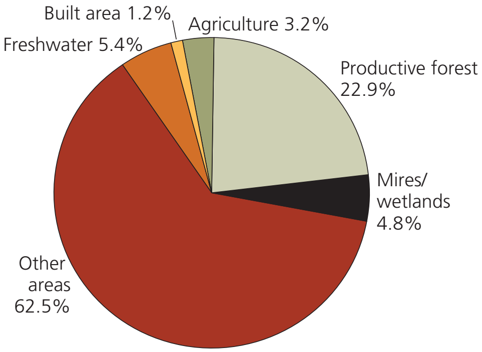
How the land is used is of great importance in terms of economics and the environment, and it affects people's lives. Changes in land use result in changes in the cultural landscape and the local environment. This has considerable impact on human health and quality of life, and on the productivity and 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 (Reports No. 8 (1999-2000), No. 24 (2000-2001) and No. 25 (2002-2003)), which set national targets for biological diversity, outdoor recreation and the cultural heritage.

9.1. Land use in Norway

Figure 9.1. Proportion of different types of land cover. Mainland Norway. 2000



Source: Norwegian Mapping Authority and Statistics Norway.

The most common types of land use

- In 2000, developed land contained a total of 3.4 million buildings, 4 000 km of rail track and 91 000 km of public roads, in addition to about 73 000 km of forest roads and other roads. (Norwegian Mapping Authority 2002 and Norwegian State Railways 1992).
- Agricultural area covers about 10 400 km² and productive forest about 75 000 km² (Norwegian Institute for Land Inventory 1999).
- The remaining land area comprises other cultivated land, non-developed coastal areas, scrub and heaths, marginal forest, and mountains. About 2 600 km² 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 323 758 km² in total (306 252 km² land and 17 505 km² 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 2003, pp. 19-23 and 47- http://www.ssb.no/english/yearbook/).

Box 9.2. Protected areas. Overview of legislation

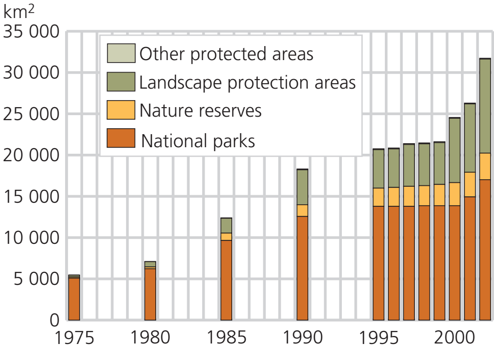
Most of the protected areas in Norway are protected under the Nature Conservation Act. Other legislation and treaties of importance in this connection include:

- 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.

9.2. Protection and development

Figure 9.2. Areas protected under the Nature Conservation Act. Whole country. 1975-2002. 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 2003, protected areas included 19 national parks, 1 615 nature reserves, 126 protected landscapes and 79 other types of protected area. See also Appendix, table I5.
- Protected areas account for about 31 700 km² or 9.8 per cent of Norway's total area.
- At the end of 2002, a total of 2 292 km² of forest had been protected, of which 751 km² productive forest. This included 570 km² of productive coniferous forest, or just below 1 per cent of the total productive coniferous forest area (Directorate for Nature Management 2003).

Box 9.3. Building activity in the 100-metre belt along the coast

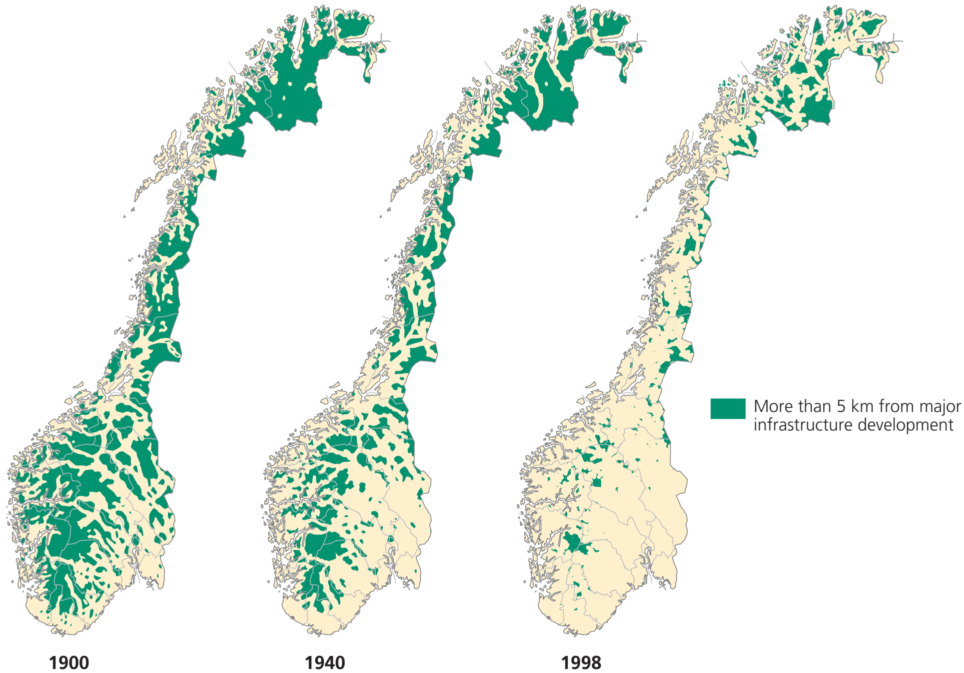
Protecting areas of recreational value is an expressed national target. Several specific key figures have been drawn up as operational tools to monitor developments in relation to the national targets for the priority area *Outdoor recreation* in environmental policy.

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 23.4 per cent of the total length of the coastline is less than 100 metres from the nearest building (registered in the GAB as of 1 January 2003). 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 38.7 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 1.9 and Appendix, table I4).

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 about 12 per cent in 1998. See also figure 1.8 in Chapter 1.

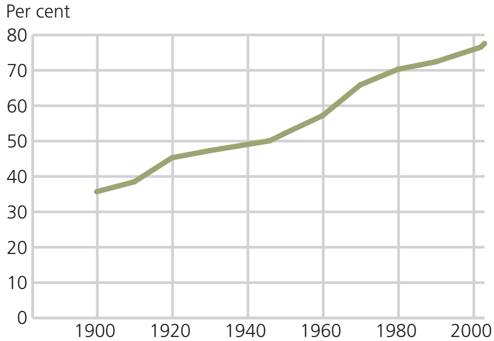
Figure 9.3. Wilderness-like areas. 1900, 1940 and 1998



Source: Directorate for Nature Management and Norwegian Mapping Authority.

9.3. Area and population in urban settlements

Figure 9.4. Percentage of population resident in urban settlements/densely populated areas. 1900-2003



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 2003. A total of 77.6 per cent of the Norwegian population lived in a total of 932 urban settlements at 1 January 2003.
- Close to half of the population growth in urban settlements in 2002 occurred in the four largest towns: Oslo, Bergen, Stavanger/Sandnes and Trondheim.

- From 2002 to 2003 urban settlement area in Norway increased somewhat more than the number of residents in urban settlements. This may indicate that land use is becoming less effective. However, since the changes are small and the observation period relatively short, these figures must be used with caution. (See also Statistics Norway 2002a and 2003c).
- The smallest urban settlements of between 200 and 499 residents have expanded most from 2002 to 2003.
- Finnmark is the only county where the population in urban settlements decreased in 2002.

Table 9.1. Urban settlements. Residents and area, by size of population. 2003. Change from 2002 to 2003

	Number	Population	Residents per km²	Total area in km²	Percentage change in population 2002-2003	Percentage change in area 2002-2003
All settlements	932	3 514 417	1 580	2 225	1.1	1.4
200 - 499	361	123 077	711	173	3.3	5.0
500 - 999	221	153 466	833	184	-1.4	0.1
1 000 - 1 999	142	199 127	991	201	0.0	-0.5
2 000 - 19 999	189	996 220	1 340	744	1.5	1.9
20 000 - 99 999	15	722 956	1 696	426	0.9	1.3
100 000 -	4	1 319 571	2 659	496	1.3	1.1

Source: Population statistics and land use statistics, Statistics Norway.

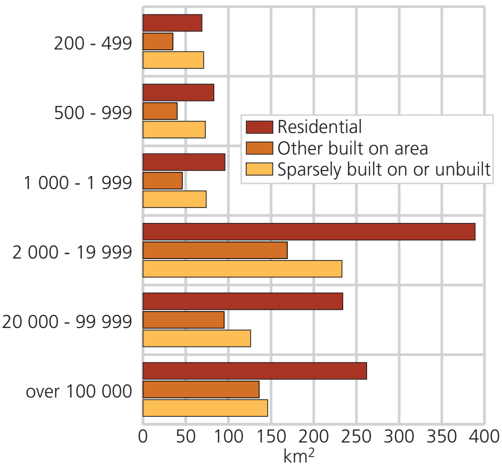
Box 9.4. Delimitation of urban settlements and background data

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. Land use in urban settlements, by size of population. 2002*



Source: Land use statistics, Statistics Norway.

Land use in urban settlements

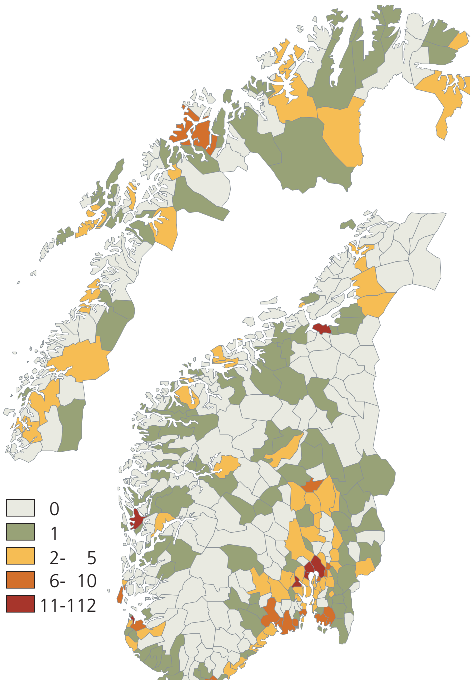
- The total area used for housing and holiday cabins accounted for between 39 and 48 per cent of the total land area in the various size categories of urban settlements.
- Areas used for purposes other than housing and holiday cabins accounted for between 20 and 25 per cent.
- Between 27 and 41 per cent of urban settlement area is characterised as *sparsely built on* or *unbuilt*.

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 2002c-g).

Figure 9.6. Number of centre zones by municipality. 2003



Source: Land use statistics, Statistics Norway.

Centre zones

- Centre zones (see box 9.6 and figure 9.6) only figured in 230 of Norway's 932 urban settlements as of 1 January 2003, and tend not to be formed in the smallest urban settlements (Statistics Norway 2003b).
- 9.5 per cent of Norway's population were resident in centre zones. Residential density in these centres was about twice the level in other parts of the urban settlements.
- The total of 112 large and small centre zones recorded in the City of Oslo housed 43.2 per cent of the population.

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 2002b)

9.4. Key figures for national targets for recreational areas

Table 9.2. Percentage of day care centres, schools, residential housing and residents with access to play and recreational areas. 2002*

	Day care centres	Schools	Residen-tial –row, detached houses, etc.	Residen-tial – blocks of flats	Resi-dents
Whole country ..	87	88	84	66	81
Oslo	78	79	67	67	71
Bergen	74	75	80	52	75
Stavanger/Sandne	68	71	57	56	59
Trondheim	75	82	69	58	72

Source: Land use statistics, Statistics Norway.

Table 9.3. Percentage day care centres, schools, residential buildings and residents with access to nearby outdoor recreational areas. 2002*

	Day care centres	Schools	Residen-tial –row, detached houses, etc.	Residen-tial – blocks of flats	Resi-dents
Whole country ..	83	82	87	61	81
Oslo	60	61	67	41	58
Bergen	75	72	80	65	78
Stavanger/Sandnes	41	44	43	28	42
Trondheim	50	40	59	27	56

Source: Land use statistics, Statistics Norway.

Access to play and recreational areas and nearby areas for outdoor recreation

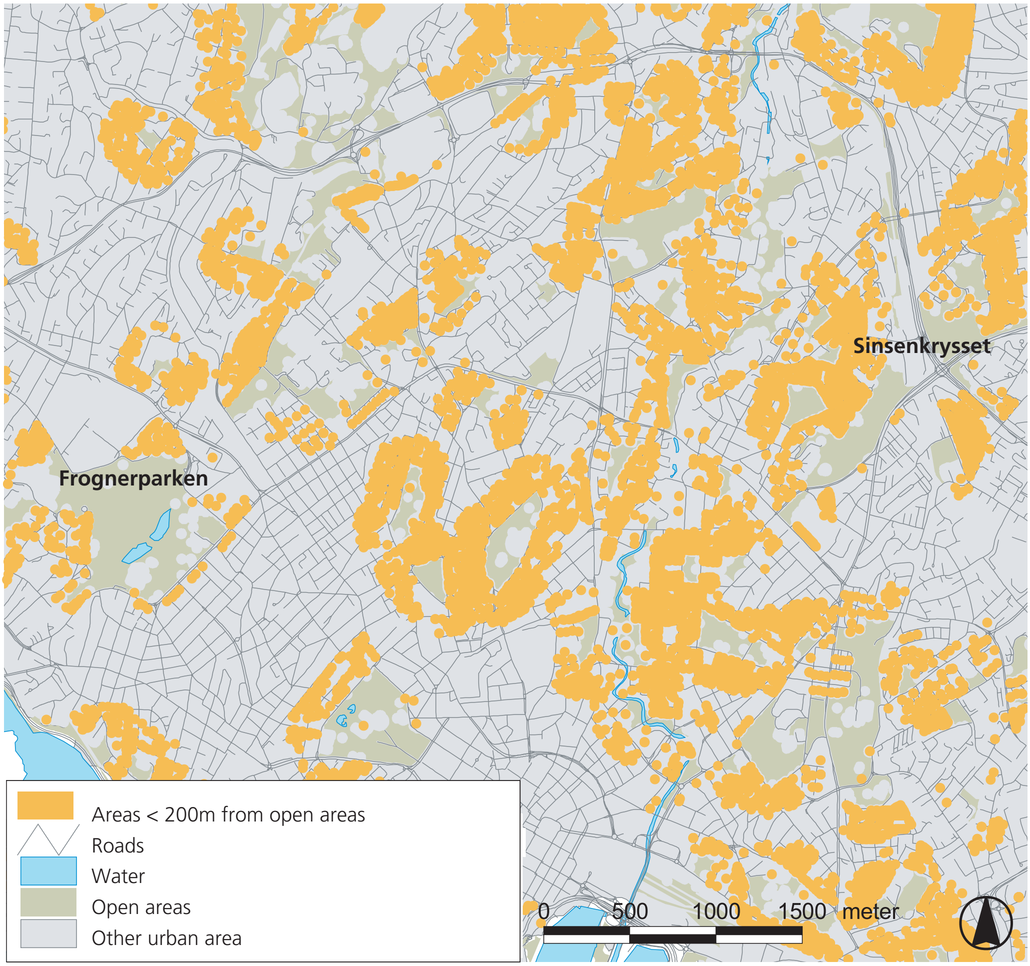
- There is a larger share of day-care centres and schools than of housing with access to play and recreational areas.
- There is a larger share of row houses, detached houses, etc. than blocks of flats with access to play and recreational areas.
- The population of Sandnes/Stavanger has poorer access to local outdoor recreation areas than the population of other towns. This may partly be because Sandnes/Stavanger is largely surrounded by agricultural land, which is not regarded as local outdoor recreation area.
- The results also indicate that the largest housing units are more often located near local outdoor recreation areas.

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.

Figure 9.7. Modelled "play and recreational areas" and areas with access to these. Central parts of Oslo. 2002



Source: Land use statistics, Statistics Norway. Digital mapping data: Norwegian Mapping Authority, LKS 82003-596.

9.5. 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 does not seem to be high on the list of priorities. The same can be said of the cultural heritage.
- 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.
- It is mainly the densely populated municipalities that incorporate these aspects in their municipal master plan.

Table 9.4. The status of biological diversity, outdoor recreation and preservation of the cultural heritage in municipal land use planning. 2001 and 2002

	No. reporting municipalities		Municipalities with plans					
			Percentage[1]		Percentage of Norway's pop.in these municipalities		Percentage of Norway's total area in these municipalities	
	2001	2002	2001	2002	2001	2002	2001	2002
Adopted plan with special focus on:								
Biological diversity	398	396	16	19	40	50	18	17
Outdoor recreation	401	397	57	54	73	72	52	55
Cultural heritage	399	..	26	27	54	56	26	28

[1]Per cent of all Norwegian municipalities.
Source: Statistics Norway (2003a).

Administration of plans in areas of particular environmental value

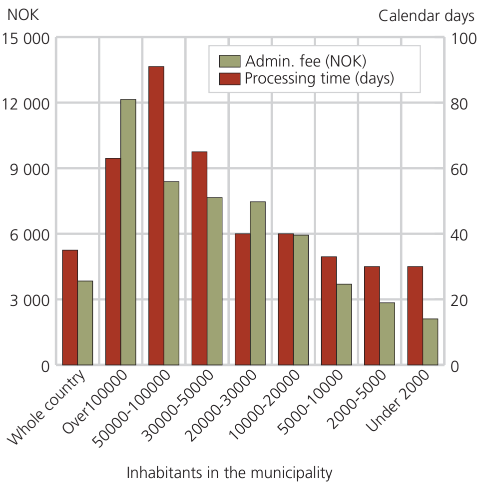
- Plans can be binding or in the form of guidelines indicating which projects can be implemented. Reports on projects in areas of particular environmental value (defined as agricultural areas, areas of natural environment and outdoor recreation areas, the 100-metre belt along the coast and special areas set aside for the preservation of the cultural heritage) show that most applications are in accordance with plans and are approved (see table 9.5).
- Applications for exemptions from adopted plans are granted more often than they are rejected. This applies to all types of area. There were no clear changes from 2001 to 2002.
- The number of applications for exemption processed by a municipality has little effect on the number of exemptions granted.

Table 9.5. Building project applications in areas of particular environmental value. 2001 and 2002

	Projects in agricultural areas, areas of natural environment and outdoor recreation areas		Projects in the coastal zone where building is prohibited		Projects along rivers and lakes where building is prohibited		Projects in areas set aside for preservation of the cultural heritage	
	2001	2002	2001	2002	2001	2002	2001	2002
No. reporting municipalities	377	384	377	370	348	362	345	366
No. of cases processed	15 853	17 167	1 636	1 570	336	410	799	568
Applications consistent with plan, percentage approved	70	74	.	.	.	.	79	71
Applications that include exemptions, percentage approved	23	20	67	69	80	80	12	16
Rejected applications, percentage	8	6	33	31	20	20	10	13

Source: Statistics Norway (2003a).

Figure 9.8. Administrative fee for building of single family dwelling and average case processing time for undertakings for which application is required, by number of inhabitants in the municipality. 2002



Source: Statistics Norway (2003a).

Fees and case processing time in municipal land use management

- In 2002, the municipalities used fees and other revenues to cover about half of their land use planning expenses. Net expenses for this purpose 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 in the largest municipalities is shorter than in the medium-sized municipalities. This may be because of a more specialised and professionalised administration, in spite of a case complexity that is assumed to be at least equally high. However, this has not been further analysed.

More information: Vilni Bloch, Erik Engelien and Henning Høie (municipal land use management).

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 Water Resources and Energy Directorate: http://www.nve.no/
Statistics Norway, land use statistics: http://www.ssb.no/english/subjects/01/01/20
Statistics Norway, municipal land use management: http://www.ssb.no/english/subjects/01/miljo_kostra_en/
Norwegian Pollution Control Authority: http://www.sft.no/english/
Norwegian Mapping Authority: http://www.statkart.no/

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Report No. 25 (2002-2003) to the Storting: *Regjeringens miljøvernpolitikk og rikets miljøtilstand* (The Government's environmental policy and the state of the environment in Norway), Ministry of the Environment.

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Statistics Norway (2002b): *Natural Resources and the Environment 2002. Norway*. Statistical Analyses 58.

Statistics Norway (2002c): *Arealstatistikk fra GAB og FKB Bygg - Datagrunnlag og metode for produksjon av arealtall* (Land use statistics from the GAB register and FKB Bygg - Background data and method for production of area figures). Notater 02/72.

Statistics Norway (2002d): *Arealstatistikk fra GAB og BoF - Datagrunnlag og metode for overføring av næringskode* (Land use statistics from the GAB register and the Register of Business Enterprises - Data basis and method for transferring business codes). Notater 02/68.

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Status and important trends

Appendix A

Table A1. Investment in pollution treatment equipment (end-of-pipe). 1 000 NOK

Industry division (SIC 94)	Air/ climate	Waste- water	Solid waste	Noise	Other	Total	Gross invest- ment (Acqui- sitions less disposals of fixed assets)	End of pipe investment as percent- age of gross investment
10, 12-37 MANUFACTURING, MINING AND QUARRYING	**278 174**	**117 436**	**87 495**	**20 141**	**290 536**	**793 788**	**15 172 860**	**5.2**
NACE C, 10, 12-14 MINING AND QUARRYING	10 648	100	3	574	398	11 723	546 264	2.1
10 Coal and peat	-	-	-	-	-	-	201 392	-
13 Metal ores	-	-	-	-	-	-	29 117	-
14 Other mining and quarrying . .	10 648	100	3	574	398	11 723	315 755	3.7
NACE D, 15-37 INDUSTRY	267 526	117 336	87 492	19 567	290 138	782 065	14 626 596	5.3
15-16 FOOD PRODUCTS; BEVERAGES AND TOBACCO	15 409	13 209	7 392	1 283	8 469	45 762	3 814 584	1.2
15.0-15.8 Food products	15 409	13 009	7 212	1 253	8 407	45 290	3 169 036	1.4
15.1 Meat and meat products .	8 129	825	550	40	6 271	15 815	663 977	2.4
15.2 Fish and fish products. . . .	2 047	5 830	4 862	1 156	1 654	15 549	1 003 707	1.5
15.5 Dairy products	489	1 408	668	-	182	2 747	349 372	0.8
15.3-4/6-8 Other food products	4 744	4 946	1 132	57	300	11 179	1 151 980	1.0
15.9/16 Beverages and tobacco . .	-	200	180	30	62	472	645 548	0.1
17-19 TEXTILES AND TEXTILE PRODUCTS, LEATHER AND LEATHER PRODUCTS	309	683	87	53	322	1 454	78 118	1.9
17 Textiles	279	663	77	33	312	1 364	55 670	2.5
18 Wearing apparel, dressing and dyeing of fur.	30	20	10	20	10	90	19 060	0.5
19 Leather and leather products. .	-	-	-	-	-	-	3 388	-
20 WOOD AND WOOD PRODUCTS .	1 287	651	900	846	2 702	6 386	320 681	2.0
21 PULP, PAPER AND PAPER PRODUCTS	15 748	12 969	1 539	3 352	185 257	218 865	908 767	24.1
21.1 Pulp, paper and paperboard .	15 734	12 566	1 034	2 692	185 257	217 283	754 900	28.8
21.2 Articles of paper and paper- board	14	403	505	660	-	1 582	153 867	1.0
22. PUBLISHING AND PRINTING ETC.	2 740	1 182	2 762	42	391	7 117	1 071 939	0.7
23-24 PETROLEUM PRODUCTS AND CHEMICAL PRODUCTS	18 636	33 052	12 834	3 314	20 385	88 221	2 395 515	3.7
23-24.1 Refined petroleum products and basic chemicals	5 012	25 028	12 057	3 214	18 674	63 985	1 748 915	3.7
24.2-24.7 Other chemical products	13 624	8 024	777	100	1 711	24 236	646 600	3.7
24.3 Paints, varnishes and simi- lar coatings, printing ink and mastics	9 809	1 254	214	-	1 711	12 988	59 261	21.9
24.4 Pharmaceuticals, medicinal chemicals and botanical products	1 570	6 300	223	40	-	8 133	490 312	1.7
24.5 Soap and detergents, cleaning and polishing prepara- tions, perfumes and toilet prep- arations	1 752	-	-	-	-	1 752	13 952	12.6
24.6 Other chemical products .	493	470	340	60	-	1 363	83 075	1.6

Table A1. (cont.). Investment in pollution treatment equipment (end-of-pipe). 1 000 NOK

Industry division (SIC 94)	Air/ climate	Waste-water	Solid waste	Noise	Other	Total	Gross investment (Acquisitions less disposals of fixed assets)	End of pipe investment as percentage of gross investment
25.RUBBER AND PLASTIC PRODUCTS	1 277	250	1 086	1 204	1 804	5 621	416 565	1.3
26. OTHER NON-METALLIC MINERAL PRODUCTS	5 292	1 723	8 596	1 346	1 620	18 577	797 709	2.3
27 BASIC METALS	173 932	45 055	42 679	2 915	65 629	330 216	1 603 081	20.6
28. METAL PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT	9 142	470	359	928	894	11 793	487 793	2.4
29 MACHINERY AND EQUIPMENT N.E.C	1 192	310	133	330	1 063	3 028	770 003	0.4
30-33 ELECTRICAL AND OPTICAL EQUIPMENT	625	3 218	2 607	254	7	6 711	956 391	0.7
30 Office machinery and computers	-	-	-	-	-	-	12 569	-
31 Electrical machinery and apparatus n.e.c.	625	3 035	1 548	239	-	5 447	371 358	1.5
32 Radio, television, communication equipment.	-	183	1 050	3	7	1 243	378 667	0.3
33 Medical, precision and optical instruments	-	-	9	12	-	21	193 797	0.0
34-35 (-35.114/5) TRANSPORT EQUIPMENT	1 335	706	1 648	1 958	729	6 376	564 273	1.1
34 Motor vehicles, trailers and semitrailers	519	45	302	1 505	373	2 744	321 577	0.9
35 (-35.114/5) Other transport equipment	816	661	1 346	453	356	3 632	242 696	1.5
35.114/5 OIL PLATFORMS	1 809	4	56	729	40	2 638	-162 201	-1.6
36-37 MANUFACTURING N.E.C.	18 793	3 854	4 814	1 013	826	29 300	603 378	4.9
36 Furniture and manufacturing n.e.c.	2 241	474	2 724	463	756	6 658	466 832	1.4
37 Recycling	16 552	3 380	2 090	550	70	22 642	136 546	16.6

Source: Environmental protection expenditure statistics, Statistics Norway.

Energy

Appendix B

Table B1. Reserve accounts for crude oil. Fields already developed or where development has been approved. Million Sm^3 o.e.

	1990	1995	1996	1997	1998	1999	2000	2001[1]	2002
Reserves as of 01.01	1 189	1 477	1 654	1 795	1 858	1 810	1 692	1 770	1 776
New fields	126	131	315	84	-	36	190	106	2
Re-evaluations	125	214	13	168	133	26	81	97	3
Extraction	-99	-168	-188	-189	-181	-181	-193	-197	-191
Reserves as of 31.12	1 340	1 654	1 795	1 858	1 810	1 692	1 770	1 776	1 589
R/P-ratio	13	10	10	10	10	9	9	9	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 B2. Reserve accounts for natural gas. Fields already developed or where development has been approved. Million Sm^3 o.e.

	1990	1995	1996	1997	1998	1999	2000	2001[1]	2002
Reserves as of 01.01	1 261	1 346	1 352	1 479	1 173	1 172	1 247	1 259	2 189
New fields	17	32	195	12	-	45	61	229	7
Re-evaluations	-20	5	-27	-271	47	82	5	759	-9
Extraction	-28	-31	-41	-47	-48	-52	-54	-58	-70
Reserves as of 31.12	1 230	1 352	1 479	1 173	1 172	1 247	1 259	2 189	2 117
R/P-ratio	45	43	36	25	24	24	23	38	30

[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 B3. Norway´s hydropower potential and developed and undeveloped hydropower[1]. GWh

Year	Hydro-power potential[2]	Developed as of 31 Dec.	Undeveloped						
			Under con-struction[3]	Licence granted	Applied for licence	Licence denied[4]	Notifica-tion sub-mitted	Perma-nently pro-tected	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	..	..	..	..	11464	..
1982	170 638	96 963	7 774	..	..	..	..	11668	..
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

[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.

Source: Norwegian Water Resources and Energy Directorate.

Table B4. Extraction, conversion and use[1] of energy commodities. 2001*

	Coal and coke	Wood, wood waste, black liquor, waste	Crude oil	Natural gas	Petro-leum products[2]	Electricity	District heating	Total	Average annual change 1976-2001	Average annual change 2000-2001
	PJ								Per cent	
Extraction of energy commodities	50	-	6 602	2 340	[3] 271	436	-	9 698		
Energy use in extraction sectors	-	-	-	[4]-174	-13	-8	0	-195		
Imports and Norwegian purchases abroad	50	1	41	-	303	39	-	434		
Exports and foreign purchases in Norway	-42	0	-6 006	-2 031	-667	-26	-	-8 773		
Stocks (+decrease, -increase)	-5	-	87	-	12	-	-	94		
Primary supplies	53	1	725	134	-94	440	0	1 259		
Oil refineries	7	-	-560	-	538	-2	-	-16		
Other energy sectors or supplies	-1	53	-	0	19	1	8	80		
Registered losses, statistical errors	-10	-	-165	-103	49	-35	-1	-266		
Registered use outside energy sectors	50	54	-	31	512	404	7	1 058	1.0	4.3
Domestic use	50	54	-	31	335	404	7	881	1.5	5.3
Agriculture and fisheries	0	0	-	-	27	8	0	35	0.6	2.6
Energy-intensive manufacturing	38	1	-	30	72	119	0	261	1.9	5.7
Other manufacturing and mining	11	29	-	0	29	54	0	124	-0.1	-4.6
Other industries	-	0	-	0	135	84	5	224	2.0	7.7
Private households	0	24	-	0	72	140	1	237	1.8	8.9
International maritime transport	-	-	-	-	177	-	-	177	-0.8	-0.5

[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: Statistics Norway.

Table B5. Use of energy commodities outside the energy sectors and international maritime transport[1]

Energy commodity	1976	1980	1985	1990	1995	1997	1998	1999	2000	2001*	2002*	Average annual change 1976-2001	2001-2002
	PJ											Per cent	
Total	**608**	**677**	**735**	**751**	**784**	**820**	**852**	**858**	**836**	**881**	**849**	**1.5**	**-3.6**
Electricity	241	269	329	349	374	374	394	393	394	404	389	2.1	-3.8
Firm power	232	265	312	324	348	352	367	370	358	371	...	1.9	...
Spot power	9	4	17	24	26	22	27	24	36	33	...	5.3	...
Oil, total	299	294	259	246	252	267	271	277	250	264	262	-0.5	-1.0
Oil other than transport	159	137	77	57	51	54	56	55	43	47	43	-4.8	-8.0
Petrol	9	3	0	0	0	0	0	0	0	0	0	-22.6	0.0
Kerosene	17	16	9	7	7	8	7	7	5	6	6	-4.2	-1.7
Middle distillates	66	62	43	35	30	31	32	33	27	28	30	-3.4	7.1
Heavy fuel oil	66	56	25	14	14	16	17	15	11	13	8	-6.2	-42.0
Oil for transport	141	157	183	189	202	212	215	222	207	217	219	1.8	0.5
Petrol, aviation fuel, jet fuel	74	82	92	99	102	99	100	103	97	100	99	1.2	-0.4
Middle distillates	64	71	83	86	99	112	115	119	110	118	119	2.5	1.4
Heavy fuel oil	3	5	7	3	1	1	1	1	1	0	0	-9.9	-21.6
Gas[2]	1	41	52	64	53	71	77	76	81	102	92	18.5	-9.7
District heating	-	-	2	3	4	5	5	6	5	7	7	.	0.0
Solid fuel	65	73	93	90	100	103	105	106	105	104	100	1.9	-3.9
Coal and coke	47	48	57	49	56	56	58	56	56	50	46	0.3	-8.1
Wood, wood waste, black liquor, waste	19	25	35	41	44	47	48	50	50	54	54	4.2	0.0

[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: Statistics Norway.

Table B6. Net use[1] of energy in the energy sectors. PJ

	1976	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001*	2002*
Total	**52**	**87**	**91**	**156**	**185**	**197**	**206**	**196**	**197**	**217**	**215**	**211**
Of this:												
Electricity	4	6	8	7	10	7	11	8	9	8	10	9
Natural gas	30	52	61	116	141	151	153	147	145	165	174	175

[1]Does not include energy use for conversion purposes.
Source: Statistics Norway.

Table B7. Use of energy commodities ouside the energy sectors and international maritime transport, by sector[1]. 2000. PJ

	Coal and coke	Wood, wood waste, black liquor, waste	Crude oil	Natural gas	Petroleum products[2]	Electricity	District heating	Total
Total	**55.5**	**49.9**	**-**	**27.5**	**303.6**	**394.3**	**5.4**	**836.3**
Manufacturing and mining	**55.4**	**25.9**	**-**	**27.5**	**83.8**	**183.5**	**0.8**	**376.8**
Oil drilling	-	-	-	-	4.6	-	-	4.6
Manufacture of pulp and paper	-	17.6	-	0.1	4.3	26.2	-	48.1
Manufacture of basic chemicals	11.6	-	-	26.1	49.7	25.4	0.3	113.0
Manufacture of minerals[3]	8.8	0.2	-	-	6.8	5.1	-	20.8
Manufacture of iron, steel and ferro-alloys	26.1	-	-	-	1.2	27.7	0.0	55.0
Manufacture of other metals	4.8	-	-	0.9	3.8	69.1	0.0	78.7
Manufacture of metal goods, boats, ships and oil platforms	4.2	0.0	-	0.0	3.0	12.4	0.1	19.6
Manufacture of wood, plastic, rubber and chemical goods, printing	-	8.1	-	0.0	3.5	5.6	0.1	17.4
Manufacture of consumer goods	-	-	-	0.3	6.9	12.0	0.3	19.6
Other industries, total	**0.1**	**24.0**	**-**	**0.1**	**219.8**	**210.8**	**4.6**	**459.4**
Construction	-	0.1	-	0.0	9.1	2.1	-	11.3
Agriculture and forestry	0.0	0.1	-	-	6.0	7.1	0.0	13.2
Fishing, whaling and sealing	-	-	-	-	20.1	0.5	-	20.6
Land transport[4]	-	-	-	0.0	43.2	2.2	-	45.5
Sea transport, domestic	-	-	-	-	19.9	0.0	-	20.0
Air transport[4]	-	-	-	-	25.0	0.3	-	25.2
Other private services	-	-	-	0.0	23.5	50.2	2.0	75.8
Public sector, municipal	-	-	-	0.0	2.1	16.3	1.0	19.5
Public sector, state	-	-	-	-	3.0	7.3	0.6	10.9
Private households	0.1	23.8	-	0.0	67.9	124.7	0.9	217.4

[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: Statistics Norway.

Table B8. Electricity balance

	1975	1980	1985	1990	1995	1998	1999	2000	2001*	2002*	Average annual change 1990-2002*	Average annual change 2001-2002*
	TWh										Per cent	
Production	77.5	84.1	103.3	121.8	123.0	116.8	122.4	142.8	121.6	130.6	0.6	7.4
+ Imports	0.1	2.0	4.1	0.3	2.3	8.0	6.9	1.5	10.8	5.3	26.0	-50.5
- Exports	5.7	2.5	4.6	16.2	9.0	4.4	8.8	20.5	7.2	15.0	-0.7	109.5
= Gross domestic consumption	71.9	83.6	102.7	105.9	116.3	120.4	120.5	123.8	125.2	120.9	1.1	-3.4
- Consumption in pumped storage power plants	0.1	0.5	0.8	0.3	1.4	0.8	0.6	0.7	0.8	0.6	4.7	-26.8
- Consumption in power plants, losses and statistical differences	7.1	8.0	10.0	7.9	10.0	9.1	9.4	12.2	11.1	9.8	1.9	-11.7
= Net domestic consumption	64.7	75.1	91.9	97.7	105.0	110.4	110.5	110.9	113.3	110.5	1.0	-2.4
- Spot power	3.2	1.2	4.8	6.7	7.5	7.5	7.0	10.5	7.8	4.4	-3.5	-43.9
= Net firm power consumption	61.4	73.9	87.1	91.0	97.5	103.0	103.5	100.4	105.5	106.1	1.3	0.6
- Energy-intensive manufacturing	26.2	27.9	30.0	29.6	28.4	30.2	31.1	30.5	32.1	29.8	0.1	-7.0
= General consumption	35.2	46.0	57.1	61.5	69.1	72.8	72.4	69.9	73.4	76.3	1.8	4.0
General consumption corrected for temperature	36.3	45.1	54.6	65.4	69.6	73.5	74.9	74.4	74.0	79.0	1.6	6.8

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

Table B9. 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
	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	60.5	61.8
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
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
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
Petrol, unl. 95 octane	594	677	717	757	761	807	849	888	873	919	1 052	944	901
Auto diesel	286	341	326	403	649	701	757	779	781	827	991	862	808

[1] Including all taxes. [2]Price for households and agriculture. The price includes energy price, grid rent and taxes. Until 1992, prices are for firm power only. From 1993, both firm power and spot 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: Statistics Norway, Norwegian Water Resources and Energy Directorate and Norwegian Petroleum Institute.

Table B10. Total primary energy supply. World total and selected countries

	1971	1978	1990	1995	1999	2000	Per unit GDP (2000)	Per unit GDP (2000)	Per capita (2000)
	Million toe						toe/1 000 1995 USD	toe/1 000 1995 USD PPP[1]	toe/ capita
World total	**5 458.2**	**6 958.7**	**8 618.0**	**9 141.8**	**9 717.5**	**9 963.0**	**0.29**	**0.24**	**1.65**
OECD	**3 386.1**	**4 075.4**	**4 514.7**	**4 884.5**	**5 213.4**	**5 316.9**	**0.19**	**0.22**	**4.74**
Norway	13.9	18.5	21.5	23.5	26.6	25.6	0.15	0.22	5.70
Denmark	19.2	20.6	18.1	20.3	20.0	19.5	0.09	0.14	3.64
Finland	18.4	22.9	28.8	29.3	33.4	33.2	0.20	0.27	6.40
Iceland	1.0	1.3	2.1	2.1	3.2	3.4	0.39	0.46	12.20
Sweden	36.5	41.1	46.7	49.9	50.5	47.5	0.17	0.23	5.35
Belgium	39.9	46.9	48.4	52.4	58.6	59.2	0.19	0.23	5.78
France	154.5	179.4	226.0	239.9	255.2	257.1	0.15	0.19	4.25
Greece	9.2	15.2	21.8	23.1	26.6	27.8	0.20	0.18	2.64
Italy	114.1	134.8	151.6	159.8	169.0	171.6	0.14	0.14	2.97
Netherlands	51.3	65.5	66.5	73.2	74.6	75.8	0.15	0.19	4.76
Poland	86.3	118.3	99.9	99.9	93.5	90.0	0.55	0.26	2.33
Portugal	6.5	9.1	17.2	20.0	24.3	24.6	0.19	0.15	2.46
Spain	43.1	65.8	90.5	103.1	118.5	124.9	0.18	0.17	3.13
United Kingdom	211.0	209.4	212.4	224.3	231.2	232.6	0.18	0.18	3.89
Switzerland	17.1	19.7	25.1	25.3	26.7	26.6	0.08	0.13	3.70
Czech Republic	45.6	45.6	47.4	41.4	38.2	40.4	0.74	0.30	3.93
Turkey	19.5	31.9	52.7	61.4	70.5	77.1	0.38	0.18	1.15
Germany	307.9	353.8	355.5	339.9	341.1	339.6	0.13	0.18	4.13
Hungary	19.2	28.9	28.4	25.5	25.2	24.8	0.46	0.22	2.47
Austria	19.0	22.1	25.2	26.4	28.6	28.6	0.11	0.15	3.52
Canada	142.7	181.8	209.1	231.8	243.0	251.0	0.36	0.31	8.16
Mexico	45.6	79.8	124.0	132.7	149.9	153.5	0.41	0.19	1.58
United States	1 593.2	1 885.2	1 927.2	2 088.1	2 247.8	2 299.7	0.26	0.26	8.35
Japan	269.6	335.5	438.9	497.8	515.6	524.7	0.09	0.17	4.13
Republic of Korea	17.0	34.7	92.6	150.6	181.2	193.6	0.31	0.30	4.10
Australia	52.2	67.2	87.5	94.4	107.7	110.2	0.24	0.23	5.75
Non-OECD	**2 072.1**	**2 884.3**	**4 103.3**	**4 257.3**	**4 504.1**	**4 646.1**	**0.73**	**0.27**	**0.95**
Romania	42.1	64.1	62.4	46.4	36.4	36.3	1.11	0.27	1.62
Russia	..	..	..	628.4	603.3	614.0	1.72	0.55	4.22
Egypt	7.8	13.0	32.0	35.2	44.2	46.4	0.59	0.21	0.73
Ethiopia	9.0	10.5	15.2	16.5	18.2	18.7	2.51	0.46	0.29
Nigeria	36.2	48.5	70.9	79.7	87.6	90.2	2.80	0.87	0.71
South Africa	45.3	59.9	91.2	104.1	109.3	107.6	0.63	0.29	2.51
Argentina	33.7	38.9	45.0	53.1	61.8	61.5	0.21	0.14	1.66
Brazil	69.6	103.5	132.5	153.5	179.9	183.2	0.23	0.15	1.07
Guatemala	2.8	3.9	4.5	5.4	6.9	7.2	0.40	0.18	0.63
Venezuela	20.1	30.5	44.9	53.0	56.3	59.3	0.74	0.44	2.45
Bangladesh	5.7	7.6	12.9	16.2	17.8	18.7	0.38	0.10	0.14
India	183.2	227.5	359.1	430.1	485.7	501.9	1.08	0.22	0.49
Indonesia	36.3	54.9	92.8	123.1	136.7	145.6	0.70	0.25	0.69
China[2]	391.7	590.5	870.4	1 066.6	1 118.3	1 142.4	1.10	0.24	0.90
Thailand	14.1	21.5	43.2	63.2	70.5	73.6	0.43	0.20	1.21

[1]PPP (purchasing power parity): GDP adjusted for local purchasing power. [2]Hong Kong not included.
Source: OECD/IEA (2002a, b).

Table B11. Norway´s net exports of energy commodities. Selected countries and regions. 2002*. Million NOK

	Coal, coke and briquettes	Mineral oil and products	Gas, natural and manufactured	Electricity
Nordic countries	164	14 816	975	1 319
EFTA	4	54	72	-
EU	241	161 481	59 820	1 319
Developing countries	-115	6 959	810	-
Denmark	146	4 278	-24	-263
Finland	75	3 556	55	-23
Sweden	-60	6 590	958	1 606
Belgium	-32	2 110	7 468	-
France	31	17 469	14 003	-
Ireland	-	3 792	0	-
Italy	0	7 773	4 386	-
Netherlands	-32	31 885	4 672	-
Portugal	20	576	78	-
Spain	-4	183	2 744	-
UK	-107	68 803	1 334	-
Czech Republic	-	1	2 591	-
Turkey	-	0	1 365	-
Germany	179	14 462	24 122	-
China	-53	3 309	470	-
Canada	0	15 272	0	-
USA	-25	26 604	350	-

Source: Statistics Norway.

Agriculture

Appendix C

Table C1. Agricultural area in use. km^2

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*	10 325	3 320	526	4 860	1 619

Source: Agricultural statistics from Statistics Norway.

Table C2. 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	11.5	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	9.8	1.2

Source: Agricultural statistics from Statistics Norway and Norwegian Agricultural Inspection Service.

Table C3. Sales of pesticides. Environmental taxes on pesticides

Year	Sales of pesticides. Tonnes active substances: Total	Fungi-cides	Insecti-cides	Herbi-cides	Other sub-stances including additives	Taxes as per cent of purchase price[1]: Environ-mental tax	Control fee	Taxes: Total[2]	Environ-mental tax	Control fee
	Tonnes					Per cent		Million NOK		
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	28.6	20.2	8.3
1991	771.0	144.2	18.4	563.6	44.8	13.0	6.0	26.9	18.8	7.9
1992	781.0	148.6	26.9	561.2	44.3	13.0	6.0	31.7	22.5	9.1
1993	764.5	179.7	16.9	510.0	57.9	13.0	6.0	32.3	21.9	10.1
1994	861.6	156.7	22.0	625.9	57.0	13.0	6.0	30.9	21.0	9.7
1995	931.3	167.3	20.4	688.9	54.7	13.0	6.0	27.9	18.9	8.7
1996	706.2	139.7	15.8	503.2	47.4	15.5	7.0	32.5	21.8	10.5
1997	754.2	175.4	19.5	503.8	55.5	15.5	7.0	30.7	21.0	9.5
1998	954.6	263.3	22.8	544.3	124.3	15.5	9.0	38.2	24.1	13.8
1999	796.3	219.0	24.7	448.7	103.9	.	.	52.8	35.4	17.2
2000	380.2	53.1	10.7	283.4	33.0	.	.	69.2	52.9	15.9
2001	518.7	118.6	9.8	377.2	13.1	.	.	44.8	34.9	9.7
2002	818.5	148.7	11.0	632.2	26.6	.	.	72.8	56.1	16.2

[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. [2] Registration fee included.
Source: Norwegian Agricultural Inspection Service and Norwegian Agricultural Economics Research Institute.

Table C4. Organic farming. 1986-2002

Year	No. of holdings with organic farming[1]	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[2]	Total grants to organic farming	Of which conversion and acreage support
		Decares				Million NOK	
1986	19	..	..	..	..	-	-
1987	41	..	..	..	..	-	-
1988	52	..	..	..	..	-	-
1989	89	..	..	..	..	5	-
1990	263	..	..	..	..	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	552	38 278	6 916	437	10 064	22	6
1995	680	44 596	13 082	572	10 628	23	6
1996	946	46 573	32 401	766	13 291	35	14
1997	1 310	73 921	43 143	1 816	18 895	35	21
1998	1 590	105 200	50 615	2 705	29 812	33	13
1999	1 745	149 510	38 225	2 998	18 393	54	37
2000	1 823	180 841	24 387	3 531	20 776	59	35
2001	2 086	197 900	68 831	3 729	22 911	76	54
2002	2303	252 556	72 904	4 070	47 907	85	58

[1] Include holdings approved for grants and/or to sell products labelled as organically produced. The figure for 2002 comprises inspected farms, of which 79 were totally or partly not approved. [2] Up to and including 1998 the registration date was 31 July, in 1999-2001 the registration date was 31 December while in 2002 the registration date again was 31 July.
Source: Debio and Norwegian Agricultural Authority.

Table C5. Organic farming. County. 2002

	No. of holdings with organic farming[1]	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	**2 303**	**252 556**	**72 904**	**3.2**	**4 070**	**1.5**
Østfold	139	11 476	6 426	2.3	243	4.3
Akershus and Oslo	140	19 545	3 602	2.9	478	9.1
Hedmark	227	26 068	10 117	3.4	559	3.5
Oppland	258	29 894	5 633	3.4	286	0.9
Buskerud	169	16 682	4 794	4.1	182	2.9
Vestfold	83	10 080	3 269	3.1	229	8.3
Telemark	113	10 869	3 605	5.6	197	7.3
Aust-Agder	38	2 935	644	3.1	68	3.0
Vest-Agder	50	6 268	1 563	4.0	197	3.1
Rogaland	45	5 518	1 139	0.7	182	0.4
Hordaland	104	7 777	1 292	2.1	154	1.1
Sogn og Fjordane	184	19 144	751	4.2	65	0.3
Møre og Romsdal	116	11 364	2 096	2.2	190	0.7
Sør-Trøndelag	287	32 273	14 872	6.1	483	1.7
Nord-Trøndelag	182	18 960	8 843	3.1	368	1.2
Nordland	111	14 260	3 092	2.9	117	0.6
Troms	51	8 248	932	3.4	72	1.2
Finnmark	6	1 196	235	1.4	-	-

[1]Comprise inspected holdings of which 79 were totally or partly not approved.
Source: Debio and agricultural statistics from Statistics Norway.

Table C6. 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*	61 554	9 579	13 868	19 854	16 232	2 021

[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 D1. Forest balance 2001. 1000 m³ without bark

	Total	Spruce	Pine	Broad-leaved trees
Growing stock as of 01.01	697 998	308 614	233 949	155 436
Total losses	11 455	7 471	2 333	1 652
Of which total round-wood cut	9 209	6 367	1 839	1 003
Sales, excl. fuel-wood	7 685	5 915	1 716	53
Fuelwood, sales and private	1 322	292	83	947
Own use	202	160	40	3
Other losses	2 246	1 104	493	649
Logging waste	593	382	110	100
Natural losses	1 654	722	383	549
Total increments	23 904	12 033	6 381	5 490
Volume as of 31.12	710 447	313 176	237 997	159 273

Source: Statistics Norway and Norwegian Institute for Land Inventory.

Table D2. Growing stock under bark and annual increment. 1 000 m³

	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
1998/2002[1]	689 099	306 527	230 965	151 605	23 281	12 136	6 022	5 126
Region, 1998/2002								
Østfold, Akershus/Oslo, Hedmark	192 107	98 106	72 352	21 648	7 175	4 007	2 221	947
Oppland, Buskerud, Vestfold	149 461	84 960	40 920	23 581	4 923	3 022	982	918
Telemark, Aust-Agder, Vest-Agder	123 300	39 965	55 598	27 738	3 710	1 468	1 313	929
Rogaland, Hordaland, Sogn og Fjordane, Møre og Romsdal	87 759	21 951	34 942	30 866	3 331	1 503	881	947
Sør-Trøndelag, Nord-Trøndelag	83 811	49 573	18 741	15 496	2 497	1 587	394	517
Nordland, Troms	49 447	11 971	5 938	31 537	1 561	549	162	852
Finnmark	3 214	1	2 474	739	84	0	69	16

[1]Volume and average annual increment for all types of land use classes for 1998-2002 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 D3. 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 reindeer	Roe deer	Moose	Red deer	Wild reindeer	Roe deer	Moose	Red deer	Wild reindeer	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

Source: Statistics Norway.

Table D4. Registered mortality of large carnivores and eagles

Hunting year	Total				
	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
Cause of death 2001/2002					
Killed by vechicle or train	-	-	-	12	8
Felled by permit[1]	3	1	21	1	-
Licenced hunting of wolverine	.	.	23	.	.
Quota hunting of lynx	.	.	.	87	.
Other causes[1]	-	1	4	2	34

[1]Including animals felled in self-defence or illegally, unknown reasons, etc.
Source: Statistics Norway.

Fisheries, sealing, whaling and fish farming

Appendix E

Table E1. 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[2]	Greenland halibut[7]	Barents Sea capelin[3,5]	Norwegian spring-spawning herring[3]	North Sea herring[4]	North Sea cod[3]
1978	1 580	260	460	90	6 120	550	70	810
1979	1 110	320	430	110	6 580	560	110	810
1980	860	260	550	90	8 220	600	130	1 020
1981	980	190	530	90	4 490	590	200	860
1982	750	120	480	90	4 210	580	280	840
1983	740	60	480	100	4 770	640	430	650
1984	820	50	410	90	3 300	650	680	720
1985	960	140	370	90	1 090	540	700	500
1986	1 290	290	350	90	160	430	680	680
1987	1 120	240	360	90	110	910	900	570
1988	910	160	360	80	360	2 780	1 200	430
1989	890	120	330	90	770	3 380	1 250	420
1990	960	120	400	80	4 900	3 540	1 180	330
1991	1 560	160	530	70	6 650	3 680	980	300
1992	1 910	230	690	50	5 370	3 560	700	400
1993	2 360	460	760	50	990	3 440	470	340
1994	2 150	540	740	50	260	3 930	520	420
1995	1 820	490	790	60	190	4 870	480	420
1996	1 700	420	800	70	470	6 520	460	370
1997	1 530	310	730	70	870	7 780	560	490
1998	1 220	200	830	70	1 860	7 040	740	300
1999	1 100	190	820	80	2 580	6 530	850	220
2000	1 110	170	790	80	3 840	5 260	830	220
2001	1 390	260	890	80	3 480	4 770	1 270	180
2002	1 590	310	910	80	2 120	5 100	1 690	220
2003	1 820	400	870	90	..	5 200	1 450	..

Year	North Sea haddock[3]	North Sea saithe[3,6]	North Sea whiting[3]	North Sea plaice[3]	North Sea sole[3]	Blue whiting (northern and southern stock)[4]	Mackerel (North Sea, western and southern)[4]
1978	670	570	750	470	60	..	3 350
1979	670	580	890	470	50	..	2 900
1980	1 250	540	820	490	40	..	2 440
1981	670	640	630	490	50	4 870	2 510
1982	840	690	480	560	60	3 430	2 410
1983	760	810	490	540	70	2 500	2 670
1984	1 490	840	480	550	70	1 840	2 660
1985	860	710	440	540	60	1 870	2 650
1986	720	690	630	640	50	2 090	2 640
1987	1 070	500	520	620	60	1 890	2 610
1988	430	480	410	610	70	1 710	2 630
1989	400	460	500	570	100	1 700	2 690
1990	340	420	440	530	110	1 670	2 540
1991	740	460	440	440	100	2 240	2 850
1992	600	490	390	420	110	2 970	2 880
1993	850	540	360	370	100	2 900	2 720
1994	500	550	350	300	90	2 850	2 540
1995	930	700	350	280	70	2 590	2 760
1996	580	590	290	260	50	2 420	2 770
1997	630	620	240	320	50	2 470	2 900
1998	480	640	250	360	60	3 480	2 940
1999	370	700	290	370	60	4 210	3 220
2000	1 800	790	360	350	60	4 100	3 160
2001	890	730	320	320	50	4 030	3 420
2002	..	840	..	..	..	3 820	3 080
2003	..	..	..	..	..	3 260	..

[1] Fish aged 3 years and older. [2] Fish aged 2 years and older. [3] Fish aged 1 year and older. [4] Spawning stock. [5] As of 1 August. [6] Including saithe west of Scotland. [7] Fish aged 5 years and older.
Source: ICES and the Institute of Marine Research.

Table E2. Norwegian catches by species and groups of species. 1 000 tonnes

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*	2001*	2002*
Total	1 789	2 198	2 619	2 584	2 526	2 702	2 820	3 055	3 040	2 809	2 894	2 861	2 922
Cod	125	164	219	275	374	365	358	401	321	257	219	209	228
Haddock	23	25	40	44	74	80	97	106	79	53	46	52	55
Saithe	112	140	168	188	189	219	222	184	194	198	170	170	202
Tusk	28	27	26	27	20	19	19	14	21	23	22	19	18
Ling/Blue ling	24	23	22	20	19	19	19	16	23	20	18	15	16
Greenland halibut	24	33	11	15	13	14	17	12	12	20	13	15	12
Redfish	41	56	38	33	29	22	30	23	29	31	26	29	16
Others and unspecified[2]	30	44	43	57	31	27	32	40	43	29	29	40	29
Capelin	92	576	811	530	113	28	208	158	88	92	374	483	532
Mackerel	150	179	207	224	260	202	137	137	158	161	174	181	184
Herring	208	201	227	352	539	687	763	923	832	829	800	581	570
Sprat	6	34	33	47	44	41	59	7	35	22	6	13	3
Other industrial fisheries[1]	655	447	527	541	587	745	642	798	964	828	734	811	804
Crustaceans and molluscs	73	58	57	61	48	49	44	45	61	68	71	71	72
Seaweed	197	191	189	170	185	185	173	192	180	179	192	175	183

[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 E3. 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	Flume-quin	Flor-fenicol
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

Source: Norwegian Institute of Public Health.

Table E4. 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*	434.1	931.1	176.5	48.1	75.3	12.3	123.5	34.8

Source: External Trade Statistics from Statistics Norway.

Table E5. 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*	28 740.0	15 508.0	2 191.2	2 948.5	2 020.3	1 389.6	13 232.0	3 866.2	1 297.0

Source: External Trade Statistics from Statistics Norway.

Table E6. 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*	360.7	9 544.2	315.6	7 367.2	45.1	2 177.0

[1] Mainly farmed salmon, but other categories are also included.
Source: External Trade Statistics from Statistics Norway.

Table E7. Catch quantities[1] and export value[2] of fish and fish products. Selected countries

Country[3]	1996		1997		1998		1999		2000	
	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	**93 483**	**52 828**	**93 910**	**53 285**	**87 283**	**51 163**	**93 205**	**52 829**	**94 849**	**55 197**
China[5]	14 182	2 857	15 722	2 937	17 230	2 656	17 240	2 960	16 987	3 606
Peru	9 515	1 120	7 870	1 342	4 338	639	8 429	788	10 659	1 129
Japan	5 934	709	5 926	889	5 263	718	5 202	720	4 989	802
USA	5 001	3 148	4 983	2 850	4 709	2 400	4 750	2 945	4 745	3 055
Chile	6 691	1 697	5 811	1 782	3 265	1 597	5 051	1 700	4 300	1 785
Indonesia	3 558	1 678	3 791	1 621	3 965	1 628	3 987	1 527	4 140	1 584
Russia	4 677	1 686	4 662	1 356	4 455	1 168	4 141	1 248	3 974	1 386
India	3 448	1 116	3 523	1 227	3 373	1 049	3 472	1 180	3 594	1 405
Thailand	3 005	4 118	2 890	4 330	2 928	4 031	2 929	4 110	2 924	4 367
Norway	2 648	3 416	2 863	3 399	2 861	3 661	2 620	3 765	2 703	3 533
Iceland	2 060	1 426	2 206	1 360	1 682	1 434	1 736	1 379	1 983	1 229
Philippines	1 784	437	1 806	435	1 833	445	1 873	372	1 893	400
Republic of Korea	2 414	1 509	2 204	1 376	2 027	1 246	2 120	1 393	1 823	1 386
Denmark	1 682	2 699	1 827	2 649	1 557	2 898	1 405	2 884	1 534	2 756
Viet Nam	1 224	504	1 276	763	1 294	821	1 386	940	[4]1 442	1 480

[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 2000. [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 (2002b and c).

Table E8. Total catches[1] in world fisheries. 2000

	1000 tonnes	Per cent
Total catches	**94 849**	**100**
By area:		
Inland waters	8 801	9.3
Marine areas	86 048	90.7
By animal group:		
Fishes	79 967	84.3
Crustaceans	6 500	6.9
Molluscs	7 793	8.2
Others	588	0.6
Catches in marine areas by various distributions		
Marine catches, total	**86 048**	**100**
By marine fishing areas:		
North Atlantic	12 983	15.1
Central Atlantic	5 354	6.2
Mediterranean and Black Sea	1 485	1.7
South Atlantic	3 771	4.4
Indian Ocean	8 620	10.0
North Pacific	25 658	29.8
Central Pacific	11 601	13.5
South Pacific	16 576	19.3
By continents:		
Africa	4 228	4.9
North America	7 597	8.8
South America	17 618	20.5
Asia	39 812	46.3
Europe	15 546	18.1
Oceania	1 050	1.2
Other, not elsewhere specified	196	0.2
By species:		
Anchoveta - *Engraulis ringens*	11 276	13.1
Alaska pollock - *Theragra chalcogramma*	3 025	3.5
Atlantic herring - *Clupea harengus*	2 370	2.8
Skipjack tuna - *Katsuwonus pelamis*	1 890	2.2
Japanese anchovy - *Engraulis japonicus*	1 725	2.0
Chilean jack mackerel - *Trachurus murphyi*	1 540	1.8
Largehead hairtail - *Trichiurus lepturus*	1 480	1.7
Chub mackerel - *Scomber japonicus*	1 456	1.7
Capelin - *Mallotus villosus*	1 456	1.7
Blue whiting - *Micromesistius poutassou*	1 420	1.7
Yellowfin tuna - *Thunnus albacares*	997	1.2
Atlantic cod - *Gadus morhua*	945	1.1
European pilchard - *Sardina pilchardus*	943	1.1
Argentine shortfin squid - *Illex argentinus*	929	1.1
Araucanian herring - *Strangomera bentincki*	723	0.8
Atlantic mackerel - *Scomber scombrus*	674	0.8
European sprat - *Sprattus sprattus*	660	0.8
Akiami paste shrimp - *Acetes japonicus*	639	0.7
European anchovy - *Engraulis encrasicolus*	605	0.7
Gulf menhaden - *Brevoortia patronus*	591	0.7
Japanese flying squid - *Todarodes pacificus*	570	0.7
Japanese Spanish mackerel - *Scomberomorus niphonius*	539	0.6
Californian pilchard - *Sardinops caeruleus*	528	0.6
Pacific herring - *Clupea pallasii*	456	0.5
Bigeye tuna - *Thunnus obesus*	433	0.5
Kawakawa - *Euthynnus affinis*	428	0.5

[1] Not including farmed fish. Not including whales, seals and other sea mammals and aquatic plants.
Source: FAO (2002b).

Air pollution and climate

Appendix F

Table F1. 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	CF4	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. . .	31.9	259	14	-	-	-	-	-	-	-	..	..	..	0	..
1981. . .	31.7	..	..	-	-	-	-	-	-	-	..	..	..	0	..
1982. . .	30.8	..	..	-	-	-	-	-	-	-	..	..	..	91	..
1983. . .	31.8	..	..	-	-	-	-	-	-	-	..	..	..	100	..
1984. . .	33.7	..	..	-	-	-	-	-	-	-	..	..	..	185	..
1985. . .	32.1	..	..	-	-	-	-	-	-	-	..	489	20	199	..
1986. . .	34.6	..	..	-	-	-	-	-	-	-	..	479	20	240	..
1987. . .	33.2	292	16	-	-	-	-	-	-	-	..	464	19	240	53
1988. . .	35.4	292	16	-	-	-	-	-	-	-	..	443	18	223	55
1989. . .	34.1	307	17	-	-	-	-	-	-	-	..	430	18	107	51
1990. . .	34.9	306	18	-	-	-	-	-	0	-	..	441	18	91	52
1991. . .	33.2	311	17	-	-	-	0	-	0	-	..	369	14	86	50
1992. . .	34.0	315	15	-	-	-	0	-	1	-	..	294	11	29	48
1993. . .	35.7	321	16	-	-	-	2	-	1	-	..	290	10	30	50
1994. . .	37.4	325	17	0	0	0	5	0	1	-	..	251	9	36	52
1995. . .	37.5	328	17	0	0	2	10	2	1	-	0	229	8	24	52
1996. . .	40.7	332	17	0	0	5	17	4	1	0	0	214	5	23	55
1997. . .	40.9	334	17	0	0	10	26	7	2	0	0	201	8	23	55
1998. . .	41.1	329	18	0	0	15	38	10	5	0	0	185	7	29	56
1999. . .	41.6	327	18	0	1	20	50	15	6	0	0	164	6	35	56
2000. . .	41.1	332	18	0	1	26	61	20	8	0	0	131	5	37	56
2001*. .	41.6	332	18	0	2	33	72	27	10	0	0	149	6	32	56
2002*. .	40.3	330	19	0	2	40	88	33	12	0	0	160	7	11	55

[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 F2. Emissions to air

	SO_2	NO_X	NH_3	Acid equivalents[1]	NMVOC	CO	Particulates[2]
				1000 tonnes			
1973	156	183	..	..	187	719	..
1974	149	180	..	..	178	679	..
1975	138	185	..	..	200	732	..
1976	146	181	..	..	201	776	..
1977	146	195	..	..	207	822	..
1978	142	187	..	..	166	848	..
1979	144	197	..	..	182	886	..
1980	136	191	23	9.7	173	909	47
1981	128	181	..	..	181	872	..
1982	110	185	..	..	188	880	..
1983	103	190	..	..	201	872	..
1984	95	204	..	..	212	899	..
1985	98	216	..	..	231	902	..
1986	91	231	..	..	249	926	..
1987	72	230	23	8.6	253	919	51
1988	67	226	21	8.3	251	917	..
1989	58	225	23	8.0	276	910	48
1990	52	224	23	7.8	294	867	70
1991	44	213	23	7.4	294	799	64
1992	36	212	25	7.2	322	778	62
1993	35	222	24	7.3	338	781	68
1994	34	219	25	7.3	352	766	69
1995	33	221	26	7.4	367	734	68
1996	33	230	27	7.6	371	707	70
1997	30	233	26	7.5	368	670	74
1998	30	235	26	7.5	354	633	68
1999	29	238	25	7.6	358	599	65
2000	27	224	25	7.2	367	568	66
2001*	25	221	25	7.0	376	548	64
2002*	23	214	25	6.8	334	526	63

[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 F3. Emissions of greenhouse gases to air by sector. 2000

	CO_2	CH_4	N_2O	HFC[1]	PFC[2]	SF_6	CO_2 equivalents
	Mill. tonnes	1000 tonnes		Tonnes			Mill. tonnes
Total	**41.1**	**332.0**	**17.9**	**116.3**	**136.2**	**37.3**	**55.7**
Energy sectors	**13.8**	**32.3**	**0.1**	**1.3**	**0.0**	**2.7**	**14.6**
Extraction of oil and gas[3]	11.4	31.7	0.1	1.2	0.0	-	12.1
Extraction of coal	0.0	0.3	-	0.0	-	-	0.0
Oil refining	2.1	0.1	0.0	0.0	-	-	2.1
Electricity supplies[4]	0.3	0.1	0.0	0.0	-	2.7	0.4
Manufacturing and mining	**11.9**	**28.6**	**5.8**	**21.8**	**136.2**	**32.4**	**16.0**
Oil drilling	0.4	0.2	0.0	0.0	-	-	0.4
Manufacture of pulp and paper	0.3	11.6	0.1	0.0	-	-	0.6
Manufacture of basic chemicals	3.1	1.0	5.6	0.1	-	-	4.9
Manufacture of minerals[5]	2.0	0.0	0.0	0.0	-	-	2.0
Manufacture of iron, steel and ferro-alloys	2.8	0.0	0.0	0.5	-	-	2.8
Manufacture of other metals	2.3	0.0	0.0	0.5	136.2	32.4	3.9
Manufacture of metal goods, boats, ships and oil platforms	0.3	0.0	0.0	11.9	-	0.1	0.3
Manufacture of wood, plastic, rubber, and chemical goods, printing	0.2	15.8	0.0	0.5	-	-	0.5
Manufacture of consumer goods	0.6	0.0	0.0	8.1	0.0	-	0.6
Other	**10.5**	**263.0**	**10.8**	**80.8**	**0.0**	**1.9**	**19.6**
Construction	0.7	0.1	0.1	1.5	-	-	0.7
Agriculture and forestry	0.6	99.2	9.6	1.1	-	-	5.6
Fishing, whaling and sealing	1.4	0.1	0.0	4.8	0.0	-	1.4
Land transport, domestic	3.2	0.2	0.2	6.6	0.0	-	3.3
Sea transport, domestic	1.5	0.1	0.0	2.5	0.0	-	1.5
Air transport[6]	1.1	0.0	0.0	0.4	-	-	1.1
Other private services	1.7	0.4	0.3	59.2	0.0	1.9	2.0
Public sector, municipal[7]	0.2	162.8	0.5	2.9	0.0	-	3.8
Public sector, state	0.2	0.0	0.0	1.7	0.0	-	0.2
Private households	**4.9**	**8.1**	**1.1**	**12.4**	**-**	**0.3**	**5.5**

[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 F4. Emissions to air by sector. 2000

	SO_2	NO_X	NH_3	Acid equivalents[1]	NMVOC	CO	Particulates[2]
				1000 tonnes			
Total	**26.6**	**223.8**	**25.4**	**7.2**	**367.4**	**568.2**	**65.9**
Energy sectors	**3.3**	**63.7**	**0.0**	**1.5**	**245.5**	**8.8**	**0.9**
Extraction of oil and gas[3]	0.6	59.8	-	1.3	234.9	7.7	0.6
Extraction of coal	0.0	0.1	-	0.0	0.0	0.0	0.0
Oil refining	2.0	2.6	-	0.1	10.1	0.0	0.1
Electricity supplies[4]	0.7	1.3	0.0	0.0	0.5	1.0	0.1
Manufacturing and mining	**18.6**	**31.0**	**0.6**	**1.3**	**23.2**	**48.6**	**12.2**
Oil drilling	0.2	7.6	-	0.2	0.6	0.8	0.4
Manufacture of pulp and paper	1.5	1.6	-	0.1	0.4	3.5	0.6
Manufacture of basic chemicals	5.7	5.1	0.5	0.3	1.7	32.8	2.4
Manufacture of minerals[5]	1.6	5.7	-	0.2	2.0	0.7	2.3
Manufacture of iron, steel and ferro-alloys	6.5	6.8	-	0.4	1.9	0.1	3.8
Manufacture of other metals	1.9	1.4	-	0.1	0.0	1.1	2.5
Manufacture of metal goods, boats, ships and oil platforms	0.1	0.7	0.0	0.0	2.6	1.4	0.0
Manufacture of wood, plastic, rubber, and chemical goods, printing	0.3	0.8	0.0	0.0	12.7	7.3	0.2
Manufacture of consumer goods	0.6	1.2	0.0	0.0	1.3	0.9	0.1
Other	**3.8**	**110.1**	**23.6**	**3.9**	**42.6**	**102.9**	**8.0**
Construction	0.2	6.0	0.0	0.1	10.5	5.0	1.7
Agriculture and forestry	0.2	6.0	23.2	1.5	3.1	14.6	2.9
Fishing, whaling and sealing	0.9	31.1	0.0	0.7	0.7	6.6	0.2
Land transport, domestic	0.3	22.7	0.1	0.5	4.9	20.8	2.3
Sea transport, domestic	1.5	31.5	-	0.7	1.6	1.3	0.3
Air transport[6]	0.1	3.6	-	0.1	2.0	5.0	0.0
Other private services	0.4	7.0	0.3	0.2	16.6	48.8	0.4
Public sector, municipal[7]	0.1	0.2	-	0.0	1.6	0.2	0.0
Public sector, state	0.1	2.0	0.0	0.0	1.6	0.7	0.0
Private households	**0.9**	**18.9**	**1.3**	**0.5**	**56.2**	**407.8**	**44.8**

[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 F5. Emissions to air by source[1]. 2000

	CO_2	CH_4	N_2O	SO_2	NO_X	NH_3	NMVOC	CO	Particulates[2]
	Mill. tonnes	1000 tonnes							
Total	**41.1**	**332.0**	**17.9**	**26.6**	**223.8**	**25.4**	**367.4**	**568.2**	**65.9**
Stationary combustion	18.1	11.0	0.3	5.4	58.0	0.1	11.9	195.0	46.3
Process emissions	8.2	318.1	15.5	17.0	12.1	23.8	296.2	33.7	14.4
Mobile combustion	14.9	2.9	2.1	4.2	153.6	1.6	59.3	339.6	5.2
Stationary combustion									
Total	**18.1**	**11.0**	**0.3**	**5.4**	**58.0**	**0.1**	**11.9**	**195.0**	**46.3**
Oil and gas extraction	10.0	3.3	0.1	0.3	43.7	-	1.4	7.4	0.4
Natural gas	7.2	2.8	0.1	-	26.7	-	0.7	5.2	0.4
Flaring	1.6	0.2	0.0	-	8.2	-	0.0	1.0	0.0
Diesel combustion	0.5	0.0	0.0	0.3	8.1	-	0.5	0.6	0.0
Gas terminals	0.7	0.3	0.0	0.0	0.7	-	0.1	0.6	0.0
Manufacturing and mining	6.3	0.7	0.2	3.7	10.6	-	2.1	12.0	0.8
Refining	2.1	0.1	0.0	0.2	1.6	-	0.9	0.0	0.1
Manufacture of pulp and paper	0.3	0.3	0.1	1.1	1.6	-	0.3	3.5	0.2
Manufacture of mineral products	0.8	0.0	0.0	0.4	3.9	-	0.0	0.2	0.0
Manufacture of chemicals	1.7	0.1	0.0	0.4	1.5	-	0.0	0.1	0.1
Manufacture of metals	0.6	0.0	0.0	0.2	0.6	-	0.0	0.1	0.1
Other manufacturing	0.9	0.2	0.0	1.5	1.3	-	0.8	8.1	0.3
Other industries	0.9	0.6	0.0	0.6	1.1	-	0.1	10.5	2.2
Dwellings	0.7	6.3	0.0	0.6	1.7	0.1	7.9	164.9	42.8
Incineration of waste and landfill gas	0.2	0.1	0.0	0.2	1.0	-	0.4	0.2	0.0
Process emissions									
Total	**8.2**	**318.1**	**15.5**	**17.0**	**12.1**	**23.8**	**296.2**	**33.7**	**14.4**
Oil and gas extraction	0.8	28.5	0.0	-	0.1	-	233.1	0.0	0.3
Venting, leaks, etc.	0.1	10.6	0.0	-	0.1	-	5.1	0.0	0.3
Oil loading at sea	0.7	16.4	-	-	-	-	212.0	-	-
Oil loading, on shore	0.0	0.1	-	-	-	-	14.0	-	-
Gas terminals	0.0	1.4	-	-	-	-	2.1	-	-
Manufacturing and mining	7.0	1.2	5.6	17.0	12.0	0.5	12.5	33.6	12.1
Refining	0.0	-	-	1.8	1.0	-	9.2	-	-
Manufacture of pulp and paper	-	-	-	0.5	-	-	-	-	0.4
Manufacture of chemicals	0.7	0.9	5.6	2.4	1.4	0.5	0.7	32.6	1.0
Manufacture of mineral products	0.9	-	-	0.7	-	-	-	-	3.2
Manufacture of metals	5.2	-	-	11.6	9.6	-	1.8	1.0	7.5
Iron, steel and ferro-alloys	3.2	-	-	9.3	8.7	-	1.8	-	5.0
Aluminium	1.7	-	-	1.4	0.9	-	-	-	2.3
Other metals	0.3	-	-	0.9	0.0	-	-	1.0	0.2
Other manufacturing	0.1	0.3	-	-	-	-	0.8	-	0.0
Petrol distribution	0.0	-	-	-	-	-	8.3	-	-
Agriculture	0.1	98.7	9.4	-	-	23.2	-	-	0.0
Landfill gas	0.0	188.7	-	-	-	-	-	-	-
Solvents	0.1	-	-	-	-	-	42.3	-	0.0
Road dust	-	-	-	-	-	-	-	-	1.9
Other process emissions	0.0	1.0	0.5	-	-	-	-	-	0.0

Table F5. (cont.). Emissions to air by source[1]. 2000

	CO_2	CH_4	N_2O	SO_2	NO_X	NH_3	NMVOC	CO	Particulates[2]
Mobile combustion									
Total	**14.9**	**2.9**	**2.1**	**4.2**	**153.6**	**1.6**	**59.3**	**339.6**	**5.2**
Road traffic	8.8	2.2	1.6	0.7	47.4	1.6	41.0	276.9	2.6
Petrol engines	4.8	1.9	1.5	0.3	20.4	1.6	32.4	245.0	0.3
Passenger cars	4.2	1.7	1.4	0.2	17.8	1.5	29.0	218.0	0.3
Other light vehicles	0.6	0.1	0.1	0.0	2.1	0.1	2.9	24.4	0.0
Heavy vehicles	0.0	0.0	0.0	0.0	0.6	0.0	0.5	2.6	0.0
Diesel engines	3.9	0.1	0.2	0.4	26.8	0.0	3.6	13.1	2.3
Passenger cars	0.4	0.0	0.0	0.0	1.1	0.0	0.3	1.5	0.4
Other light vehicles	1.1	0.0	0.1	0.1	2.3	0.0	0.9	4.0	0.7
Heavy vehicles	2.4	0.1	0.1	0.3	23.3	0.0	2.4	7.6	1.2
Motorcycles, mopeds	0.1	0.1	0.0	0.0	0.2	0.0	5.0	18.8	0.0
Motorcycles	0.1	0.1	0.0	0.0	0.1	0.0	2.4	13.9	0.0
Mopeds	0.0	0.0	0.0	0.0	0.0	0.0	2.6	4.9	0.0
Snow scooters	0.0	0.0	0.0	0.0	0.0	0.0	1.6	3.1	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	0.3	11.6	0.0	3.8	25.5	1.4
Railways	0.0	0.0	0.0	0.0	0.7	-	0.1	0.2	0.1
Air traffic	1.1	0.0	0.0	0.1	3.8	-	1.1	5.3	0.0
Domestic < 1000 m	0.4	0.0	0.0	0.0	1.1	-	0.3	1.9	0.0
Domestic > 1000 m	0.7	-	0.0	0.1	2.7	-	0.8	3.4	0.0
Shipping	4.0	0.3	0.1	3.0	89.0	-	2.8	5.9	0.8
Coastal traffic, etc.	2.3	0.2	0.1	2.0	50.6	-	1.7	1.8	0.5
Fishing vessels	1.4	0.1	0.0	0.9	31.0	-	0.6	3.4	0.2
Mobile oil rigs, etc.	0.3	0.1	0.0	0.2	7.5	-	0.5	0.7	0.1

[1] Does not include international sea traffic. [2] PM_{10}.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F6. Emissions to air by source[1]. 2001*

	CO_2	CH_4	N_2O	SO_2	NO_x	NH_3	NMVOC	CO	Parti-culates[2]
	Mill. tonnes	1000 tonnes							
Total	**41.6**	**332.5**	**18.0**	**24.8**	**220.7**	**24.6**	**375.8**	**548.2**	**64.4**
Stationary combustion	18.1	11.3	0.4	6.3	59.0	0.1	11.9	194.4	45.5
Process emissions	8.1	318.3	15.2	14.7	10.6	22.7	307.2	33.1	13.8
Mobile combustion	15.4	2.9	2.4	3.8	151.1	1.8	56.7	320.7	5.1
Stationary combustion, total	**18.1**	**11.3**	**0.4**	**6.3**	**59.0**	**0.1**	**11.9**	**194.4**	**45.5**
Oil and gas extraction	10.5	3.6	0.1	0.3	44.4	-	1.5	7.8	0.5
Natural gas	8.0	3.1	0.1	-	29.1	-	0.8	5.8	0.4
Flaring	1.3	0.1	0.0	-	6.6	-	0.0	0.8	0.0
Diesel combustion	0.5	0.0	0.0	0.3	7.8	-	0.5	0.5	0.0
Gas terminals	0.7	0.3	0.0	0.0	0.8	-	0.1	0.6	0.0
Manufacturing and mining	5.6	0.7	0.2	4.0	10.8	-	2.0	14.2	0.8
Refining	1.4	0.1	0.0	0.4	1.5	-	0.6	0.0	0.1
Manufacture of pulp and paper	0.5	0.4	0.1	1.6	2.1	-	0.5	5.8	0.2
Manufacture of mineral products	0.8	0.0	0.0	0.3	3.8	-	0.0	0.1	0.0
Manufacture of chemicals	1.5	0.1	0.0	0.5	1.4	-	0.0	0.1	0.1
Manufacture of metals	0.5	0.0	0.0	0.2	0.6	-	0.1		0.0
Other manufacturing	0.9	0.1	0.0	1.5	1.3	-	0.7	7.2	0.3
Other industries	1.1	0.6	0.0	0.7	1.2	-	0.1	10.0	2.1
Dwellings	0.8	6.3	0.0	0.7	1.7	0.1	7.9	162.2	42.1
Incineration of waste and landfill gas	0.2	0.1	0.0	0.2	0.9	-	0.4	0.2	0.0
Process emissions Total	**8.1**	**318.3**	**15.2**	**14.7**	**10.6**	**22.7**	**307.2**	**33.1**	**13.8**
Oil and gas extraction	1.0	32.8	0.0	-	0.4	-	244.9	0.1	0.8
Venting, leaks, etc.	0.2	12.3	0.0	-	0.4	-	5.4	0.1	0.8
Oil loading at sea	0.7	18.9	-	-	-	-	221.9	-	-
Oil loading, on shore	0.0	0.1	-	-	-	-	15.3	-	-
Gas terminals	0.0	1.6	-	-	-	-	2.2	-	-
Manufacturing and mining	6.8	1.8	5.5	14.7	10.2	0.4	11.8	33.0	11.1
Refining	0.0	-	-	1.5	0.9	-	8.8	-	-
Manufacture of pulp and paper	-	-	-	0.4	-	-	-	-	0.4
Manufacture of chemicals	0.7	0.8	5.5	1.9	1.4	0.4	0.7	32.0	1.1
Manufacture of mineral products	0.9	-	-	0.7	-	-	-	-	3.1
Manufacture of metals	5.1	-	-	10.2	7.9	-	1.6	1.0	6.5
Iron, steel and ferro-alloys	3.0	-	-	8.0	7.0	-	1.6	-	3.5
Aluminium	1.8	-	-	1.3	0.9	-	-	-	2.7
Other metals	0.3	-	-	0.9	0.0	-	-	1.0	0.2
Other manufacturing	0.1	1.0	-	-	-	-	0.7	-	0.0
Petrol distribution	0.0	-	-	-	-	-	8.3	-	-
Agriculture	0.1	97.9	9.2	-	-	22.4	-	-	0.0
Landfill gas	0.0	184.8	-	-	-	-	-	-	-
Solvents	0.1	-	-	-	-	-	42.3	-	0.0
Road dust	-	-	-	-	-	-	-	-	1.9
Other process emissions	0.0	1.0	0.5	-	-	-	-	-	0.0

Table F6. (cont.). Emissions to air by source[1]. 2001*

	CO_2	CH_4	N_2O	SO_2	NO_x	NH_3	NMVOC	CO	Particulates[2]
Mobile combustion									
Total	**15.4**	**2.9**	**2.4**	**3.8**	**151.1**	**1.8**	**56.7**	**320.7**	**5.1**
Road traffic	9.3	2.2	1.9	0.6	47.6	1.8	37.9	257.2	2.5
Petrol engines	5.0	1.9	1.7	0.3	19.2	1.8	29.3	225.0	0.3
Passenger cars	4.4	1.7	1.6	0.3	16.8	1.7	26.3	201.1	0.3
Other light vehicles	0.6	0.1	0.1	0.0	2.0	0.1	2.6	22.0	0.0
Heavy vehicles	0.0	0.0	0.0	0.0	0.5	0.0	0.4	2.0	0.0
Diesel engines	4.3	0.2	0.2	0.3	28.2	0.0	3.7	13.3	2.2
Passenger cars	0.5	0.0	0.0	0.0	1.2	0.0	0.3	1.5	0.4
Other light vehicles	1.2	0.0	0.1	0.1	2.4	0.0	0.8	4.3	0.7
Heavy vehicles	2.6	0.1	0.1	0.2	24.6	0.0	2.5	7.5	1.2
Motorcycles, mopeds	0.1	0.1	0.0	0.0	0.2	0.0	5.0	18.8	0.0
Motorcycles	0.1	0.1	0.0	0.0	0.1	0.0	2.4	13.9	0.0
Mopeds	0.0	0.0	0.0	0.0	0.0	0.0	2.6	4.9	0.0
Snow scooters	0.0	0.0	0.0	0.0	0.0	0.0	1.7	3.3	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	12.1	0.0	3.8	25.6	1.4
Railways	0.0	0.0	0.0	0.0	0.7	-	0.1	0.2	0.1
Air traffic	1.1	0.0	0.0	0.2	3.8	-	1.6	5.9	0.0
Domestic < 1000 m	0.4	0.0	0.0	0.1	1.1	-	0.3	2.0	0.0
Domestic > 1000 m	0.8	-	0.0	0.1	2.8	-	1.2	3.9	0.0
Shipping	3.9	0.3	0.1	2.8	85.8	-	2.7	5.9	0.8
Coastal traffic, etc.	2.1	0.2	0.1	1.8	47.3	-	1.6	1.8	0.5
Fishing vessels	1.4	0.1	0.0	0.9	32.2	-	0.6	3.6	0.2
Mobile oil rigs, etc.	0.3	0.1	0.0	0.2	6.3	-	0.4	0.6	0.0

[1] Does not include international sea traffic. [2] PM_{10}.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Table F7. Emissions to air by county. 2000

	CO_2	CH_4	N_2O	SO_2	NO_x	NH_3	NMVOC	CO	Particulates[4]
	Mill. tonnes	1000 tonnes							
Total	**41.3**	**332.0**	**17.9**	**27.1**	**226.5**	**25.4**	**367.6**	**568.9**	**65.9**
Of this, national emission figures	41.1	332.0	17.9	26.6	223.8	25.4	367.4	568.2	65.9
Of this, international sea and air traffic[1]	0.2	0.0	0.0	0.5	2.7	-	0.2	0.7	0.0
Østfold	1.4	15.4	0.8	2.4	5.8	1.5	7.7	29.7	3.1
Akershus	1.6	19.2	1.0	0.4	7.8	1.4	13.1	58.5	4.6
Oslo	1.1	8.7	0.2	0.5	5.1	0.1	10.9	27.1	1.1
Hedmark	0.7	18.6	1.1	0.2	4.4	2.2	5.6	32.7	4.0
Oppland	0.7	21.7	1.1	0.2	3.9	2.5	5.3	32.3	4.5
Buskerud	0.9	17.4	0.6	0.7	5.3	1.0	6.7	38.6	5.3
Vestfold	1.2	11.7	0.5	1.1	4.8	0.9	8.1	26.5	2.5
Telemark	3.2	11.5	4.0	1.1	7.0	0.9	5.6	27.2	4.1
Aust-Agder	0.5	7.1	0.2	1.1	1.9	0.3	3.1	40.3	1.7
Vest-Agder	1.1	12.0	0.3	1.6	3.2	0.6	4.4	17.9	1.8
Rogaland	2.7	35.4	1.3	1.1	7.7	3.5	11.6	33.6	3.5
Hordaland	3.7	26.9	0.6	2.3	9.3	1.3	33.1	35.6	3.6
Sogn og Fjordane	1.2	11.5	0.5	1.4	3.9	1.3	2.7	12.5	2.3
Møre og Romsdal	1.5	17.2	0.7	0.5	5.5	1.8	6.3	26.1	3.9
Sør-Trøndelag	1.2	17.0	0.8	2.5	5.3	1.7	6.4	34.4	5.3
Nord-Trøndelag	0.6	15.8	0.9	1.0	3.3	2.1	3.9	27.7	5.0
Nordland	2.3	19.6	2.5	3.4	8.4	1.6	5.7	26.3	5.2
Troms	0.8	8.5	0.3	1.3	3.9	0.6	3.5	14.4	2.1
Finnmark	0.3	6.3	0.2	0.1	1.8	0.2	2.0	8.5	0.8
Svalbard and Jan Mayen	0.1	0.3	0.0	0.4	0.2	0.0	0.1	0.2	0.1
Continental shelf	13.3	30.2	0.2	2.7	117.0	-	220.9	14.5	1.4
Airspace[2]	0.9	0.0	0.0	0.1	3.3	-	1.0	3.9	0.0
Open sea[3]	0.3	0.0	0.0	0.2	7.8	-	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 F8. International emissions of CO_2 from energy use[1]. Emissions per unit GDP and per capita

	1980	1985	1990	1995	1999	Per unit GDP[2]	Per capita
	Mill. tonnes					kg/1000 USD	tonnes per capita
Whole world	18 102	18 834	20 652	21 512	22 414	..	3.7
OECD	10 923	10 582	11 095	11 555	12 239	516	11.0
Norway	29	27	28	30	37	311	8.3
Denmark	61	60	50	58	53	399	10.0
Finland	59	52	53	55	58	497	11.2
Iceland	2	2	2	2	2	282	7.2
Sweden	69	59	49	51	48	234	5.4
Belgium	126	103	106	114	119	486	11.6
France	472	374	364	344	361	274	6.2
Greece	45	56	69	72	82	538	7.8
Ireland	26	27	32	34	40	422	10.7
Italy	370	357	397	412	421	342	7.3
Luxembourg	12	10	10	8	7	400	16.2
Netherlands	154	146	156	170	167	438	10.6
Poland	437	439	348	336	310	926	8.0
Portugal	25	25	40	49	61	385	6.1
Slovak republic	63	62	55	41	39	693	7.2
Spain	192	187	212	239	272	393	6.9
United Kingdom	584	559	572	552	535	435	9.0
Switzerland	40	39	41	38	40	209	5.6
Czech Republic	165	169	150	125	111	845	10.8
Turkey	73	100	138	157	183	466	2.8
Germany	1 074	1 021	967	866	822	442	10.0
Hungary	81	79	68	59	58	541	5.8
Austria	57	54	57	57	61	319	7.5
Canada	429	400	421	452	489	623	16.0
Mexico	244	269	297	314	358	472	3.7
United States	4 765	4 614	4 846	5 116	5 585	647	20.5
Japan	913	895	1 049	1 134	1 158	377	9.1
Republic of Korea	124	154	234	364	410	684	8.8
Australia	212	221	260	278	322	694	17.0
New Zealand	17	22	23	27	31	445	8.1

[1]The Norwegian figures in this OECD survey diverge somewhat from the most recent emission calculations. [2]GDP at 995 prices and purchasing power parities.
Source: OECD (2002).

Table F9. International emissions of SO_X[1]. Emissions per unit GDP and per capita

	1980	1985	1990	1995	Late 1990s	Per unit GDP[2]	Per capita
	1000 tonnes					kg/1000 USD	kg per capita
Norway	137	98	53	34	28	0.2	6.4
Denmark	452	339	181	149	28	0.2	5.2
Finland	584	382	260	97	76	0.6	14.6
Sweden	508	266	136	90	71	0.4	8.0
Belgium	828	400	327	246	205	0.9	20.1
France	3 208	1 473	1 269	926	837	0.7	14.0
Italy	3 841	1 963	1 719	1 262	923	0.8	16.0
Netherlands	495	254	202	142	100	0.3	6.0
Poland	4 100	4 300	3 210	2 376	1 511	4.3	39.1
Portugal	266	199	359	366	375	2.5	37.6
Russian Fed.	..	..	..	6 612	5 877	6.0	39.9
Spain	2 967	2 494	2 136	1 776	1 592	2.4	40.4
United Kingdom	4 880	3 750	3 754	2 348	1 187	1.0	19.9
Switzerland	116	76	43	34	28	0.1	3.9
Czech Republic	2 257	2 277	1 876	1 091	265	2.0	25.8
Germany	..	..	5 321	1 994	831	0.4	10.1
Hungary	1 633	1 404	1 010	705	592	5.7	58.5
Austria	385	190	91	54	41	0.2	5.0
Canada	4 643	3 178	3 305	2 806	2 691	3.7	89.7
United States	23 501	21 463	21 481	17 407	17 116	2.0	62.7
Japan	1 263	..	900	827	870	0.3	6.9
Republic of Korea	..	1 351	1 611	1 532	1 146	1.8	24.7

[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.
Source: OECD (2002).

Table F10. International emissions of NO_X[1]. Emissions per unit GDP and per capita

	1980	1985	1990	1995	Late 1990s	Per unit GDP[2]	Per capita
	1000 tonnes					kg/1000 USD	kg per capita
Norway	194	218	226	223	240	2.1	53.7
Denmark	273	294	277	261	208	1.5	38.9
Finland	295	275	300	259	236	1.9	45.6
Sweden	448	..	349	310	267	1.4	30.2
Belgium	442	325	314	327	364	1.5	35.7
France	2 032	1 830	1 882	1 716	1 654	1.3	28.1
Italy	1 569	1 630	1 944	1 795	1 485	1.2	25.8
Netherlands	584	581	578	489	408	1.1	25.8
Poland	1 229	1 500	1 280	1 120	838	2.4	21.7
Portugal	165	..	317	358	369	2.4	37.0
Russian Fed.	3 304	3 393	4 023	3 119	3 029	3.1	20.5
Spain	1 091	989	1 226	1 304	1 299	2.0	33.0
United Kingdom	2 583	2 544	2 760	2 094	1 603	1.3	26.9
Switzerland	170	179	154	120	105	0.6	14.8
Czech Republic	937	831	742	412	397	3.0	38.6
Germany	..	..	2 706	1 967	1 637	0.9	19.9
Hungary	273	263	238	190	221	2.1	22.0
Austria	227	216	202	183	184	0.9	22.7
Canada	1 959	2 044	2 106	1 998	2 056	2.6	67.4
United States	22 121	21 044	21 926	22 725	23 037	2.6	84.4
Japan	1 602	1 322	1 650	1 731	1 654	0.5	13.1
Republic of Korea	..	722	925	1 153	1 083	1.7	23.3

[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.
Source: OECD (2002).

Table F11. Emissions to air of hazardous substances

	Lead	Cadmium	Mercury	Arsenic	Chromium	Copper	PAHs	Dioxins
	Tonnes	kg					Tonnes	Grammes
1990	186	1 644	1 704	3 098	12 797	21 882	156	130
1991	143	1 573	1 583	2 997	12 718	19 010	143	98
1992	126	1 567	1 421	2 968	12 595	19 290	140	96
1993	86	1 637	1 120	3 151	12 348	19 303	144	95
1994	23	1 182	1 171	3 558	11 654	17 848	141	94
1995	21	1 012	1 088	2 896	11 367	18 648	141	70
1996	9	1 052	1 118	2 999	11 438	18 887	146	49
1997	8	1 073	1 130	2 823	12 374	19 375	152	41
1998	8	1 138	1 097	3 285	11 886	20 363	145	35
1999	7	978	1 155	3 286	11 287	20 530	138	39
2000	6	725	996	2 457	8 814	19 329	138	34
2001*	5	696	950	2 165	7 083	19 658	143	34

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

Table F12. Emissions to air of hazardous substances[1] by source. 2001*

	Lead	Cadmium	Mercury	Arsenic	Chromium	Copper	PAH-total	Dioxins
	kg						Tonnes	Grammes
Total	**5 156.6**	**696.4**	**949.8**	**2 164.8**	**7 082.9**	**19 658.3**	**143.2**	**33.7**
Stationary combustion	1 222.3	429.8	492.1	761.4	2 144.9	2 311.5	52.4	20.1
Process emissions	1 972.1	217.3	304.1	1 156.3	4 698.0	11 652.7	80.8	8.4
Mobile combustion	1 962.2	49.3	153.6	247.2	240.0	5 694.1	10.0	5.2
Stationary combustion								
Total	**1 222.3**	**429.8**	**492.1**	**761.4**	**2 144.9**	**2 311.5**	**52.4**	**20.1**
Oil and gas extraction	15.4	8.8	11.5	23.6	96.5	76.3	0.3	0.8
Natural gas	0.9	5.8	3.4	13.0	72.0	54.8	0.1	0.2
Flaring	0.1	0.9	0.6	2.1	11.6	8.9	0.0	0.0
Diesel combustion	14.3	1.4	7.1	7.1	5.7	7.1	0.2	0.6
Gas terminals	0.1	0.6	0.3	1.3	7.2	5.5	0.0	0.0
Manufacturing and mining	738.0	247.5	246.2	469.7	1 626.0	1 569.2	0.4	4.2
Refining	3.1	0.3	0.6	3.7	14.7	9.7	0.0	0.0
Manufacture of pulp and paper	339.4	165.3	158.0	286.0	634.1	726.2	0.3	3.4
Manufacture of mineral products	157.3	14.0	5.4	16.2	347.9	239.4	0.0	0.1
Manufacture of chemicals	52.9	5.3	10.8	39.1	350.7	257.3	0.0	0.1
Manufacture of metals	26.3	8.9	7.3	13.5	13.6	38.6	0.0	0.1
Other manufacturing	158.8	53.6	64.1	111.2	264.9	298.0	0.1	0.5
Other industries	86.9	24.8	36.3	50.8	142.4	171.0	5.5	3.2
Dwellings	94.2	121.4	129.6	206.9	195.7	436.3	45.4	9.3
Incineration of waste and landfill gas	287.9	27.4	68.5	10.4	84.4	58.7	0.8	2.6

Table F12. (cont.). Emissions to air of hazardous substances[1] by source. 2001*

	Lead	Cadmium	Mercury	Arsenic	Chromium	Copper	PAH-total	Dioxins
			kg				Tonnes	Grammes
Process emissions								
Total	**1 972.1**	**217.3**	**304.1**	**1 156.3**	**4 698.0**	**11 652.7**	**80.8**	**8.4**
Oil and gas extraction	-	-	-	-	-	-	0.4	0.3
Venting, leaks, etc. . . .	-	-	-	-	-	-	0.4	0.3
Oil loading at sea	-	-	-	-	-	-	-	-
Oil loading, on shore . .	-	-	-	-	-	-	-	-
Gas terminals	-	-	-	-	-	-	-	-
Manufacturing and mining	1 871.6	176.3	259.4	1 156.3	4 300.7	2 609.7	70.2	8.1
Refining.	-	-	-	-	-	-	-	-
Manufacture of pulp and paper	-	-	-	-	-	-	-	-
Manufacture of chemicals	371.8	64.9	2.7	735.4	223.8	521.0	2.1	0.0
Manufacture of mineral products	77.1	5.4	47.3	3.3	64.3	35.3	-	0.1
Manufacture of metals	1 422.6	106.0	209.4	417.6	4 012.6	2 053.4	68.1	7.8
Iron, steel and ferro-alloys.	1 392.7	43.4	199.4	253.9	3 664.9	728.1	1.5	5.7
Aluminium	1.9	1.6	0.2	0.3	5.7	5.3	64.3	1.0
Other metals.	28.0	61.0	9.8	163.4	342.0	1 320.0	2.4	1.1
Other manufacturing .	-	-	-	-	-	-	0.0	0.1
Petrol distribution	-	-	-	-	-	-	-	-
Agriculture	-	-	-	-	-	-	-	-
Landfill gas	-	-	-	-	-	-	-	-
Solvents	-	-	-	-	-	-	9.8	-
Road dust	9.0	39.7	2.3	-	397.2	8 052.3	0.4	-
Use of products	-	-	42.0	-	-	-	-	-
Other process emissions . .	10.5	1.3	0.4	-	0.1	990.6	-	0.0
Mobile combustion								
Total	**1 962.2**	**49.3**	**153.6**	**247.2**	**240.0**	**5 694.1**	**10.0**	**5.2**
Road traffic.	183.7	29.7	67.6	148.4	148.4	5 045.0	6.9	0.3
Petrol engines	47.7	15.9	-	79.4	79.4	2 700.7	1.6	0.2
Passenger cars.	41.8	13.9	-	69.7	69.7	2 368.8	1.4	0.1
Other light vehicles .	5.5	1.8	-	9.2	9.2	313.0	0.2	0.0
Heavy vehicles.	0.3	0.1	-	0.6	0.6	18.9	0.0	0.0
Diesel engines	135.2	13.5	67.6	67.6	67.7	2 299.1	5.2	0.1
Passenger cars.	15.4	1.5	7.7	7.7	7.7	261.6	0.7	0.0
Other light vehicles .	36.8	3.7	18.4	18.4	18.4	625.2	1.6	0.0
Heavy vehicles.	83.1	8.3	41.5	41.5	41.6	1 412.4	3.0	0.1
Motorcycles, mopeds .	0.8	0.3	-	1.3	1.3	45.2	0.1	0.0
Motorcycles	0.6	0.2	-	1.0	1.0	33.3	0.0	0.0
Mopeds	0.2	0.1	-	0.3	0.3	11.8	0.0	0.0
Snow scooters	0.1	0.0	-	0.2	0.2	7.9	0.0	0.0
Small boats	2.7	0.6	0.7	2.8	2.8	96.1	0.1	0.0
Motorized equipment	24.5	2.6	12.0	12.9	12.9	434.1	0.8	0.0
Railways	1.5	0.1	0.7	0.7	0.7	25.3	0.0	0.0
Air traffic	1 622.4	3.6	10.7	18.0	18.0	21.9	0.1	0.0
Domestic < 1000 m . .	321.6	1.2	3.5	5.8	5.8	6.6	0.1	0.0
Domestic > 1000 m . .	1 300.8	2.4	7.3	12.2	12.2	15.3	0.1	0.0
Shipping	127.3	12.7	61.7	64.1	56.9	63.8	1.9	4.9
Coastal traffic, etc. . . .	73.3	7.3	34.8	37.1	35.2	36.8	1.1	2.7
Fishing vessels	45.1	4.5	22.5	22.5	18.1	22.5	0.7	1.8
Mobile oil rigs, etc. . . .	9.0	0.9	4.5	4.5	3.6	4.5	0.1	0.4

[1]Does not include international sea and air traffic.
Source: Emission inventory from Statistics Norway and Norwegian Pollution Control Authority.

Waste

Appendix G

Table G1. Waste in Norway. By material type. 1990-2002* and projections for 2003-2010. 1000 tonnes

	Total	Paper, cardboard and pasteboard	Metals	Plastic	Glass	Wood waste	Textiles	Biodegradable waste	Concrete	Other	Hazardous
1990	..	..	..	271	..	1 263	82	..	..	..	610
1991	..	..	..	295	..	1 160	83	..	..	..	613
1992	..	1 049	1 223	285	..	1 092	83	..	..	..	617
1993	7 386	1 055	1 301	324	158	1 105	87	878	610	1 247	621
1994	7 407	1 040	1 348	339	157	1 095	90	906	638	1 156	640
1995	7 451	1 011	1 370	351	159	1 103	94	964	661	1 109	628
1996	7 529	1 032	1 498	366	155	1 068	99	1 005	665	1 032	608
1997	7 887	1 120	1 523	367	148	1 037	103	1 057	726	1 211	596
1998	8 265	1 131	1 541	380	145	1 038	108	1 076	751	1 386	709
1999	8 311	1 102	1 554	381	146	990	109	1 091	735	1 553	650
2000	8 564	1 334	1 563	376	146	1 000	110	1 102	715	1 534	684
2001*	8 661	1 246	1 611	392	154	1 053	117	1 128	739	1 538	684
2002*	8 752	1 265	1 627	398	155	1 040	120	1 156	735	1 562	694
2003	8 837	1 288	1 636	405	158	1 039	125	1 185	733	1 571	698
2004	8 961	1 319	1 656	413	161	1 040	130	1 223	733	1 584	703
2005	8 927	1 303	1 669	406	156	1 035	125	1 192	737	1 595	710
2006	8 933	1 305	1 682	404	154	1 044	123	1 183	739	1 591	709
2007	9 054	1 324	1 703	410	155	1 025	126	1 211	748	1 628	723
2008	9 181	1 349	1 718	419	159	1 009	131	1 253	752	1 658	733
2009	9 328	1 376	1 736	429	162	991	137	1 299	760	1 693	744
2010	9 475	1 402	1 758	438	165	973	142	1 337	770	1 730	759
By product type, 2000											
Total	8 564	1 334	1 563	376	146	1 000	110	1 102	715	1 534	684
Buildings and building products	940	2	18	51	51	143	..	.	618	58	..
Electrical and electronic equipment	169	.	113	40	10	2	..	.	3	..	..
Packaging	709	379	35	132	46	110	6	.	..	..	..
Clothing, footwear and other textile products	45	.	..	.	.	..	45	.	.	..	..
Food	566	.	.	.	.	.	.	566	.	.	.
Furniture and household products	343	91	49	82	15	81	26	.	..	..	..
Park and garden waste	94	.	.	.	.	.	.	94	.	.	.
Ships and large constructions	..	..	..	..	..	..	..	.	..	..	..
Means of transport excl. ships	267	..	218	14	4	2	2	.	..	28	..
Printed matter	642	642	..	..	..	..	..	.	..	..	..
Other	2 227	84	1 002	46	7	11	29	.	21	343	684
Residues from manufacturing	2 562	135	128	11	13	651	3	443	73	1 105	..

Source: Waste statistics from Statistics Norway.

Table G2. Waste in Norway. By source of origin. 1993-2002* and projections for 2003-2010. 1000 tonnes

	Total	Households[1]	Agriculture, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas and water supply	Construction	Service industries	Unspecified
1993	7 386	1 142	39	34	3 374	21	624	698	1 453
1994	7 407	1 198	41	39	3 273	20	662	726	1 447
1995	7 451	1 249	73	41	3 139	22	698	771	1 457
1996	7 529	1 435	102	45	3 026	19	702	802	1 398
1997	7 887	1 337	107	123	3 151	21	754	853	1 541
1998	8 265	1 461	86	137	3 287	21	793	910	1 569
1999	8 311	1 505	123	111	3 364	18	772	900	1 517
2000	8 564	1 565	97	122	3 372	21	757	906	1 725
2001*	8 661	1 631	96	128	3 417	21	789	947	1 634
2002*	8 752	1 690	100	129	3 429	21	777	954	1 652
2003	8 837	1 765	100	129	3 432	21	774	957	1 658
2004	8 961	1 853	104	130	3 434	21	772	967	1 679
2005	8 927	1 757	109	129	3 442	21	776	983	1 708
2006	8 933	1 723	113	127	3 438	21	780	999	1 733
2007	9 054	1 777	119	121	3 461	22	787	1 010	1 758
2008	9 181	1 868	126	116	3 478	22	788	1 013	1 770
2009	9 328	1 968	132	110	3 500	22	794	1 018	1 784
2010	9 475	2 048	139	106	3 522	22	804	1 027	1 808
By material type, 2000									
Total	8 564	1 565	97	122	3 372	21	757	906	1 725
Paper, cardboard and pasteboard	1 333	466	4	3	169	2	22	319	348
Metals	1 563	152	..	..	193	..	49	96	1 073
Plastic	376	178	..	..	46	..	7	128	17
Glass	145	54	..	..	13	..	46	19	13
Wood waste	1 001	29	..	..	690	..	129	47	106
Textiles	110	88	5	-	6	-	-	11	-
Biodegradable waste	1 101	471	86	..	445	..	1	78	20
Concrete	715	3	..	..	178	..	494	..	40
Other	1 534	112	..	37	1 193	15	..	149	28
Hazardous	684	11	1	82	440	3	9	58	80

[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 G3. 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	7 451	1 783	137	799	119	1 636	2 976
1996	7 529	1 951	189	712	126	1 757	2 793
1997	7 887	2 105	249	746	127	1 707	2 954
1998	8 265	2 165	282	763	120	1 703	3 232
1999	8 308	2 294	334	793	97	1 391	3 399
2000	8 564	2 276	364	842	121	1 613	3 348
2001*	8 661	2 345	407	893	121	1 562	3 334
2002*	8 752	2 426	439	917	124	1 526	3 321
By material type, 2000							
Total	8 564	2 276	364	842	121	1 613	3 348
Paper, cardboard and pasteboard	1 334	514	..	114	51	613	42
Metals	1 562	693	.	..	..	46	823
Plastic	375	21	..	56	6	280	12
Glass	146	39	.	.	.	107	-
Wood waste	1 000	226	80	378	8	202	106
Textiles	111	10	..	18	7	76	-
Biodegradable waste	1 102	502	189	132	50	219	10
Concrete	715	150	.	.	.	70	495
Other	1 534	120	93	141	..	129	1 051
Hazardous	684	..	.	..	..	..	684

Source: Waste statistics from Statistics Norway.

Table G4. Hazardous waste generated, by material. 1999-2001. Tonnes

	1999	2000*	2001*
Total	**650 252**	**684 397**	**684 207**
Waste containing oil	169 089	185 826	188 568
Waste containing solvents	15 672	15 090	13 858
Other organic hazardous wastes [1]	15 513	15 812	15 062
Waste containing heavy metals	166 761	181 368	174 135
Corrosive waste	240 423	250 790	253 546
Other inorganic hazardous wastes	1 481	1 365	1 358
Photochemicals	6 897	4 660	5 481
Contaminated wastewater	32 301	25 198	21 513
Nonclassified hazardous waste	2 115	4 288	10 686

[1] Clean concrete sticked to PCB-containing concrete, is defined as hazardous waste as long as the clean concrete is inseparable from the PCB-containing concrete. This clean concrete is not included in the figures. Frames from PCB-containing glass windows are treated in the same way as hazardous waste, but they are not defined as hazardous waste. These frames are not included in the figures either.
Source: Waste statistics from Statistics Norway.

Table G5. Hazardous waste with unknown treatment. By material.1999-2001. Tonnes

	1999	2000*	2001*
Total	**63 302**	**61 216**	**45 760**
Waste containing oil. . .	44 979	46 812	32 745
Waste containing solvents	3 688	1 767	1 634
Other organic hazardous wastes [1]	6 921	7 134	6 763
Waste containing heavy metals	3 423	2 273	1 254
Corrosive waste	65	72	60
Other inorganic hazardous wastes	785	718	819
Photochemicals.	3 164	2 112	2 233
Contaminated wastewater	-	-	1
Nonclassified hazardous waste	277	328	251

[1] Clean concrete sticked to PCB-containing concrete, is defined as hazardous waste as long as the clean concrete is inseparable from the PCB-containing concrete. This clean concrete is not included in the figures. Frames from PCB-containing glass windows are treated in the same way as hazardous waste, but they are not defined as hazardous waste. These frames are not included in the figures either.
Source: Waste statistics from Statistics Norway.

Table G6. Hazardous waste generated, by source of origin. 1999-2001. Tonnes

	1999	2000*	2001*
Total	**650 252**	**684 397**	**684 207**
Agriculture and forestry	291	247	2 039
Fishing	505	441	411
Mining and quarrying . .	70 203	81 849	8 3104
Manufacturing	409 045	439 522	447 709
Electricity, gas and water supply	406	3 412	10 074
Construction.	10 667	9 235	12 494
Service industries	64 692	58 464	60 381
Waste management . . .	6624	15 510	13 955
Households.	11 190	11 322	11 411
Unknown	76 629	64 395	42 629

Source: Waste statistics from Statistics Norway.

Table G7. Quantities of household waste. Total and separated for recovery[1]. 1974-2002

	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
2002 by material					
Paper and cardboard	124	54	565	246	44
Glass.	12	8	53	37	70
Plastic	26	1	121	5	4
Metals.	21	10	97	44	45
EEE waste	..	6	..	27	..
Wet organic waste	89	31	406	141	35
Wood waste	29	19	130	88	68
Textiles	17	2	77	9	12
Hazardous waste	..	2	..	10	..
Other	36	27	164	125	76

[1]The figures have been adjusted downwards for the years 1992-1997 to correct for the intermixture of waste from industrial sectors.
Source: Waste statistics from Statistics Norway and Heie (1998).

Table G8. Household waste, by recovery or disposal. 1992-2002. 1 000 tonnes

	Total	Separated for recovery	Landfilled	Incinerated	Other	Per cent final disposal[1]
1992	1 012	86	657	269	0	74
1995	1 174	213	648	314	0	62
1998	1 365	453	592	320	0	50
2000	1 454	581	467	406	0	40
2001	1 507	668	382	445	11	33
2002	1 613	732	384	492	4	32

[1]Final disposal means landfilling or incineration without energy recovery. Calculated from an average energy recovery rate of 73 per cent at Norwegian waste incineration plants.
Source: Waste statistics from Statistics Norway.

Table G9. Municipal consumer waste: Investments, costs, fee income, cost coverage ratio, and annual fee[1]. County figures. 2002

	Investment in collection of waste	Investment in waste treatment	Total investment	Maintenance, running and overhead costs	Capital costs	Annual costs	Fee income	Cost coverage ratio	Annual fee[1] for a private dwelling of 120 m[2]
	1 000 NOK							Per cent	NOK
Total	**57 955**	**111 748**	**169 703**	**2 806 642**	**204 137**	**3 010 779**	**2 760 925**	**92**	**1 718**
Østfold	2 596	248	2 844	125 518	8 715	134 232	141 719	106	1 258
Akershus	2 148	7 410	9 558	306 511	11 111	317 622	329 863	104	1 666
Oslo	10 217	58 942	69 159	214 926	47 583	262 509	246 308	94	1 737
Hedmark	407	3 880	4 287	116 596	2 726	119 322	104 271	87	1 504
Oppland	593	114	707	110 535	4 899	115 435	107 260	93	1 459
Buskerud	2 384	3 773	6 157	152 705	19 869	172 574	158 943	92	1 633
Vestfold	1 051	236	1 287	153 092	7 530	160 622	162 446	101	1 598
Telemark	743	8 344	9 087	96 450	9 119	105 569	103 831	98	1 538
Aust-Agder	830	47	877	77 730	878	78 608	79 243	101	1 687
Vest-Agder	8 089	1 153	9 242	111 925	5 960	117 886	120 145	102	1 874
Rogaland	4 113	9 654	13 767	207 843	24 576	232 419	205 081	88	1 746
Hordaland	999	2 462	3 461	346 986	6 431	353 417	362 926	103	1 705
Sogn og Fjordane	523	654	1 177	74 100	5 265	79 365	70 789	89	1 815
Møre og Romsdal	5 056	6 389	11 445	163 104	10 933	174 037	156 671	90	1 709
Sør-Trøndelag	5 948	684	6 632	156 930	11 624	168 554	143 294	85	1 760
Nord-Trøndelag	253	4 629	4 882	94 936	6 636	101 572	57 296	56	1 905
Nordland	605	252	857	116 662	8 242	124 904	35 784	29	1 884
Troms	11 208	1 943	13 151	117 692	10 260	127 952	112 450	88	1 930
Finnmark	192	934	1 126	62 402	1 778	64 180	62 605	98	2 085

[1]Annual fee for the year 2003.
Source: Environmental protection expenditure statistics from Statistics Norway.

Water resources and water pollution **Appendix H**

Table H1. Water sources, number of water works and number of people supplied. By county. 2002

	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]	**1 575**	**4 056 400**	**637**	**3 302 587**	**398**	**362 747**	**567**	**391 066**
01 Østfold.	24	230 287	13	155 387	4	55 738	7	19 162
02 Akershus	30	436 853	19	317 010	3	117 133	9	2 710
03 Oslo.	1	517 000	1	517 000				
04 Hedmark	99	154 574	11	75 054	8	1 620	81	77 900
05 Oppland	77	122 595	20	65 618	7	3 173	50	53 804
06 Buskerud	67	223 738	16	149 307	2	2 640	49	71791
07 Vestfold.	38	209 935	14	204 532			24	5 403
08 Telemark	60	141 730	23	111 974	3	12 693	34	17 063
09 Aust-Agder	34	84 171	19	75 881	5	2 335	10	5 955
10 Vest-Agder	40	141 751	15	121 685	5	1 086	20	18 980
11 Rogaland	50	350 357	37	342 537	5	2 500	11	5 320
12 Hordaland	166	370 482	92	321 351	37	29 713	39	19 418
14 Sogn og Fjordane .	107	79 794	45	52 860	39	15 094	27	11 840
15 Møre og Romsdal .	156	223 146	57	175 276	57	27 374	46	20 496
16 Sør-Trøndelag	118	249 844	55	225 265	14	3 008	50	21 571
17 Nord-Trøndelag . . .	78	107 787	43	98 511	8	1 635	28	7 641
18 Nordland	220	210 634	88	164 557	93	39 377	43	6 700
19 Troms	126	130 912	31	95 925	79	28 732	19	6 255
20 Finnmark	83	69 310	37	31 657	28	18 596	20	19 057
21 Svalbard[2]	1	1 500	1	1 200	1	300		

[1]Including 3 waterworks supplying 250 persons from sea water in Nordland county. [2]One waterworks in Svalbard has two main water sources of different types. [3]The table contains information from 1557 water works. As some water works use several sources of water of different types, the total figure given in the table is higher than 1557.
Source: Norwegian Institute of Public Health.

Table H2. Number of waste water treatment plants. By county. 2001

County/region	Total[1]	Direct dis-charges	Mechanical	Biological	Chemical	Chemical-biological	Other treatment	Individual treatment fa-cilities(<50 PE)
Total 2001.	**2 639**	**700**	**976**	**125**	**256**	**299**	**283**	**336 321**
North Sea counties (01-10)	652	15	37	30	211	227	132	163 746
Rest of the counties (11-20)	1 987	685	939	95	45	72	151	172 575
01 Østfold	46	6	2	2	14	18	4	12 496
02-03 Akershus and Oslo . . .	49	2	2	-	27	17	1	23 272
04 Hedmark	86	-	-	3	30	36	17	32 055
05 Oppland	164	-	2	2	22	74	64	29 884
06 Buskerud	98	-	1	1	44	23	29	20 365
07 Vestfold.	40	-	2	1	14	19	4	13 908
08 Telemark	61	-	2	13	29	12	5	14 957
09 Aust-Agder	43	-	9	1	14	15	4	9 352
10 Vest-Agder	65	7	17	7	17	13	4	7 457
11 Rogaland	204	23	135	7	11	4	24	16 816
12 Hordaland	354	39	268	22	1	14	10	36 366
14 Sogn og Fjordane	206	41	133	8	3	6	15	16 322
15 Møre og Romsdal	464	260	154	1	3	6	40	21 365
16 Sør-Trøndelag	102	11	37	19	7	14	14	18 184
17 Nord-Trøndelag	129	24	41	21	12	17	14	13 969
18 Nordland	284	143	100	10	2	3	26	28 608
19 Troms	125	61	46	6	4	3	5	15 114
20 Finnmark	119	83	25	1	2	5	3	5 831

[1] Individual treatment facilities are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H3. Hydraulic capacity (1 000 PE) of waste water treatment plants. Whole country 1993-2001. By county. 2001

County/region	Total	Direct discharges	Mechanical	Biological	Chemical	Chemical-biological	Other treatment
Total 1993	**[1]4 837**	**..**	**1 282**	**61**	**2 685**	**752**	**49**
Total 1995	**[1]5 219**	**..**	**1 318**	**70**	**3 326**	**411**	**68**
Total 1997	**5 801**	**576**	**1 358**	**95**	**2 568**	**1 115**	**89**
Total 1999	**6 250**	**541**	**1 744**	**72**	**2 189**	**1 575**	**129**
Total 2000	**6 257**	**541**	**1 750**	**71**	**2 194**	**1 574**	**127**
Total 2001	**6 326**	**554**	**1 420**	**116**	**2 289**	**1 566**	**382**
North Sea counties (01-10)	3 497	33	117	51	1 736	1 490	70
Rest of the counties (11-20)	2 829	521	1 303	66	553	77	312
01 Østfold	351	1	0	0	327	21	1
02-03 Akershus and Oslo	1 392	2	1	-	293	1 096	1
04 Hedmark	216	-	-	2	87	106	21
05 Oppland	306	-	0	2	93	195	15
06 Buskerud	320	-	0	1	283	234	12
07 Vestfold	271	-	1	0	253	14	2
08 Telemark	234	-	1	12	210	9	2
09 Aust-Agder	172	-	90	16	33	16	16
10 Vest-Agder	237	31	24	17	157	8	1
11 Rogaland	790	67	167	26	254	2	274
12 Hordaland	525	26	403	8	66	19	3
14 Sogn og Fjordane	124	16	96	3	0	6	3
15 Møre og Romsdal	311	128	150	0	20	1	11
16 Sør-Trøndelag	372	15	186	9	140	19	3
17 Nord-Trøndelag	184	15	85	10	63.	7	4
18 Nordland	242	106	123	6	2	2	4
19 Troms	175	82	66	2	7	9	10
20 Finnmark	106	66	26	0	1	11	2

[1] Direct discharges are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H4. Number of people connected to sewage system by type of treatment. Whole country 2000-2001. By county. 2001[1]

County/region	Total[2]	Direct discharges	Mechanical	Chemical	Biological	Chemical-biological	Other treatment	Individual treatment facilities (<50 PE)	Percentage connected 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**
North Sea counties (01-10)	2 145 030	17 751	64 506	1 077 130	30 571	894 270	60 802	441 347	86
Rest of the counties (11-20)	1 495 106	303 108	758 953	315 329	45 180	41 155	31 381	489 326	74
01 Østfold	218 441	20	15	206 263	5	11 980	158	34 676	87
02-03 Akershus and Oslo	898 612	320	465	195 682	-	702 145	-	61 706	92
04 Hedmark	137 567	-	-	60 598	737	66 153	10 079	79 882	73
05 Oppland	122 244	-	-	45 403	775	75 245	821	79 016	67
06 Buskerud	193 427	-	165	169 165	562	14 528	9 007	50 584	81
07 Vestfold	202 039	-	938	165 706	60	10 128	25 207	42 547	94
08 Telemark	129 709	-	85	120 272	5 716	3 094	542	44 578	78
09 Aust-Agder	88 846	-	44 445	12 082	10 160	7 485	14 674	24 367	86
10 Vest-Agder	154 145	17 411	18 393	101 959	12 556	3 512	314	23 992	98
11 Rogaland	314 667	25 608	91 595	157 727	24 983	1 290	13 464	56 637	84
12 Hordaland	315 460	14 293	231 207	54 000	3 329	11 473	1 158	104 215	72
14 Sogn og Fjordane	64 850	9 637	49 173	211	1 890	2 195	1 744	46 440	60
15 Møre og Romsdal	188 667	74 022	94 515	12 102	40	1 188	6 800	63 193	77
16 Sør-Trøndelag	192 722	9 120	113 532	50 990	4 215	13 094	1 771	48 612	73
17 Nord-Trøndelag	92 571	6 204	38 242	36 088	6 767	4 309	961	41 313	73
18 Nordland	153 069	65 620	80 159	785	3 095	898	2 512	75 273	64
19 Troms	111 127	51 132	49 539	3 180	771	3 625	2 880	35 480	73
20 Finnmark	61 973	47 472	10 991	246	90	3 083	91	18 164	84

[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 H5. Discharges of phosphorus by county and treatment methods. 2001. Tonnes

County/region	Total[1]	Direct discharges	Mechanical	Chemical	Biological	Chemical/biological	Other treatment	Individual treatment facilities (<50 PE)	Discharges per inhabitant, kilograms[1]	Average treatment efficiency, 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**
North Sea counties (01-10)	148.9	8.3	25.8	52.0	4.6	51.7	6.6	143.9	0.06	90.1
Rest of the counties (11-20)	645.9	173.8	416.7	36.6	8.5	6.1	4.3	218.2	0.32	32.2
01 Østfold	11.7	0.0	0.0	11.2	0.0	0.5	0.0	12.4	0.05	92.4
02-03 Akershus and Oslo	51.3	0.2	0.3	6.0	-	44.8	0.0	22.6	0.05	92.5
04 Hedmark	6.1	-	-	3.4	0.2	2.4	0.2	21.0	0.03	93.4
05 Oppland	4.8	-	-	1.8	0.0	2.9	0.2	18.5	0.03	94.9
06 Buskerud	10.0	-	0.9	9.1	0.0	0.4	0.3	17.5	0.04	92.4
07 Vestfold	13.3	-	0.0	9.3	0.0	0.4	3.7	20.1	0.06	89.1
08 Telemark	8.2	-	0.0	7.0	1.1	0.1	0.1	16.8	0.05	89.2
09 Aust-Agder	21.5	-	16.6	0.5	2.1	0.2	2.2	8.1	0.21	65.2
10 Vest-Agder	21.9	8.1	8.8	3.7	1.1	0.1	0.1	6.8	0.14	74.7
11 Rogaland	77.3	15.0	43.6	15.9	0.6	0.1	2.0	23.2	0.21	60.5
12 Hordaland	123.6	8.4	113.6	0.0	1.4	0.1	0.2	45.9	0.28	16.0
14 Sogn og Fjordane	31.8	5.6	25.2	0.0	0.5	0.2	0.3	17.6	0.30	21.0
15 Møre og Romsdal	90.4	43.2	45.1	1.0	0.0	0.0	1.0	30.8	0.37	26.6
16 Sør-Trøndelag	110.6	5.3	88.8	8.1	3.1	5.0	0.3	20.9	0.42	40.7
17 Nord-Trøndelag	37.7	3.6	20.9	11.9	1.8	0.7	0.1	18.8	0.30	34.6
18 Nordland	78.1	35.8	41.6	0.1	0.7	0.1	0.4	36.6	0.33	11.9
19 Troms	62.8	29.6	32.5	0.1	0.3	0.3	0.1	17.7	0.41	14.6
20 Finnmark	33.6	27.7	5.5	0.2	0.0	0.2	0.0	7.4	0.45	16.1

[1] Discharges from indvidual treatment facilities are not included. [2] Direct discharges are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H6. Discharges of nitrogen by county and treatment methods. 2001. Tonnes

County/region	Total[1]	Direct discharges	Mechanical	Chemical	Biological	Chemical-biological	Other treatment	Individual treatment facilities (<50 PE)	Discharges per inhabitant, kilograms[1]	Average treatment efficiency, 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**	**27.71**
Total 2001	**12 303**	**1 384**	**3 022**	**5 146**	**247**	**2 200**	**304**	**3 560**	**2.73**	**28.3**
North Sea counties (01-10)	6 685.0	79.0	212.8	4 040.8	93.3	2 064.7	194.9	1 563.6	2.69	37.2
Rest of the counties (11-20)	5 617.9	1 305.3	2 808.9	1 104.9	153.8	135.5	109.5	1 996.6	2.78	13.8
01 Østfold	914.3	0.1	0.0	847.4	0.0	66.2	0.6	120.5	3.64	13.0
02-03 Akershus and Oslo	2 161.5	1.4	1.7	798.9	-	1 359.5	-	243.2	2.20	55.6
04 Hedmark	507.0	-	-	180.6	2.5	306.5	17.4	262.4	2.70	22.5
05 Oppland	430.0	-	-	232.6	2.7	191.8	2.9	258.2	2.34	34.6
06 Buskerud	692.8	-	0.6	592.2	2.0	66.4	31.6	179.2	2.90	22.1
07 Vestfold	725.6	-	0.5	603.5	0.2	33.3	88.2	165.9	3.37	17.6
08 Telemark	453.7	-	0.3	421.4	19.9	10.2	1.9	162.3	2.74	20.1
09 Aust-Agder	290.8	-	135.8	52.2	29.7	21.7	51.4	87.2	2.83	22.3
10 Vest-Agder	509.4	77.5	73.8	312.1	36.4	8.5	1.1	84.5	3.25	26.6
11 Rogaland	1 131.4	112.2	327.6	552.7	87.5	4.2	47.2	297.8	3.02	17.0
12 Hordaland	1 157.2	62.6	851.9	189.2	11.7	37.7	4.0	419.1	2.64	15.6
14 Sogn og Fjordane	240.2	42.2	177.3	0.7	6.6	7.2	6.1	172.2	2.23	14.3
15 Møre og Romsdal	732.7	324.2	338.2	42.4	0.1	3.9	23.8	254.5	3.01	9.6
16 Sør-Trøndelag	705.3	39.9	422.7	178.7	14.8	43.0	6.2	184.7	2.66	16.5
17 Nord-Trøndelag	337.2	27.2	142.3	126.5	23.7	14.2	3.4	154.6	2.65	16.8
18 Nordland	609.8	265.3	323.8	2.8	6.4	3.2	8.3	303.1	2.56	10.8
19 Troms	443.6	224.0	183.8	11.1	2.7	11.9	10.1	145.2	2.92	8.7
20 Finnmark	260.5	207.7	41.2	0.9	0.3	10.1	0.3	65.3	3.52	4.6

[1] Discharges from indvidual treatment facilities are not included.
Source: Waste water treatment statistics from Statistics Norway.

Table H7. Disposal of sewage sludge. By county. 2001. Tonnes dry weight

County	Total	Agriculture	Parks and green spaces	Cover on landfills	Deposited	Delivered waste plant	Other use	Unknown use
Total 2001	**112 096**	**48 039**	**14 160**	**4 217**	**11 659**	**4 995**	**12 812**	**16 214**
Østfold	9 911	2 405	968	707	3 144	589	2 075	23
Akershus and Oslo	29 967	26 682	710	25	677	770	1 002	101
Hedmark	16 279	6 860	4 235	133	255	24	186	4 586
Oppland	6 345	1 339	270	-	400	34	3 211	1 091
Buskerud	6 986	3 163	518	460	668	-	279	1 898
Vestfold	6 673	5 656	234	-	364	-	360	59
Telemark	6 409	307	1 524	100	1 713	-	-	2 765
Aust-Agder	2 281	75	777	75	66	2	9	1 277
Vest-Agder	1 294	-	17	-	231	744	302	-
Rogaland	5 221	105	-	1 157	56	1 103	2 800	-
Hordaland	2 797	12	1 888	-	52	49	335	461
Sogn og Fjordane	1 729	248	14	481	346	24	616	-
Møre og Romsdal	2 696	-	19	587	702	-	230	1 158
Sør-Trøndelag	5 348	1 076	1 657	17	2 070	72	306	150
Nord-Trøndelag	1 682	103	412	30	54	-	1 083	-
Nordland	3 750	8	94	445	441	883	18	1 861
Troms	1 237	-	823	-	122	203	-	89
Finnmark	1 491	-	-	-	298	498	-	695

Source: Waste water treatment statistics from Statistics Norway.

Table H8. Municipal water sector: Investment, costs, income and cost coverage ratio. Counties. 2002

	Investment in production of water	Investment in distribution	Total investment	Maintenance, running and overhead costs	Capital costs	Annual costs	Fee income	Cost coverage ratio
	Million NOK							Per cent
Total	**234**	**1 015**	**1 250**	**1 914**	**1 577**	**3 491**	**3 203**	**92**
Østfold	7	40	46	105	64	169	168	100
Akershus	4	60	64	284	110	394	357	91
Oslo	16	137	152	95	..	..	232	..
Hedmark	1	23	24	71	48	119	111	93
Oppland	14	41	55	70	68	138	141	103
Buskerud	5	48	53	104	69	173	164	95
Vestfold	8	50	58	113	55	168	160	95
Telemark	6	26	31	61	62	124	112	91
Aust-Agder	5	32	37	49	42	91	74	81
Vest-Agder	11	32	43	54	32	86	84	98
Rogaland	21	83	104	196	121	317	290	91
Hordaland	30	101	131	171	163	334	395	118
Sogn og Fjordane	15	29	43	43	61	105	79	76
Møre og Romsdal	8	55	63	112	98	210	175	83
Sør-Trøndelag	12	69	82	104	101	206	202	98
Nord-Trøndelag	6	29	35	67	55	122	90	74
Nordland	41	88	129	106	136	243	184	76
Troms	17	50	67	65	75	139	116	84
Finnmark	9	22	30	43	37	80	69	86

Source: Environmental protection expenditure statistics from Statistics Norway.

Table H9. Municipal wastewater sector: Investment, costs, fee income, and cost coverage ratio. Total for Norway, 1993-2002. County figures, 2002

	Investment in wastewater treatment plants	Investment in sewerage network	Total investment	Maintenance, running and overhead costs	Capital costs	Annual costs	Fee income	Cost coverage ratio
	Million NOK							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
North Sea counties	159	804	964	1 547	1 001	2 548	2 485	98
Rest of the counties	178	603	781	868	801	1 669	1 582	95
Østfold	2	133	135	174	131	306	317	104
Akershus	18	127	145	322	171	493	484	98
Oslo	4	109	113	266	..	..	349	..
Hedmark	8	68	77	114	61	176	174	99
Oppland	32	67	99	124	86	210	206	98
Buskerud	18	79	97	124	90	214	261	122
Vestfold	14	75	89	149	94	243	248	102
Telemark	28	50	78	105	88	193	163	84
Aust-Agder	25	52	77	86	71	157	140	89
Vest-Agder	10	43	53	82	55	136	145	106
Rogaland	8	126	134	191	207	398	307	77
Hordaland	15	130	145	166	144	310	388	125
Sogn og Fjordane	21	21	42	41	34	76	64	84
Møre og Romsdal	11	51	62	98	84	182	171	94
Sør-Trøndelag	77	70	147	103	106	209	210	101
Nord-Trøndelag	14	36	50	84	66	150	120	80
Nordland	14	82	96	92	93	185	153	83
Troms	16	70	86	59	51	110	120	109
Finnmark	2	18	20	34	15	49	48	99

Source: Environmental protection expenditure statistics from Statistics Norway.

Table H10. Water fees, for a private dwelling of 120 m^2. Counties. 2003. NOK

	Fixed annual fee	Two-level fee system		Payment by water used		Connection fee	
		Variable portion (per m^3 water used)	Fixed portion	Variable portion (per m^3 water used)	Minimum use charged. m^3	Lowest level	Highest level
Total	**2 055**	**7.04**	**1 144**	**9.08**	**177**	**7 544**	**10 556**
Østfold	1 489	6.75	675	10.17	100	4 852	7 496
Akershus	2 204	10.50	836	9.89	104	8 739	16 709
Oslo	747	4.35	69	.	.	.	9 635
Hedmark	2 325	9.25	923	11.30	135	9 572	12 913
Oppland	2 139	9.50	1 030	11.76	144	6 496	14 268
Buskerud	2 289	11.06	1 254	9.99	109	8 445	12 386
Vestfold	1 775	6.06	845	6.97	182	10 822	14 878
Telemark	1 958	7.12	1 166	8.50	180	3 948	5 095
Aust-Agder	1 767	4.99	851	7.41	203	10 280	10 449
Vest-Agder	1 437	5.35	746	4.86	155	10 058	10 880
Rogaland	1 520	5.48	838	7.14	210	6 979	10 030
Hordaland	2 223	7.89	1 450	8.85	199	10 208	12 385
Sogn og Fjordane	2 299	8.63	1 933	8.80	175	6 993	11 812
Møre og Romsdal	2 109	7.74	1 714	7.47	225	6 377	8 642
Sør-Trøndelag	2 472	6.83	1 486	10.17	199	9 830	12 539
Nord-Trøndelag	2 157	7.33	1 223	8.55	185	7 083	9 323
Nordland	2 144	7.65	1 359	8.19	179	6 318	8 489
Troms	1 947	5.11	1 165	7.96	247	4 897	5 213
Finnmark	1 850	5.12	1 101	5.57	235	7 596	8 902

Source: Environmental protection expenditure statistics from Statistics Norway.

Table H11. Wastewater treatment fees, for a private dwelling of 120 m^2. Counties. 2003. NOK

	Fixed annual fee	Two-level fee system		Payment by water used		Connection fee	
		Variable portion (per m^3 wastewater)	Fixed portion	Variable portion (per m^3 wastewater)	Minimum use charged. m^3	Lowest level	Highest level
Whole country	**2 425**	**8.95**	**1 310**	**12.22**	**179**	**8 843**	**12 800**
North Sea counties	3 182	11.77	1 438	15.91	140	10 499	16 405
Rest of the counties	1 982	6.89	1 217	8.49	210	7 813	10 352
Østfold	4 054	19.57	1 352	17.50	100	8 526	15 744
Akershus	3 061	12.61	1 538	14.23	104	13 861	24 647
Oslo	1 087	6.53	69	.	.	.	14 445
Hedmark	3 363	13.12	1 491	18.22	149	10 967	15 969
Oppland	3 251	14.07	1 395	18.39	144	10 829	21 292
Buskerud	3 575	12.33	1 367	15.96	109	9 871	13 885
Vestfold	2 927	9.08	1 288	14.30	179	13 132	19 510
Telemark	2 944	10.72	1 715	13.56	180	4 170	5 594
Aust-Agder	3 042	10.38	1 742	9.80	203	11 268	11 317
Vest-Agder	2 954	9.28	1 501	10.67	191	11 602	13 399
Rogaland	1 858	6.30	934	7.00	214	8 885	13 296
Hordaland	1 848	6.90	1 037	8.11	199	10 102	12 173
Sogn og Fjordane	2 199	5.27	1 080	8.84	175	8 141	11 199
Møre og Romsdal	1 709	6.00	1 228	8.56	217	8 080	10 416
Sør-Trøndelag	2 227	7.90	1 418	9.96	212	8 702	12 958
Nord-Trøndelag	2 855	11.53	1 914	11.12	179	8 415	11 592
Nordland	1 764	7.85	1 285	6.86	173	6 117	8 053
Troms	1 970	5.51	1 271	7.84	256	4 690	5 255
Finnmark	1 804	5.23	901	8.05	235	7 553	8 259

Source: Environmental protection expenditure statistics from Statistics Norway.

Land use

Appendix I

Table I1. Urban settlements with more than 20 000 inhabitants

	1 January 2003			Percentage urb. settlemt. area built on. 1 January 2002	Percentage urb. settlemt. area covered by roads. 1 January 2002	Percentage change urb. settlemt. pop. 2002-2003	Percentage change urb. settlemt. area 2002-2003
	Population	Inhabitants per km^2	Total urb. settlemt. area km^2				
All urban settlements in Norway	3 514 417	1 580	2 224.5	9.5	14.9	1.1	1.4
Oslo	794 356	2 877	276.1	11.8	14.5	1.3	1.1
Bergen	211 326	2 394	88.3	10.6	17.4	0.9	0.6
Stavanger/Sandnes	169 455	2 336	72.5	14.0	15.6	1.7	1.2
Trondheim	144 434	2 431	59.4	12.0	11.9	1.1	0.9
Fredrikstad/Sarpsborg	95 994	1 517	63.3	10.0	14.8	1.0	0.3
Drammen	89 500	1 877	47.7	11.0	16.1	1.2	1.4
Porsgrunn/Skien	84 657	1 537	55.1	9.3	15.9	0.7	2.2
Kristiansand	63 020	2 101	30.0	14.5	16.2	0.8	1.3
Tromsø	51 352	2 342	21.9	11.1	16.5	1.2	0.6
Tønsberg	44 343	1 490	29.8	9.7	15.1	0.8	0.2
Ålesund[1]	43 655	1 501	29.1	8.6	15.0	0.8	0.3
Haugesund	39 987	1 774	22.5	11.4	18.1	0.6	0.6
Sandefjord	39 069	1 484	26.3	9.1	14.7	1.8	4.0
Moss	34 323	1 963	17.5	10.7	13.5	1.1	0.5
Bodø	33 134	2 409	13.8	12.1	17.4	1.3	2.6
Arendal	30 860	1 241	24.9	7.6	15.2	-0.2	1.1
Hamar	28 296	1 628	17.4	12.2	16.8	0.9	-0.1
Larvik	22 845	1 671	13.7	11.9	16.2	0.9	1.3
Halden	21 921	1 617	13.6	10.7	16.1	1.2	6.8

[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 I2. Urban settlement area (km^2) and main categories land use in urban settlements. Grouped by size of population. Per cent

Grouped by size of population	Total urb. settlemt. area. 1 January 2003. km^2	Land-use categories as of 1 January 2000. Per cent					
		Total area built on or near buildings	Housing, holiday homes and assocd. buildings	Business activity	Transport and communication	Other built on area	Unbuilt
All urban settlements	2 224.5	60.6	32.4	9.7	15.7	2.7	39.4
200 - 499	173.2	49.7	23.2	10.4	14.7	1.3	50.3
500 - 999	184.2	53.5	26.6	9.8	15.6	1.7	46.5
1 000 - 1 999	200.9	56.8	29.5	10.0	15.5	1.7	43.2
2 000 - 19 999	743.6	60.4	32.4	10.0	16.0	1.9	39.6
20 000 - 99 999	426.4	65.1	36.8	9.5	16.4	2.4	34.9
100000 -	496.3	65.5	35.4	9.1	15.4	5.5	34.5

Source: Land use statistics from Statistics Norway.

Table I3. Percentage day care centres, schools, residential housing and residents with safe access to recreational areas. 2002*

	Day care centres	Schools	Blocks of flats	Row, detached, etc. houses	Residents
Whole country	**87**	**88**	**66**	**84**	**81**
Østfold	86	87	68	78	77
Akershus	84	88	78	77	78
Oslo	77	76	65	65	70
Hedmark	89	90	68	86	83
Oppland	92	93	72	90	88
Buskerud	85	89	72	85	82
Vestfold	82	81	56	74	72
Telemark	91	93	77	87	86
Aust-Agder	92	81	63	88	87
Vest-Agder	90	84	63	88	86
Rogaland	79	84	60	74	72
Hordaland	90	89	57	89	85
Sogn og Fjordane	92	96	72	94	92
Møre og Romsdal	88	87	66	89	86
Sør-Trøndelag	85	86	62	84	80
Nord-Trøndelag	89	90	71	88	86
Nordland	90	94	77	92	90
Troms	94	97	75	93	90
Finnmark	95	93	81	91	89

Source: Land use statistics from Statistics Norway.

Table I4. Percentage of coastline within 100 m from buildings

	1985	1990	2000	2003
Whole country	**21.9**	**22.3**	**23.2**	**23.4**
County nos. 01-03 and 06-12	36.4	37.0	38.4	38.8
01 Østfold	41.0	41.3	42.3	42.4
02 Akershus	71.0	71.2	71.8	71.8
03 Oslo	:	:	:	79.9
06 Buskerud	67.1	67.7	68.5	68.5
07 Vestfold	42.3	42.8	44.1	44.3
08 Telemark	56.5	57.4	59.6	59.8
09 Aust-Agder	48.6	49.2	50.4	50.7
10 Vest-Agder	34.4	35.3	36.9	37.4
11 Rogaland	29.4	30.0	31.4	31.7
12 Hordaland	31.9	32.5	33.7	34.1
14 Sogn og Fjordane	21.6	22.1	22.9	23.1
15 Møre og Romsdal	27.6	28.1	29.0	29.3
16 Sør-Trøndelag	14.5	14.8	15.3	15.5
17 Nord-Trøndelag	13.5	13.8	14.3	14.5
18 Nordland	13.1	13.4	14.0	14.2
19 Troms	27.3	27.6	28.4	28.6
20 Finnmark	12.3	12.4	12.7	12.8

Source: Land use statistics from Statistics Norway.

Table I5. 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
2000								
Østfold	-	-	69	6 778	4	1 095	-	-
Akershus and Oslo	-	-	93	10 420	6	2 868	4	128
Hedmark	3	32 000	65	35 867	2	5 720	-	-
Oppland	4	145 900	77	17 062	5	16 978	6	448
Buskerud	1	84 200	78	10 377	8	39 692	-	-
Vestfold	-	-	62	1 389	6	484	1	16
Telemark	1	76 700	93	8 774	6	69 620	4	3 335
Aust-Agder	-	-	77	9 852	5	162 732	-	-
Vest-Agder	-	-	85	3 374	5	75 508	11	472
Rogaland	-	-	112	5 821	11	70 209	8	347
Hordaland	1	181 300	138	8 455	10	46 778	-	-
Sogn og Fjordane	2	154 780	85	9 651	5	61 484	4	369
Møre og Romsdal	-	-	73	10 129	4	79 608	16	867
Sør-Trøndelag	2	38 090	63	14 481	9	52 119	9	201
Nord-Trøndelag	2	56 400	77	33 249	1	270	10	4 592
Nordland	3	299 640	108	46 381	7	69 381	1	155
Troms	3	161 480	52	12 627	3	12 343	2	95
Finnmark Finnmárku	3	156 350	51	35 098	7	12 937	-	-
Svalbard[5]	3	942 420	18	2 559 371	-	-	1	1 140

[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]Including fresh-water lakes. In some cases sea area is included. [4]Flora and fauna protection areas (biotop protections). [5]Protected according to the Svalbard Environmental Protection Act. These areas are not included in the sum figures for protected areas.
Source: Directorate for Nature Management.

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